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Patrones sociales de la obesidad en España: Una revisión sistemática de la relación del nivel de educación y obesidad

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➤ **Patrones sociales de la obesidad en España: Una revisión sistemática de la relación del nivel de educación y obesidad**

RESUMEN

PALABRAS CLAVE

Clase social;
Epidemiología;
Sobrepeso;
Obesidad;
Nivel educativo;
Revisión.

Introducción: En países de altos ingresos de todo el mundo, parece haber una asociación inversa entre el nivel educativo y la obesidad. Sin embargo, la literatura sobre esta asociación en España está desordenada y desigual.

Material y Métodos: Examinamos sistemáticamente los estudios en inglés o en español de esta asociación en España de 10 bases de datos de todos los períodos de tiempo disponible.

Resultados: La búsqueda identificó veinticuatro estudios. Tanto en estudios representativos a nivel nacional como sub-nacional, las mujeres con menos educación tenían mayores probabilidades de obesidad que sus homólogas más educadas. Los hombres, a pesar de exhibir una mayor variabilidad en la relación del nivel educativo y obesidad, también demostraron un patrón social similar de peso corporal en muchos estudios. Los niveles más bajos de educación mostraban mayor probabilidad de padecer obesidad en comparación con sus contrapartes de mayor nivel de instrucción. Estas asociaciones, tanto en hombres como en mujeres, a pesar de existir algunas variaciones regionales, eran bastante consistentes a través del tiempo y lugar.

Discusión y conclusiones: Animamos a los futuros investigadores para avanzar hacia estimaciones imparciales y más coherentes de la asociación entre nivel educativo y la obesidad mediante el uso de exámenes físicos para la medición de talla y peso, el control de un conjunto más robusto de los posibles factores de confusión, y la exploración de potenciales factores de modificación de la asociación. Además, cuando sea posible, animamos a los investigadores a emplear diseños prospectivos de estudio que faciliten la inferencia causal en relación con esta asociación.

➤ Social patterning of obesity in Spain: A systematic review of the relationship between education and obesity

KEYWORDS

Educational status;
Epidemiology;
Overweight;
Obesity;
Social class;
Review.

ABSTRACT

Introduction: In high-income countries around the world, there appears to be an inverse association between educational attainment and obesity. However, the literature about this association in Spain remains disorganized and disparate.

Material and Methods: We systematically reviewed peer-reviewed English- or Spanish-language studies of this association in Spain from 10 databases from all periods of time available.

Results: Our search identified twenty-four studies. In both nationally representative and sub-national studies, women with less education had higher odds of obesity than their more-educated counterparts. Men, despite exhibiting greater variability in the education-body weight relationship, also demonstrated a similar social patterning of body weight in many studies, with those at lower levels of educational attainment having higher odds of obesity relative to their more-educated counterparts. These associations in men and women were fairly consistent across time and place, though some regional variations did exist.

Discussion and conclusions: We encourage future researchers to move towards more meaningful, unbiased estimates of the association between educational attainment and obesity by measuring height and weight with physical exams, controlling for a more robust set of possible confounders, and exploring potential modifying factors of the association. Additionally, when possible, we encourage researchers to employ prospective study designs that facilitate causal inference with respect to this association.

INTRODUCTION

The epidemic of obesity is progressing throughout Europe¹, in line with increases in obesity in diverse contexts throughout the world. Spain is experiencing increases in childhood obesity^{1,2}, adult obesity^{3,4}, and the prevalence of morbid obesity⁵, and the social environment appears to play a role⁶.

Obesity is a European public health concern for several reasons. Primarily, it is a central predictor of cardiovascular disease⁷, Europe's most common cause of death. Yet obesity also contributes to morbidity and mortality through other diseases, including diabetes mellitus, cancer, stroke, and depression⁸. It has had substantial financial implications, as health systems throughout Europe have witnessed increased spending on diseases attributable to obesity⁹. Indirectly, obesity has also been shown to contribute to other social concerns, including the increasing costs of infrastructure and development, and even climate change¹⁰.

Given the important health and social implications of obesity, there has been considerable interest in characterizing the epidemic and exploring avenues for intervention. The association between education and obesity represents one such avenue. There are several mechanisms by which education, a robust measure of socioeconomic status, may predict obesity risk. Education is an important predictor of income and wealth, which provide the material resources that improve access to high quality, nutritious foods.

Moreover, income and wealth predict housing locations, and research has demonstrated a link between neighborhood and obesity risk¹¹. In part, this is because lower income neighborhoods may have a higher density of fast food outlets, which predict poor quality diets¹², and a lower density of parks and public spaces, which deter leisure-time physical activity¹¹. These neighborhoods may also be more disordered and be perceived by residents as less safe, which may limit physical activity as well¹³. Education is an important predictor of access to health information and perceived agency over personal health¹⁴. The less-educated may not have the literacy skills required to readily access health information, nor the numeracy skills to understand advice from health media¹⁵. This lack of information is likely to shape decisions about food and physical activity in important ways. For example, a recent study showed that those without educational qualifications consumed less fruits and vegetables and more energy-dense food compared to those who were more educated¹⁶. Importantly, unlike some health determinants, there are many ways to intervene to increase educational attainment, and government can play a large role.

Evidence from across Europe has demonstrated a robust association between education and obesity. For example, a recent systematic review from the United Kingdom confirmed the association between lower education and higher risk for obesity¹⁷. Similar findings have come from France¹⁸, Finland¹⁹, and Denmark¹⁹, among other European countries. Twenty-four studies have investigated the association between education and obesity in Spain, as well. However,

despite its growth in recent years, this body of research remains disorganized and disparate. Here, we systematically reviewed the literature regarding the education-obesity relationship in Spain to better characterize the relationship in this context, to appraise the methodological strength of this literature, and to highlight future directions.

MATERIAL AND METHODS

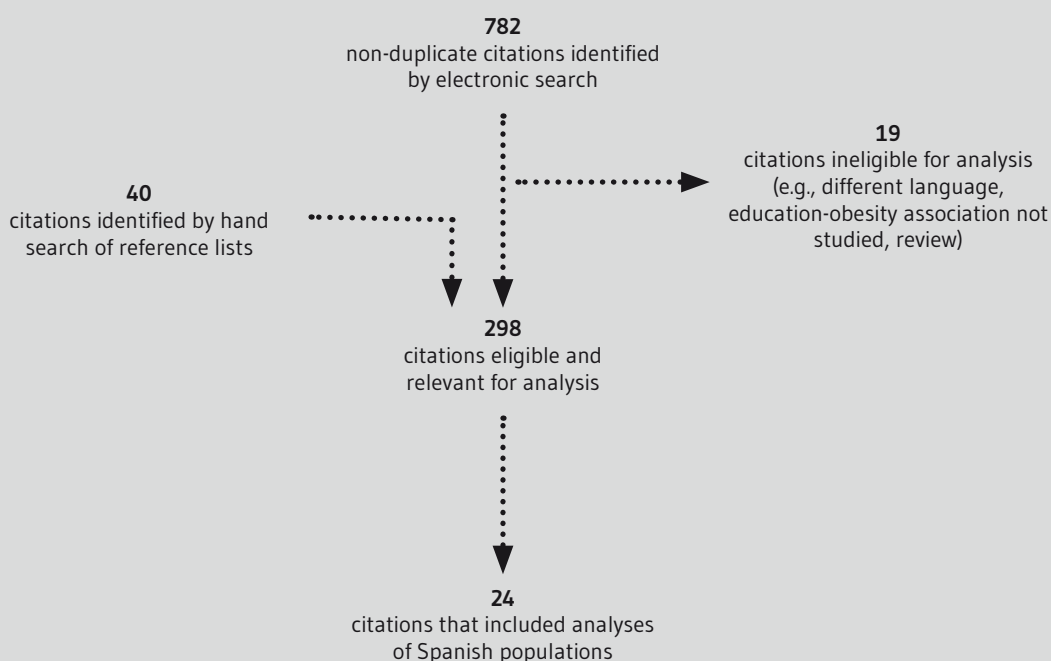
For the purposes of this systematic review, we searched for articles that considered the association between educational attainment and body weight that were written in English, French, Portuguese, or Spanish stored in myriad disciplinary databases (PubMed, the Cochrane Library, and LILACS (public health), PsycINFO (psychology), ERIC (education), IBSS (International Bibliography of the Social Sciences), Social Sciences Citation Index, Social Services Abstracts, Sociological Abstracts, and EconLit). (further details available upon request) In addition to the articles that were identified through this systematic search, we also examined the list of references of each of these articles to identify any additional relevant articles. All research designs were eligible for inclusion in the review, and the time period for

study inclusion was limited only by the databases searched. Exclusion criteria included a lack of peer review, if studies considered only parental education instead of an individual's own educational status (which, in practice, limited this study to adult populations), and if papers focused on time trends rather than specific associations (e.g., Gutierrez-Fisac et al., 2000²⁰). These papers were collected as part of a larger project (Cohen et al., in press); for the purposes of this paper, we then restricted our scope to papers that focused on Spanish populations (figure 1). A standard data abstraction form was used to collect relevant information from the papers, overseen by the primary author.

RESULTS

Twenty-four studies met our inclusion criteria²¹⁻⁴⁴ (table 1). All (100%) report associations based on cross-sectional data. Study populations ranged from being representative of the entire Spanish population^{28,34,39-43} or subpopulations within Spain²⁹, to representative samples of multiple provinces^{22-24,32,33}, to populations within a single province or city^{26,27,31,35-38,44}, to cohorts of university graduates²¹. One ecological study³⁰ was also conducted. Most studies stratified their results by gender, given that many studies elsewhere have found that the relationship between education and obesity varies by gender (e.g., McLaren, 2007⁴⁵).

Figure 1. Selection of papers for inclusion in the systematic review.



Most of the studies reviewed only adjusted for age and gender as potential confounders of the education-obesity relationship. Out of the studies that adjust for additional confounders^{21,26,28,30,32-35,37-39,42}, many included metrics related to health behaviors (like smoking or drinking), nutrition and/or physical activity, or demographic factors, such as marital status. By including these variables, these studies may provide less biased estimates of the direct relationship between educational attainment and obesity. At the same time, however, health behaviors and other adult

demographic characteristics may mediate the education-obesity relationship, and adjusting for these behaviors may actually attenuate estimates of the true association between education and obesity, so over-adjustment is a concern. Several studies utilized anthropometric measures of height and weight^{22-24,26,29,31-33,35-38,40,42,44} which may provide more reliable estimates than studies relying solely upon self-reported measures.

The studies used data from multiple decades (1980s^{25,28,41,42}, 1990s^{22,23,25,26,28,30,32,33,36-38,41,42,44}, and 2000s^{21,24,27,29,31,34,35,39,40,4}

Tabla 1. Summary of studies reviewed.

First author (year)	Study design	Region in Spain	Number of participants	Year data were collected	Covariates controlled for	Direction of observed association ^a
Alcácer et al. (2008) ²¹	Cross-sectional	Navarra	5063 women 3643 men	2003	age, alcohol consumption, marital status, smoking status, total energy intake, leisure time, physical activity, energy-adjusted fiber intake, soft drinks, fast food	- for women - for men
Aranceta et al. (1998) ²²	Cross-sectional	Spain	2855 women 2533 men	1989-1994	(none)	- for women - for men
Aranceta et al. (2001) ²³	Cross-sectional	Catalonia, Basque country, Madrid, Valencia	5388 total	1990-1994	age	- for women - for men
Aranceta et al. (2003) ²⁴	Cross-sectional	Spain	9885 total	2000	age	- for women - for men
Rodríguez-Artalejo et al. (2002) ²⁵	Cross-sectional	Spain	26848	1987, 1995, 1997	(none)	- for women - for men
Cirera et al. (1998) ²⁶	Cross-sectional	Murcia	1577 women 1514 men	1992	age, hypertension, current smoker, leisure time physical activity	- for women 0 for men
García-Medizábal et al. (2009) ²⁷	Cross-sectional	Galicia	1298 total	2004	(none)	- for women
Gutiérrez-Fisac et al. (1996) ²⁸	Cross-sectional	Spain	30040 total	1987, 1993	age, marital status, size of municipality of residence, presence of chronic condition, tobacco consumption, physical activity at work, leisure time physical activity	- for women - for men
Gutiérrez-Fisac et al. (2004) ²⁹	Cross-sectional	Spain	2042 women 1600 men	2000-2001	age	- for women 0 for men
Gutiérrez-Fisac et al. (1999) ³⁰	Cross-sectional ecological	Spain	50 provinces	1991-1993	age, energy intake, sedentary lifestyle	
Martín et al. (2008) ³¹	Cross-sectional	Andalucía	2319 total	(not provided)	(none)	- for women - for men
Martínez-Ros et al. (2001) ³²	Cross-sectional	Murcia	3091 total	1991-1993	age, employment status, type of residence	- for women - for men
Mataix et al. (2005) ³³	Cross-sectional	Andalucía	1674 women 1747 men	1998-2000	gender, age, physical exercise, smoking, alcohol consumption	
Roskam & Kunst (2008) ³⁴	Cross-sectional	Spain	4302 women 4168 men	2000	age, income, occupational level	- for women 0 for men
Soriguer et al. (2004) ³⁵	Cross-sectional	Andalucía	1226 total	(not provided)	age, gender, smoking, alcohol consumption, physical activity	
Sotillo et al. (2007) ³⁶	Cross-sectional	Andalucía	394 total	1998-2000	(none)	+ for women 0 for men
Tur et al. (2005) ³⁷	Cross-sectional	Balearic Islands	1200 total	1999-2000	For women: age, marital status, socioeconomic status, frequent drinking, work-related physical activity, leisure physical activity. For men: age, marital status	- for women - for men
Vioque et al. (2000) ³⁸	Cross-sectional	Valencia	1772 total	1994	gender, age, marital status, regular practice of sports, physical activity at work, physical activity at leisure time, sleeping time, television viewing time, smoking status	
Ortiz-Moncada et al. (2011) ³⁹	Cross-sectional	Spain	26204 total	2006-2007	gender, age, social class, marital status, monthly income	
Gutiérrez-Fisac et al. (2012) ⁴⁰	Cross-sectional	Spain	12883 total	2008-2010	age	- for women - for men
Gutiérrez-Fisac et al. (2002) ⁴¹	Cross-sectional	Spain	10219 women 11461 men	1987, 1995, 1997	age	- for women - for men
Molarius et al. (2000) ⁴²	Cross-sectional	Spain	1211 women 1398 men	1989-1996	age, smoking	- for women 0 for men
Roskam et al. (2010) ⁴³	Cross-sectional	Spain	7741 total	2001	age	- for women - for men
García-Álvarez et al. (2007) ⁴⁴	Cross-sectional	Catalonia	2157 women 1806 men	1992-2003	(none)	- for women 0 for men

^a Direction of observed association refers to the association between education and obesity. An inverse association is indicated by "-", a positive association is indicated by "+", and no association is indicated by "0".

^{3,44}), but the overall trends were consistent: across these studies, with only one exception (a positive association³⁶), an inverse association between educational attainment and obesity was observed among Spanish women^{21-29,31,32,34,37,40-44}. Most studies also found inverse associations among men^{21-25,28,31,32,37,40,41,43}, although some studies found a null association^{26,29,34,36,42,44}. Among the studies that did not stratify by gender, inverse associations were uniquely observed^{30,33,35,38,39}. Comparative studies across multiple time points and age cohorts^{28, 41} revealed that important age, period, and cohort effects may exist for the relationship between education and obesity in Spain.

A consistent, strong relationship between educational attainment and obesity existed across these studies, as illustrated by the magnitude of the published measures of association. In Spain, a substantial proportion of obesity is attributable to having less than a university education, although the point estimates were imprecise: 55.1% (95%CI: 21.3, 78.2) of obesity in women in the mid-1990s, and 19.8% (95%CI: 0.2, 40.2) of obesity among men, was attributable to less education⁴¹.

In studies of nationally representative Spanish populations, a dose-response relationship between education and obesity was evident: as compared to those with tertiary education, those without education had 2.77 (95%CI: 2.34, 3.28) times the odds of obesity, those with primary education had 1.89 (95%CI: 1.67, 2.15) times the odds of obesity, and those with secondary education had 1.27 (95%CI: 1.12, 1.43) times the odds of obesity³⁹. When education was defined as illiteracy versus literacy, those who were illiterate had a 1.05 times higher odds ($p=0.04$) of obesity than those who were literate³⁰. In a study of residents of four different Spanish provinces, women with low education had 2.36 (95% confidence interval: 2.29, 2.42) times the odds of obesity compared to women with high education, and among men, those with low education had 1.80 (95%CI: 1.78, 1.81) times the odds of obesity compared those with high education²³.

We also considered sub-national studies, many of which were conducted in Andalucía. In one Andalusian study, compared to those with a university education, those with a secondary education had 1.77 (95%CI: 1.23-2.55) times the odds of obesity, while those with a primary education had 2.45 (95%CI: 1.78-3.39) times the odds of obesity³³. This was consistent with another Andalusian study which found that adults with primary or no schooling had 5.02 (95%CI: 1.05, 24.04) times the odds of obesity as those with a university education³⁶. In Cadiz (a locality within Andalucía), a statistically significant association was observed only among women, where, compared to those with a university education, women with no formal education had 2.12 (95%CI: 1.19, 3.77) times the odds of overweight, and women with primary education had 2.45 (95%CI: 1.50, 4.01) times the odds of overweight³¹. In Malaga (also within Andalucía), a dose-response relationship was found: as compared to

those with a university education, the odds of obesity among those with secondary education was 2.3 times higher, the odds of obesity for those with primary education was 3.0 times higher, and the odds of obesity for those who were illiterate was 3.8 times higher³⁵.

There were four other regional studies. In a Murcia-based study, there was no association between education and obesity for men, but the results for women were similar to other studies, with those with a primary education having 2.26 (95%CI: 1.43, 3.57) times the odds of overweight as those with a university education. The relationship was even stronger for those who were illiterate as compared to the university-educated (OR=3.22, 95%CI: 1.97-5.27)²⁶. In Valencia, a dose-response relationship also existed; as compared to those with less than a primary education, those with a primary education had 0.60 (95%CI: 0.40, 0.89) times the odds of obesity, and those with secondary education and above had 0.49 (95%CI: 0.31, 0.76) times the odds of obesity³⁸. Similarly, in the Balearic Islands, men with low education had 4.15 (95%CI: 1.33, 12.94) times the odds of obesity as men with high education, and women with low education had 2.97 (95%CI: 1.58, 5.55) times the odds of obesity as women with high education³⁷. In Catalonia, educational attainment and obesity were inversely associated among women in both the 1990s and 2000s and for men in the 1990s, although the association was no longer statistically significant for men in the 2000s⁴⁴.

DISCUSSION

Our review of twenty-four studies of the relationship between educational attainment and body weight in Spain found consistent inverse associations among women and a mixture of inverse and null associations among men. In both nationally representative and sub-national studies, women with less education had higher odds of obesity than their more-educated counterparts. Men, despite exhibiting greater variability in the education-obesity relationship, also demonstrated social patterning of overweight and obesity in many studies, with those at lower levels of educational attainment having higher odds of obesity relative to their more-educated counterparts. Importantly, these trends were fairly consistent both across time and types of study designs, providing further support that the relationship between education and obesity is both robust and persistent.

It is important to note that the associations observed between education and obesity in the studies reviewed above were not unique to the Spanish population, nor to European populations more broadly. An inverse association between education and obesity among women has been well-established in the literature, in regions ranging from Europe⁴³, to Africa⁴⁶ and Latin America⁴⁷. For men, the associations

have been less consistent, with several studies finding no social patterning of overweight and obesity^{45,48}, and others finding negative^{49,50}, positive⁵¹, or U-shaped relationships⁵². These relationships likely vary according to the level of economic development in each particular study setting, with predominantly positive associations between education and obesity at lower levels of economic development gradually transitioning to negative associations at higher levels⁵². The extent to which these patterns exist within a single country has not been extensively studied in the literature. Given variations in economic development across Spain, this is one possible direction for future research.

There are several methodological limitations to the literature assessing the relationship between educational attainment and obesity in Spain. First, each of the studies reviewed here was cross-sectional in nature, precluding any assessments of temporality or the capacity to rule out reverse causality, which others have hypothesized⁵³. Second, in the United States, racial or ethnic group⁵⁴ and immigration status⁵⁵ have both been found to modify the relation between educational attainment and obesity, but no studies to date in Spain have considered effect modification in this regard. Third, only one nationally representative study⁴² both controlled for a broader array of potential confounders (e.g., social and nutritional factors, beyond age and gender) and used anthropometrically measured height and weight when analyzing the association between educational attainment and obesity. Fourth, while both national and regional findings were relatively consistent, there are several regions in Spain that have not been studied, leaving an incomplete understanding of regional variation in this association.

In line with these limitations, we offer several directions for future research. First, when possible, investigators are encouraged to utilize longitudinal study designs to enable causal inference regarding the relation between education and obesity in this context. Second, investigators interested in the mechanisms underlying the education-obesity association might consider effect modification of this association by factors such as immigration status or ethnicity. Third, nationally representative samples are important to preclude selection bias that may influence regional samples and to educate national obesity policy. Fourth, additional focus on regional variations in the education-obesity relationship may also provide important information for public health planning at the local level. The prevalence of obesity and the distribution of educational attainment differs across regions of Spain³⁰, and the direction of the association appears to be consistent across regions, but there may be differences across regions, which merits further exploration.

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CONFLICTS OF INTEREST

The authors state that there are no conflicts of interest in preparing the manuscript.

BIBLIOGRAPHY

1. Sánchez HD, Osella CA, De La Torre MA, González RJ, Sbodio I, Berghöfer A, Pischon T, Reinhold T, Apovian CM, Sharma AM, Willich SN. Obesity prevalence from a European perspective: a systematic review. *BMC Public Health*. 2008; 8: 200.
2. Valdés Pizarro J, Royo-Bordonada MA. Prevalence of childhood obesity in Spain: National Health Survey 2006-2007. *Nutr Hosp*. 2012; 27(1): 154–60.
3. Regidor E, Gutierrez-Fisac JL, de los Santos I, Chaso M, Fernández E. Trends in principal cancer risk factors in Spain. *Ann Oncol*. 2010; 21(Suppl 3): iii37–42.
4. Cámara AD, Spijker JJ. Super size Spain? A cross-sectional and quasi-cohort trend analysis of adult overweight and obesity in an accelerated transition country. *J Biosoc Sci*. 2010; 42(3): 377–93.
5. Basterra-Gortari FJ, Beunza JJ, Bes-Rastrollo M, Toledo E, García-López M, Martínez-González MA. [Increasing trend in the prevalence of morbid obesity in Spain: from 1.8 to 6.1 per thousand in 14 years]. *Rev Esp Cardiol*. 2011; 64(5): 424–26.
6. Font JC, Fabbri D, Gil J. Decomposing cross-country differences in levels of obesity and overweight: does the social environment matter? *Soc Sci Med*. 2010; 70(8): 1185–93.
7. Wilson PWF, D'Agostino RB, Sullivan L, Parise H, Kannel WB. Overweight and obesity as determinants of cardiovascular risk: the Framingham experience. *Arch Intern Med*. 2002; 162(16): 1867–72.
8. Wellman NS, Friedberg B. Causes and consequences of adult obesity: health, social and economic impacts in the United States. *Asia Pac J Clin Nutr*. 2002; 11 (Suppl 8): S705–9.
9. Müller-Riemenschneider F, Reinhold T, Berghöfer A, Willich SN. Health-economic burden of obesity in Europe. *Eur J Epidemiol*. 2008; 23(8): 499–509.
10. Rabin BA, Boehmer TK, Brownson RC. Cross-national comparison of environmental and policy correlates of obesity in Europe. *Eur J Public Health*. 2007; 17(1): 53–61.
11. Black JL, Macinko J. Neighborhoods and obesity. *Nutr Rev*. 2008; 66(1): 2–20.
12. Prentice AM, Jebb SA. Fast foods, energy density and obesity: a possible mechanistic link. *Obes Rev*. 2003; 4(4): 187–94.
13. Molnar BE, Gortmaker SL, Bull FC, Buka SL. Unsafe to play? Neighborhood disorder and lack of safety predict reduced physical activity among urban children and adolescents. *Am J Health Promot*. 2004; 18(5): 378–86.
14. Lawlor DA, Batty GD, Morton SM, Clark H, Macintyre S, Leon DA. Childhood socioeconomic position, educational attainment, and adult cardiovascular risk factors: the Aberdeen children of the 1950s cohort study. *Am J Public Health*. 2005; 95(7): 1245–51.
15. Galesic M, Garcia-Retamero R. Statistical numeracy for health: a cross-cultural comparison with probabilistic national samples. *Arch Intern Med*. 2010; 170(5): 462–8.
16. Nelson M, Erens B, Bates B, Church S, Boshier T. Low income

- diet and nutrition survey. London: Food Standards Agency; 2007.
17. El-Sayed AM, Scarborough P, Galea S. Unevenly distributed: a systematic review of the health literature about socioeconomic inequalities in adult obesity in the United Kingdom. *BMC Public Health*. 2012; 12: 18.
 18. Singh-Manoux A, Gormelen J, Lajnef M, Sabia S, Sitta R, Menvielle G, et al. Prevalence of educational inequalities in obesity between 1970 and 2003 in France. *Obes Rev*. 2009; 10(5): 511–8.
 19. Sarlio-Lähteenkorva S, Lissau I, Lahelma E. The social patterning of relative body weight and obesity in Denmark and Finland. *Eur J Public Health*. 2006; 16(1): 36–40.
 20. Gutiérrez-Fisac JL, Banegas JR, Artalejo FR, Regidor E. Increasing prevalence of overweight and obesity among Spanish adults, 1987-1997. *Int J Obes Relat Metab Disord*. 2000; 24(12): 1677–82.
 21. Alcácer MA, Marques-Lopes I, Fajó-Pascual M, Puzo J, Blas-Pérez J, Bes-Rastrollo M, et al. Lifestyle Factors Associated with BMI in a Spanish Graduate Population: The SUN Study. *Obes Facts*. 2008; 1(2): 80–7.
 22. Aranceta J, Rodrigo CP, Majem LS, et al. Prevalencia de la obesidad en España: estudio SEEDO'97. *Med Clin (Barc)*. 1998; 111(12): 441–5.
 23. Aranceta J, Perez-Rodrigo C, Serra-Majem L, Ribas L, Quiles-Izquierdo J, Vioque J, et al. Influence of sociodemographic factors in the prevalence of obesity in Spain. The SEEDO'97 Study. *Eur J Clin Nutr*. 2001; 55(6): 430–5.
 24. Aranceta J, Pérez Rodrigo C, Serra Majem L, Ribas Barba L, Quiles Izquierdo J, Vioque J, et al. Prevalencia de la obesidad en España: resultados del estudio SEEDO 2000. *Med Clin (Barc)*. 2003; 120(16): 608–12.
 25. Rodríguez-Artalejo F, López García E, Gutiérrez-Fisac JL, Banegas Banegas JR, Lafuente Urdinguio PJ, Domínguez Rojas V. Changes in the prevalence of overweight and obesity and their risk factors in Spain, 1987-1997. *Prev Med*. 2002; 34(1): 72–81.
 26. Cirera L, Tormo MJ, Chirlaque MD, Navarro C. Cardiovascular risk factors and educational attainment in Southern Spain: a study of a random sample of 3091 adults. *Eur J Epidemiol*. 1998; 14(8): 755–63.
 27. García-Mendizábal MJ, Carrasco JM, Pérez-Gómez B, Aragonés N, Guallar-Castillón P, Rodríguez-Artalejo F, et al. Role of educational level in the relationship between Body Mass Index (BMI) and health-related quality of life (HRQL) among rural Spanish women. *BMC Public Health*. 2009; 9: 120.
 28. Gutiérrez-Fisac JL, Regidor E, Rodríguez C. Trends in obesity differences by educational level in Spain. *J Clin Epidemiol*. 1996; 49(3): 351–4.
 29. Gutiérrez-Fisac JL, López E, Banegas JR, Graciani A, Rodríguez-Artalejo F. Prevalence of overweight and obesity in elderly people in Spain. *Obes Res*. 2004; 12(4): 710–5.
 30. Gutiérrez-Fisac JL, Rodríguez Artalejo F, Guallar-Castillon P, Banegas Banegas JR, del Rey Calero J. Determinants of geographical variations in body mass index (BMI) and obesity in Spain. *Int J Obes Relat Metab Disord*. 1999; 23(4): 342–7.
 31. Martín AR, Nieto JM, Ruiz JP, Jiménez LE. Overweight and obesity: the role of education, employment and income in Spanish adults. *Appetite*. 2008; 51(2): 266–72.
 32. Martínez-Ros MT, Tormo MJ, Navarro C, Chirlaque MD, Pérez-Flores D. Extremely high prevalence of overweight and obesity in Murcia, a Mediterranean region in south-east Spain. *Int J Obes Relat Metab Disord*. 2001; 25(9): 1372–80.
 33. Mataix J, López-Frías M, Martínez-de-Victoria E, López-Jurado M, Aranda P, Llopis J. Factors associated with obesity in an adult Mediterranean population: influence on plasma lipid profile. *J Am Coll Nutr*. 2005; 24(6): 456–65.
 34. Roskam A-JR, Kunst AE. The predictive value of different socio-economic indicators for overweight in nine European countries. *Public Health Nutr*. 2008; 11(12): 1256–66.
 35. Soriguer F, Rojo-Martínez G, Esteva de Antonio I, Ruiz de Adana MS, Catalá M, Merelo MJ, et al. Prevalence of obesity in south-east Spain and its relation with social and health factors. *Eur J Epidemiol*. 2004; 19(1): 33–40.
 36. Sotillo C, López-Jurado M, Aranda P, López-Frías M, Sánchez C, Llopis J. Body composition in an adult population in southern Spain: influence of lifestyle factors. *Int J Vitam Nutr Res*. 2007; 77(6): 406–14.
 37. Tur JA, Serra-Majem L, Romaguera D, Pons A. Profile of Overweight and Obese People in a Mediterranean Region. *Obes Res*. 2005; 13(3): 527–36.
 38. Vioque J, Torres A, Quiles J. Time spent watching television, sleep duration and obesity in adults living in Valencia, Spain. *Int J Obes Relat Metab Disord*. 2000; 24(12): 1683–8.
 39. Ortiz-Moncada R, Alvarez-Dardet C, Miralles-Bueno JJ, Ruiz-Cantero MT, Dal Re-Saavedra MA, Villar-Villalba C, et al. [Social determinants of overweight and obesity in Spain in 2006]. *Med Clin (Barc)*. 2011; 137(15): 678–84.
 40. Gutiérrez-Fisac JL, Guallar-Castillon P, León-Muñoz LM, Graciani A, Banegas JR, Rodríguez-Artalejo F. Prevalence of general and abdominal obesity in the adult population of Spain, 2008-2010: the ENRICA study. *Obes Rev*. 2012; 13(4): 388–92.
 41. Gutiérrez-Fisac JL, Regidor E, Banegas Banegas JR, Rodríguez Artalejo F. The size of obesity differences associated with educational level in Spain, 1987 and 1995/97. *J Epidemiol Community Health*. 2002; 56(6): 457–60.
 42. Molarius A, Seidell JC, Sans S, Tuomilehto J, Kuulasmaa K. Educational level, relative body weight, and changes in their association over 10 years: an international perspective from the WHO MONICA Project. *Am J Public Health*. 2000; 90(8): 1260–8.
 43. Roskam A-JR, Kunst AE, Van Oyen H, Demarest S, Klumbiene J, Regidor E, et al. Comparative appraisal of educational inequalities in overweight and obesity among adults in 19 European countries. *Int J Epidemiol*. 2010; 39(2): 392–404.
 44. García-Alvarez A, Serra-Majem L, Ribas-Barba L, Castell C, Foz M, Uauy R, et al. Obesity and overweight trends in Catalonia, Spain (1992-2003): Gender and socio-economic determinants. *Public Health Nutr*. 2007; 10(11A): 1368–78.
 45. McLaren L. Socioeconomic status and obesity. *Epidemiol Rev*. 2007; 29: 29–48.
 46. Ziraba AK, Fotso JC, Ochako R. Overweight and obesity in urban Africa: A problem of the rich or the poor? *BMC Public Health*. 2009; 9: 465.
 47. Jacoby E, Goldstein J, López A, Núñez E, López T. Social class, family, and life-style factors associated with overweight and obesity among adults in Peruvian cities. *Prev Med*. 2003; 37(5): 396–405.
 48. Boissonnet C, Schargrodsky H, Pellegrini F, Macchia A, Marcet Champagne B, Wilson E, et al. Educational inequalities in obesity, abdominal obesity, and metabolic syndrome in seven Latin American cities: the CARMELA Study. *Eur J Cardiovasc Prev Rehabil*. 2011; 18(4): 550–6.
 49. Linetzky B, De Maio F, Ferrante D, Konfino J, Boissonnet C. Sex-stratified socio-economic gradients in physical inactivity, obesity, and diabetes: evidence of short-term changes in Argentina. *Int J Public Health*. 2013; 58(2): 277–84.
 50. Marques-Vidal P, Paccaud F, Ravasco P. Ten-year trends in overweight and obesity in the adult Portuguese population, 1995 to 2005. *BMC Public Health*. 2011; 11: 772.
 51. Jones-Smith JC, Gordon-Larsen P, Siddiqi A, Popkin BM. Emerging disparities in overweight by educational attainment in Chinese adults (1989-2006). *Int J Obes (Lond)*. 2012; 36(6): 866–75.
 52. Monteiro CA, Moura EC, Conde WL, Popkin BM. Socioeconomic status and obesity in adult populations of developing countries: a review. *Bull. World Health Organ*. 2004; 82(12): 940–6.
 53. Gortmaker SL, Must A, Perrin JM, Sobol AM, Dietz WH. Social and economic consequences of overweight in adolescence and young adulthood. *N Engl J Med*. 1993; 329(14): 1008–12.
 54. Yu Y. Educational differences in obesity in the United States: a closer look at the trends. *Obesity (Silver Spring)*. 2012; 20(4): 904–8.
 55. Buttenheim A, Goldman N, Pebley AR, Wong R, Chung C. Do Mexican immigrants “import” social gradients in health to the US? *Soc Sci Med*. 2010; 71(7): 1268–76.