

Childhood and adolescent obesity and adult mortality: a systematic review of cohort studies

Obesidade na infância e adolescência e mortalidade na idade adulta: uma revisão sistemática de estudos de coorte

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Abstract

This systematic review addressed cohort studies on obesity in childhood and adolescence and adult mortality, published from January 1990 to March 2007. We searched the PubMed database with the following uniterms: obesity, mortality, child, adolescent; obesity and mortality; overweight and mortality. References were also analyzed. The age limit was 2 to 18 years. Quality of the articles was assessed, and eight were identified and reviewed. All used weight and stature for determination of obesity, and seven used body mass index (BMI). The quality score varied from 9 to 17. Evidence of association between obesity in childhood and adolescence and adult mortality should be viewed with caution. Use of BMI and potential confounders were discussed. Further research is needed to analyze the relationship between childhood and adolescent obesity and adult mortality.

Obesity; Overweight; Mortality; Child; Adolescent

Introduction

Obesity can be defined as excess body fat in the individual ^{1,2}. It is considered a chronic, non-communicable disease, like diabetes, cardiovascular diseases, and cancer. Such diseases are currently the principal causes of death in both developed and developing countries, thus making them the largest contemporary public health problem ³.

The consequences of obesity in adulthood are well known. Obesity has both a direct influence on mortality and acts as a risk factor for various diseases and health problems. It is associated with non-fatal but debilitating illnesses such as respiratory difficulties, musculoskeletal disorders, skin problems, and infertility. Meanwhile the association with fatal chronic diseases includes cardiovascular diseases, conditions related to insulin resistance and non-insulin-dependent diabetes, certain types of cancer, and gall bladder disease. Psychological consequences such as body dissatisfaction and eating disorders, in addition to social consequences such as prejudice, are also associated with obesity ^{4,5}.

Another concern related to obesity is its international prevalence. According to the World Health Organization (WHO) ⁵, worldwide obesity prevalence has increased at an alarming rate. In the last two decades, what used to be considered a disease of the developed countries now also affects individuals from developing countries,

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at higher growth rates than in the wealthy countries^{5,6}.

The epidemic's impact on national economies and individual health makes the study of the causes of obesity crucially important, in order to take measures to orient its control, prevention, and treatment⁷.

However, studies on obesity in the first two decades of life are relatively recent as compared to those on obesity in adulthood. Two aspects should be highlighted when considering the theme's importance in children and adolescents: (1) the association between overweight and obesity and mortality and morbidity and (2) the increase in the world prevalence in this younger age bracket.

Various studies have dealt with the increase in prevalence of childhood and adolescent obesity in recent decades^{8,9}, highlighting the importance of its increasingly early prevention. However, few studies have focused on the association between childhood and adolescent obesity and adult mortality. Based on the above, the aim of this article was to identify and analyze studies on the relationship between obesity in childhood and adolescence and mortality in adulthood.

Method

A systematic review was performed in the electronic database of the National Library of Medicine (MEDLINE) with the objective of identifying and analyzing studies on the theme "*association between obesity in childhood and adolescence and mortality in adulthood*". The uniterms used were: obesity, mortality, child, and adolescent, all according to *Medical Subject Headings* (MeSH). Searches were also conducted using only the terms obesity and mortality, as well as overweight and mortality. The electronic article search used the following limits: studies with humans, published from January 1, 1990, to March 1, 2007, and involving individuals from 2 to 18 years of age. The initial search yielded 718 articles.

The following eligibility criterion was defined: cohort studies plus the requirement that the article present a comparison of mortality data between exposed (obesity) and unexposed individuals (without obesity). Studies were excluded that approached the association between mortality and variables related to the fetal period, as were studies that verified mortality in age brackets other than those proposed in the current article.

The bibliographic references in the selected articles were also analyzed. Thus, articles considered relevant were selected for analysis, even

if they had not been located in the electronic search. Only eight studies were finally identified that met the eligibility criteria.

Evaluation of the articles' quality was based on the method proposed by Downs & Black¹⁰. The authors developed a questionnaire with 27 questions divided into four groups: presentation (related to issues like clarity in the description of objectives, confounding variables, probability values), external validity (related to data extrapolation to the population where the sample was drawn), internal validity (analysis of biases, like reliability of the exposure and outcome measures, use of confounders), and study power (whether the study had sufficient power to detect an important clinical effect). Since this method has specific questions on randomized clinical trials, the current study used an adapted version presented by Monteiro & Victora¹¹. In this version, four questions were removed (numbers 8, 13, 23, and 24), thereby allowing analyses of non-randomized studies, which includes cohort studies.

The 23 questions are on objective aspects that (according to the authors) relate to the study quality. The article either does or does not deal with what is asked in the question. The nature of the evaluation is thus objective. For each question, one applies a score of zero (0) if the article does not deal with what the question asks and one (1) if it successfully deals with it. For question 5 only, the score can reach two (2). Each article can obtain a maximum score of 24.

Results

As shown in Table 1, for the period studied, only eight articles were identified that covered cohort studies on the relationship between childhood and adolescent obesity and adult mortality. Of these, four were relatively recent, having been published in the last five years.

All eight articles used the anthropometric variables weight and stature to determine exposure (obesity), and only one article¹² did not use body mass index (BMI). In two articles, participants' age was 18 years, and exposure was determined on the basis of reported weight and stature^{13,14}. Three studies analyzed individuals from 13 to 18 years of age^{15,16,17} and the other three ranged from 2 to 14 years¹⁸, 5 to 18 years¹², and 2 to 18 years¹⁹.

Criteria for determining overweight and obesity differed among the studies. Yarnell et al.¹⁴ used BMI distribution by quintiles, in which the last quintile was used to define exposure. Van Dam et al.¹³ used the international reference for

Table 1

Cohort studies that analyzed the relationship between obesity/overweight at 2 to 18 years of age and adult mortality, published from January 1, 1990, to March 1, 2007.

Author	Country/Year	Subjects (starting year of cohort)/ Follow-up period	Exposure (criterion for defining overweight/obesity)/ Reference group	Outcome	Results/Comments	Quality score/ Comments
Van Dam et al. ¹³	United States/2006	102,400 women from 24 to 44 years, followed for 12 years	Women's self-reported weight at 18 years. Reference: BMI from 18.5 to 21.9kg/m ² ; Exposure: BMI from 25 and 29.9; and above 30kg/m ²	All-cause mortality	Relative risk (confidence interval). BMI from 25 to 29.9: 1.29 (1.03-1.62); BMI from 30 to 34.9: 1.39 (1.03-1.86); BMI from 35 to 40: 2.24 (1.68-3.00). Data adjusted for smoking and maintenance of stable weight in adulthood	Score: 15. 2% loss of sample during follow-up. Weight and stature self-reported for 18 years of age and adulthood. Adjustments for variables in adulthood (lifestyle, including smoking and physical activity, and BMI) and at 18 years, plus adjustment for maintenance of stable weight. Correlation > 0.84 between self-reported and measured values (118 individuals)
Engeland et al. ¹⁵	Norway/2003	227,003 boys and girls from 14 to 19 years (1963-1975) followed for 32 years	BMI distribution for the U.S. population, proposed by CDC ²¹ according to gender and age. Reference: BMI from percentiles 25 to 74; Exposure: percentile 85 to 94 (risk of overweight); and ≥ 95 th BMI percentile (overweight)	All-cause mortality	Relative risk (confidence interval). Risk of overweight: ♂ 1.29 (1.14-1.47); ♀ 1.31 (1.14-1.52). Overweight: ♂ 1.82 (1.48-2.25); ♀ 2.03 (1.51-2.72)	Score: 17. Loss of 2% of sample during follow-up. No adjustments for variables like smoking, stable weight, and BMI in adulthood. Deaths occurred predominantly after age 30 years.

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overweight and obesity in the adult population (BMI > 25 and 30kg/m², respectively), as recommended by the WHO²⁰. Engeland et al.^{15,16} used the Centers for Disease Control and Prevention (CDC) reference²¹, with the 85th BMI percentile by gender and age as the cutoff point for diagnosing overweight. Gunnell et al.¹⁸ used the 75th

BMI percentile by gender and age, with the British population as the reference. Must et al.¹⁷ also used the 75th BMI percentile by gender and age as the cutoff for exposure, but their reference population was that of the National Health and Nutrition Examination Survey (NHANES I)²². Nieto et al.¹² used that last weight-for-stature quintile by

Table 1 (continued)

Author	Country/Year	Subjects (starting year of cohort)/ Follow-up period	Exposure (criterion for defining overweight/obesity)/ Reference group	Outcome	Results/Comments	Quality score/ Comments
Engeland et al. ¹⁶	Norway/2004	128,121 boys and girls from 14 to 19 years (1963-1975). Follow-up in two stages: (1) until adulthood, mean of 23 years (range, 10-34 years); (2) after reaching adulthood: mean of 9.7 years (range, 0-29 years)	BMI distribution for U.S. population proposed by CDC ²¹ according to gender and age. Reference: BMI from percentiles 25 to 74; Exposure: percentile 75 to 84 (high); and $\geq 85^{\text{th}}$ BMI percentile (very high)	All-cause mortality	Relative risk (confidence interval). No adjustment for adult BMI σ : high: 1.2 (1.0-1.5); very high: 1.4 (1.0-1.8). Adjustment for adult BMI σ : high: 1.1 (0.9-1.1); very high: 1.1 (0.8-1.5). No adjustment for adult BMI ρ : high: 1.1 (0.9-1.4); very high: 1.4 (1.1-1.8). Adjustment for adult BMI ρ : high: 1.1 (0.9-1.4); very high: 1.3 (1.0-1.7)	Score: 16. Loss of 56% of initial sample. Adjustment for adult BMI and smoking. Among persons with adult BMI below 27.5, no evidence of association between obesity in childhood /adolescence and adult mortality
Gunnell et al. ¹⁸	Great Britain/1998	2,399 boys and girls from 2 to 14 years (1948) followed for 57 years	BMI distribution for British population proposed in 1990 by gender and age. Reference: BMI from percentiles 25 to 49; Exposure: percentile 50 to 75; and $> 75^{\text{th}}$ BMI percentile	All-cause mortality, cardiovascular mortality, ischemic heart disease mortality, and stroke. ICD used to describe causes of death	Relative risk (confidence interval). (1) All-cause mortality: percentiles 50 to 75 [σ 1.5 (1.0-2.1); ρ 1.3 (0.8-2.1)]; $> 75^{\text{th}}$ percentile [σ 1.6 (1.0-2.5); ρ 1.5 (0.8-2.8)]. (2) Cardiovascular disease: percentiles 50 to 75 [σ 1.9 (1.2-3.2); ρ 1.2 (0.6-2.6)]; $> 75^{\text{th}}$ percentile [σ 1.9 (1.0-3.6); ρ 0.9 (0.3-3.2)]	Score: 15. Number of losses not presented. However, no differences found between study sample and initial sample in BMI values by gender and age, or in socioeconomic variables. Adjustments made for age and socioeconomic variables.

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gender and age, with their own study population as the reference. Lawlor et al.¹⁹ used the cutoff points proposed by Cole et al.²³ by gender and age for overweight and obesity. For individuals 18 years or older, the reference used was 25kg/m² and 30kg/m².

There was less heterogeneity in relation to outcome. All the studies verified all-cause (total) mortality, except for Lawlor et al.¹⁹, who focused only on deaths from ischemic heart disease and

stroke. Gunnell et al.¹⁸ also determined causes of death from cardiovascular disease and Must et al.¹⁷ from coronary heart disease.

The quality score varied from 9 in Must et al.¹⁷ to 17 for the studies by Engeland et al.¹⁵ and Nieto et al.¹². Questions on sample representativeness had the most zero (0) scores among the studies, along with the question on study power. This question reflects whether the study is capable of identifying differences between the groups

Table 1 (continued)

Author	Country/Year	Subjects (starting year of cohort)/ Follow-up period	Exposure (criterion for defining overweight/ obesity)/ Reference group	Outcome	Results/Comments	Quality score/ Comments
Must et al. ¹⁷	United States/1992	508 boys and girls from 13 to 18 years (1922-1935) followed for 55 years	BMI distribution for U.S. population proposed by NHANES I ²² according to gender and age. Reference: BMI from percentiles 25 to 50; Exposure: BMI > 75 th percentile	All-cause mortality, from coronary heart disease, cerebrovascular atherosclerosis, colorectal cancer, and breast cancer. ICD-9 used to describe causes of death	Relative risk (confidence interval). Without adjustment for adult BMI and smoking: (1) all-cause mortality [σ 2.9 (1.5-5.8); ρ 1.0 (0.6-1.6)]; (2) coronary heart disease [σ 2.6 (1.1-6.6); ρ 0.8 (0.3-2.1)]. With adjustment: (1) σ 2.4 (1.1-5.0); (2) σ 1.9 (0.7-5.2). For women, values not presented after adjusting variables.	Score: 9. Loss of 16% of initial sample. Adjustment made for adult BMI and smoking. Adult weight and stature were obtained by self-reporting. Small number of deaths (161 in all), which may influence the relative risk value
Yarnell et al. ¹⁴	England/2000	2,335 men from 45 to 59 years (1979-1983) followed for 14 years	Men's self-reported weight at 18 years. Reference: 1 st quintile of BMI distribution at 18 years; Exposure: last quintile of BMI distribution at 18 years	All-cause mortality	Odds ratio (confidence interval): 1.29 (0.93-1.79)	Score: 12. Loss of 19% of initial sample. Relationship between weight at 18 years and adult weight was weak ($r = 0.34$). Only 41 men (1.8%) had BMI > 30 at 18 years and there was low prevalence of individuals that had never smoked in adulthood. Adjustment made for age, smoking, and social class.

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with 95% certainty. Only the studies by Van Dam et al. ¹³ and Engeland et al. ^{15,16} had scores of 1 on this question.

Engeland et al. ^{15,16}, Gunnell et al. ¹⁸, and Must et al. ¹⁷ found that the risk of death in adulthood was 30, 40, 50, and 190% greater, respectively, for boys who were more exposed to overweight and obesity during childhood and adolescence as compared to unexposed boys. Importantly, Must et al. ¹⁷ used a small sample, which may have influenced the risk values.

This risk is already higher when using the 75th percentile as the cutoff, lower than the cutoffs normally used in population surveys (i.e., 85th percentile for overweight ^{21,22}). Yarnell et al. ¹⁴ and Nieto et al. ¹² did not find a higher probability of death when they compared boys exposed (versus not exposed) to excess weight in childhood and adolescence. However, Yarnell et al. ¹⁴, obtained the anthropometric measurements at 18 years of age through self-reported information from the interviewees, meaning that the in-

Table 1 (continued)

Author	Country/Year	Subjects (starting year of cohort)/ Follow-up period	Exposure (criterion for defining overweight/obesity)/ Reference group	Outcome	Results/Comments	Quality score/ Comments
Nieto et al. ¹²	United States/1992	13,146 boys and girls from 5 to 18 years (1933-1945) followed for 52 years	Weight in relation to weight-for-height distribution in the sample itself, by gender and age. Reference: 1st quintile of distribution; Exposure: last quintile of distribution	All-cause mortality	Results divided for pre-pubertal and post-pubertal individuals. Odds ratio (confidence interval). Pre-pubertal: ♂ 1.5 (0.9-2.7); ♀ 1.5 (0.8-3.1); all 1.5 (1.0-2.4). Post-pubertal: ♂ 1.2 (0.6-2.2); ♀ 2.0 (1.1-3.6); all 1.6 (1.0-2.4)	Score: 17. Loss of > 50% in the initial sample. However, no differences in growth parameters between study participants and initial sample. Adjustments made for socioeconomic variables (schooling, marital status) and smoking. 10 controls matched for each case.
Lawlor et al. ¹⁹	Great Britain/2006	3 historical cohort studies: (1) 2,586 boys and girls from 2 to 15 years (1937-1939); (2) 1,420 boys from 9 to 12 years and 15 to 18 years (1936-1969); (3) 10,555 men and women from 16 to 23 years (1948-1968). Cohort 1 was followed until 2003; cohorts 2 and 3 followed until 2004	For individuals 18 years of age, the cutoffs proposed by Cole et al. ²³ by gender and age were used for overweight and obesity. For individuals over 18 years, the reference was 25kg/m ² and 30kg/m ² . Reference: all those not overweight or obese; exposure: All overweight and obese	Death from ischemic heart disease and stroke. ICD-9 and ICD-10 were used.	Relative risk (confidence interval). Death from ischemic heart disease: cohort 1: 1.34 (0.66-2.72); cohort 2: 0.89 (0.28-2.84); cohort 3: 1.44 (0.9-2.3); all cohorts: 1.34 (0.93-1.95). Death from stroke: cohort 1: 0.51 (0.07-3.71); cohort 3: 1.44 (0.75-2.75); all cohorts: 1.30 (0.70-2.42)	Score: 13. Cohort 1: loss of 12%; cohort 2: loss of 56%; cohort 3: loss of 31%. Low prevalence of overweight (mean of 4.9%) and obese individuals (mean of 0.234%; 44 individuals). Adjustments made for age, gender (cohort 1), social class and smoking (cohort 3)

BMI: body mass index; CDC: Centers for Disease Control and Prevention; ICD: International Classification of Diseases; ICD-9: International Classification of Diseases – 9th Revision; ICD-10: International Classification of Diseases – 10th Revision. NHANES I: National Health and Nutrition Examination Survey.

dividuals had to recall a period that occurred 27 to 41 years previously. Meanwhile, Nieto et al. ¹² did not use either BMI as the exposure measurement or cutoff points taken from other populations.

In women, Must et al. ¹⁷ and Gunnell et al. ¹⁸ did not find an increased risk of adult mortality for girls exposed to excess weight in adolescence. However, Engeland et al. ^{15,16} found a 30 to 40% increase in risk of death for girls with BMI in the 85th percentile or greater, and an increase of 100% for those with BMI greater than or equal

to the 95th percentile. Van Dam et al. ¹³ also found a 30 to 40% increase in risk of death for women who had a BMI of 25 to 35kg/m² at 18 years of age, and 120% for women with BMI greater than 35 at 18 years.

Meanwhile, Lawlor et al. ¹⁹ found no increased risk of adult mortality when they compared individuals with overweight or obesity (according to Cole et al. ²³) to those with normal BMI.

In relation to confounders, only Engeland et al. ¹⁵ failed to use adjustments to verify the association between childhood and adolescent obe-

sity and adult mortality. Engeland et al.¹⁶, Must et al.¹⁷, and Van Dam et al.¹³ adjusted for BMI in adulthood. Of these last three, only Engeland et al.¹⁶ found that after adjusting for BMI in adulthood, there was no excess mortality in men. In women, the association between overweight and obesity and mortality was not modified by the inclusion of BMI in adulthood in the study by Van Dam et al.¹³.

Discussion

The studies analyzed here can be considered heterogeneous in relation to the criterion adopted for defining exposure, ages for measuring exposure, and outcome and control for confounders. Homogeneity can be observed in the definition of outcome, i.e., the individual's death. The studies that verified cause of death used the International Classification of Diseases as the reference.

As for the sample, all the studies were derived from epidemiological studies that conducted sample designs to ensure that the population was representative, except for the second cohort in Lawlor et al.¹⁹, whose sample was selected intentionally. Nevertheless, as discussed previously, the questions on the study's representativeness and power were the ones with the most negative scores, which in a sense places doubt on these samples' representativeness. As for losses, only Gunnell et al.¹⁸ failed to report the number of losses from the initial sample. However, the authors made comparisons of anthropometric and socioeconomic variables with the original cohort and did not find statistically significant differences.

The follow-up period was greater than 50 years for Must et al.¹⁷, Gunnell et al.¹⁸, Nieto et al.¹², and Lawlor et al.¹⁹. Meanwhile, in the studies by Engeland et al.^{15,16}, the follow-up was approximately 30 years. Yarnell et al.¹⁴ and Van Dam et al.¹³ followed their samples for some 15 years. Follow-up period is an important variable for analyzing the quality of these studies, since it increases the likelihood that deaths will occur. However, each cohort cited above began over the course of several years, collecting data from individuals with different ages, meaning that the follow-up periods were expressed as averages. Thus, the individuals in each study did not all have the same follow-up period.

As for diagnosis of childhood and adolescent obesity using BMI, some questions need to be analyzed. Except for the two articles by Engeland et al.^{15,16}, the studies all used different reference populations for defining their cutoff points. For the cutoff to determine exposure, two studies

used the 75th percentile^{17,18} and another two the last quintile^{12,14}, with each of the remaining studies using a different criterion.

Since 1995, WHO has recommended establishing an international criterion for diagnosing overweight and obesity²⁴. In 2000, Cole et al.²³, based on BMI distribution curves for six countries, proposed cutoff points for determining overweight and obesity that could be used as an international reference. The idea of adopting this international reference was to allow comparisons of prevalence rates between different countries.

These authors further proposed determining the cutoff point based on an epidemiological criterion, with BMI for overweight and obesity at 18 years of age. Recently, Conde & Monteiro²⁵, using a similar methodology, also determined cutoff points for overweight and obesity in Brazilian children and adolescents. The use of epidemiological cutoff points, based on outcomes in adulthood as the criteria, allows greater evidence in relation to determination of risk, as compared to probabilistic criteria (in which the cutoff point is defined according to the variable's distribution in the population)^{23,25}.

However, even the international reference proposed by Cole et al.²³ has been criticized. Despite its sensitivity in diagnosing risk factors for cardiac diseases in American children and adolescents²⁶, its sensitivity for determining overweight and obesity in children from Switzerland²⁷ and Sri Lanka and Australia²⁸ has been low, thus highlighting the fact that this reference is not sensitive for diagnosing obesity in different countries. Socioeconomic, cultural, ethnic, and maturational factors determine the BMI distribution curve and can influence the cutoff point adopted for overweight and obesity.

The age at which exposure was measured also varied greatly in the eight studies. One cross-sectional study found no influence from age at onset of obesity (≤ 8 years, 12-17 years, and ≥ 18 years) on morbidity data in adulthood²⁹. Even the study by Lawlor et al.¹⁹ found no differences in the association between BMI and mortality when analyses were performed in different age groups. Still, onset of puberty is considered a critical period for the development of obesity^{30,31,32}, increased insulin resistance^{33,34}, and increase in central adiposity³⁵. Such variables are recognized as important risk factors for cardiac diseases³⁶.

The use of confounding variables was quite heterogeneous among the studies. Van Dam et al.¹³, Engeland et al.¹⁶, Must et al.¹⁷, Yarnell et al.¹⁴, Nieto et al.¹², and the third cohort study by Lawlor et al.¹⁹ performed adjustments for smoking. As for physical activity, only Van Dam et al.¹³ adjusted for this variable. Gunnell et al.¹⁸, Yarn-

nell et al.¹⁴, Nieto et al.¹², and Lawlor et al.¹⁹ adjusted for socioeconomic variables. Only Van Dam et al.¹³ adjusted for stable weight maintenance.

For the adult population, the literature has demonstrated the independence and importance of physical inactivity as a strong predictor of mortality^{37,38}. In children and adolescents, physical inactivity has also been observed as an independent factor for increased BMI and body fat³⁹. Therefore, lack of adjustment for physical activity becomes one of the principal limitations of the studies analyzed here.

Van Dam et al.¹³ were the only authors that adjusted for stable weight maintenance, smoking, and adult BMI. These authors found a linear association linear between BMI and all-cause mortality, and adjusting those variables did not change the direction of the results. Meanwhile, Gunnell et al.¹⁸ found that the association between BMI and mortality was best fitted to a quadratic curve. The authors thus proposed a J-shaped curve to explain the relationship between BMI and mortality. However, variables like smoking and stable weight maintenance were not kept in the model, which raises doubts as to the J-shaped trend. The linear relationship between BMI and mortality, after adjusting for maintenance of stable weight and smoking, is already well known in the literature on adults^{5,40}. For children and adolescents, the scarcity of studies (only one) does not allow corroborating this tendency.

Adjusting for BMI in adulthood is extremely important for verifying the relationship between BMI and mortality in children and adolescents. Fat deposition differs between periods in life. In childhood, fat is deposited more in the lower limbs and buttocks. In adulthood, adipose tissue tends to deposit more in the trunk and abdomen, which is characterized by a high waist-hips ratio and various cardiovascular and metabolic complications¹². Thus, the highest risk of mortality would be due to obesity in adulthood. However, the confirmation of this model by only one study¹⁵ further raises the need to increase the research to corroborate or refute such a model.

Given the above, the evidence on the increased risk of mortality in adulthood in individuals with overweight or obesity in childhood and adolescence should be viewed with caution, although there is a tendency towards this association in males. The lack of adjustments for potential confounding variables (like physical activity, maintenance of stable weight, smoking, and adult BMI) may jeopardize the model.

In addition, two other potential problems can be identified for such studies: (1) the use of BMI to determine obesity and (2) the use of old sam-

ples, in which members of the cohort were born before the mid-20th century. In relation to the first item, the waist-hips ratio in adults is a better predictor than BMI for cardiovascular disease and mortality⁴¹. In addition, studies in children have already demonstrated relationships between morbidity indicators and waist circumference⁴² and intra-abdominal fat depot⁴³. Thus, the use of more accurate measurements of obesity should be a priority for future studies on the association between obesity and mortality in children and adolescents. As for item 2, the fact that such cohorts were born long before the reference population deserves critical attention. In children and adolescents, the increase in prevalence of overweight and obesity has reached alarming rates in the last three decades in both developed and developing countries⁴⁴. Thus, one cannot refute the possibility that the reference may overestimate the cutoff values for diagnosing overweight and obesity in older samples. Studies are thus needed with more recent populations.

Even given all these limitations, obesity in childhood and adolescence should be viewed as a disease with a major public health impact. Various studies have demonstrated that obese children have higher odds of becoming obese adults^{45,46}. Results have also shown the increased risk of children and adolescents with overweight and obesity for developing diseases like high blood pressure⁴⁷, high cholesterol⁴⁸ and triglycerides⁴⁹, insulin resistance syndrome⁵⁰, and increased carotid intima-media thickness⁵¹.

One of the limitations of the current study is not having worked with ages below two years. The decision not to include this age was due to issues like difficulty in determining obesity at this age and the fact that studies on associations between this age and mortality data have focused on discussions concerning the fetal period, birth weight, and maternal morphophysiological aspects^{52,53}, and not obesity. In fact, the studies that have analyzed this age bracket have either not found an association with mortality⁵⁴ or have found that the association with mortality is due to catch-up growth rather than obesity at this age⁵⁵.

Thus, one can highlight the scarcity of studies determining the risk of mortality in adulthood in relation to overweight and obesity in childhood and adolescence. There is also a clear need for studies that control for variables like physical activity, smoking, maintenance of stable weight, adult BMI, and puberty. We thus conclude that there is still no clear evidence on the association between childhood and adolescent overweight and obesity and adult mortality.

Resumo

Esta revisão sistemática avaliou artigos de coorte sobre obesidade na infância e adolescência e mortalidade adulta, publicados entre janeiro de 1990 e março de 2007, indexados na base de dados PubMed. Os unitermos utilizados foram: obesity, mortality, child, adolescent; obesity e mortality; overweight e mortality. Referências bibliográficas também foram analisadas. Foi utilizado limite de idade entre 2 e 18 anos. A qualidade dos artigos foi determinada por meio de metodologia apropriada para avaliação de estudos de coorte. Foram encontrados e revisados oito estudos, e todos utilizaram peso e estatura para determinação da obesidade e sete usaram o índice de massa corporal (IMC). O escore de qualidade variou de 9 a 17 (escore máximo obtido = 24). Deve ser vista com cautela a evidência sobre o aumento do risco de mortalidade na idade adulta em indivíduos com sobrepeso ou obesidade na infância e adolescência, apesar de existir tendência dessa associação para o sexo masculino. Foram discutidos uso do IMC e variáveis de confusão utilizadas nos estudos. São necessários mais estudos que façam associação entre obesidade na infância e adolescência e mortalidade na idade adulta.

Obesidade; Sobrepeso; Mortalidade; Criança; Adolescente

Contributors

F. Adami contributed to the study idea, literature review, critical discussions on the theme and selected articles, and writing of the preliminary and final versions of the article. F. A. G. Vasconcelos contributed to the study idea, critical discussions of the theme and selected articles, and reformulations and commentary on the preliminary and final versions of the article.

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