

## Current mapping of obesity

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### Abstract

Obesity is a major risk factor for non-communicable diseases (NCDs), such as diabetes, cardiovascular diseases, and cancers. The worldwide prevalence of obesity has almost doubled between 1980 and 2008. In some regions, such as Europe, the Eastern Mediterranean and the Americas, more than 50% of women are overweight. Tonga, Nauru and the Cook Islands show the highest prevalence of obesity worldwide, above 60% in men and in women. China and the United States are the countries that experienced the largest absolute increase in the number of overweight and obese people between 1980 and 2008, followed by Brazil and Mexico. The regions with the largest increase in the prevalence of female obesity were Central Latin America, Oceania and Southern Latin America. Updated data provide evidence that the progression of the epidemic has effectively slowed for the past ten years in several countries. In low-income countries obesity is generally more prevalent among the better-off, while disadvantaged groups are increasingly affected as countries grow. Many studies have shown an overall socio-economic gradient in obesity in modern industrialized societies. Rates tend to decrease progressively with increasing socio-economic status. Children obesity rates in Spain are amongst the highest in the OECD. One in 3 children aged 13 to 14 are overweight. Overweight in infants and young children is observed in the upper middle-income countries. However, the fastest growth occurs in the group of lower middle-income countries. There is a growing body of evidence for an inverse association between SES and child obesity in developed countries. The prevalence of overweight and obesity is high in all age groups in many countries, but especially worrying in children and adolescents in developed countries and economies in transition.

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Key words: *Overweight. Obesity. Prevalence. Trends. Inequalities.*

### MAPPING DE LA OBESIDAD ACTUAL

#### Resumen

La obesidad es un importante factor de riesgo para las enfermedades crónicas no transmisibles, como la diabetes, las enfermedades cardiovasculares y el cáncer. La prevalencia mundial de obesidad se ha duplicado entre 1980 y 2008. En algunas regiones, como Europa, el Mediterráneo Oriental y América, más del 50% de las mujeres tienen sobrepeso. Tonga, Nauru y las Islas Cook muestran la mayor prevalencia de obesidad en todo el mundo, por encima del 60% tanto en los hombres como en las mujeres. China y Estados Unidos son los países que experimentaron el mayor aumento absoluto en el número de personas con sobrepeso y obesidad entre 1980 y 2008, seguido de Brasil y México. Las regiones con el mayor incremento en la prevalencia de obesidad femenina fueron Centro América, Oceanía y el sur de América Latina. Datos actualizados sugieren que la progresión de la epidemia se ha reducido durante los últimos diez años en varios países. En los países de renta baja la obesidad suele ser más frecuente entre los niveles socioeconómicos más favorecidos, mientras que los grupos desfavorecidos están cada vez más afectados en los países en desarrollo. Muchos estudios han demostrado un gradiente socioeconómico global de la obesidad en las sociedades industrializadas modernas. Las tasas tienden a disminuir progresivamente a medida que aumenta el nivel socio-económico. La prevalencia de obesidad en España se encuentra entre las más altas de la OCDE. Uno de cada 3 niños de 13 a 14 años tiene sobrepeso. El sobrepeso en los lactantes y niños de corta edad se observa en los países de ingresos medios-altos. Sin embargo, el mayor crecimiento se produce en el grupo de países de ingresos medianos bajos. Hay un creciente cuerpo de evidencia de una asociación inversa entre la obesidad SES-infantil en los países desarrollados. La prevalencia del sobrepeso y la obesidad es alta en todos los grupos de edad en muchos países, pero especialmente preocupante en los niños y adolescentes en los países desarrollados y las economías en transición.

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Palabras clave: *Sobrepeso. Obesidad. Prevalencia. Tendencia. Desigualdades.*

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## Abbreviations

NCDs: Non Communicable Diseases.  
OECD: Organization for Economic Co-operation and Development.  
BMI: Body Mass Index.  
UK: United Kingdom.  
USA: United States of America.  
WHO: World Health Organization.  
SES: Socio Economical status.  
IOTF: International Obesity Task Force.  
GIS: Geographic Information System.  
BF%: Percentage body fat.  
SD: Standard deviation.  
OR: Odds Ratio.

Obesity is a major risk factor for non-communicable diseases (NCDs), such as diabetes, cardiovascular diseases, and cancers. In fact, the World Health Organization (WHO) recognizes high blood pressure, tobacco use, high blood glucose, physical inactivity, and overweight and obesity as the leading global risks for mortality in the world, overweight and obesity being responsible for 5% of deaths globally. A high body mass index (BMI) is among the eight risk factors which account for 61% of cardiovascular deaths and over 75% of ischemic heart disease, the leading cause of death worldwide.<sup>1</sup>

In cohort studies an increased risk of all-cause mortality both among participants who had been persistently obese since early adulthood and participants who showed an increase in BMI category from normal to obese, compared with participants with a stable normal BMI category has been reported.<sup>2</sup>

International cohort studies have quantified the associations between high BMI and different diseases in populations worldwide. However additional research is needed into how the duration of being overweight or obese affects risk, and whether the health benefits of prevention of weight gain are similar to those of weight loss.<sup>3</sup> A recent study informed that while relative to normal weight, both obesity (all grades) and grades 2 and 3 obesity were associated with significantly higher all-cause mortality, grade 1 obesity overall was not associated with higher mortality, and overweight was associated with significantly lower all-cause mortality.<sup>4</sup>

Every 15 kg extra in body weight increases the risk of early death approximately 30%. Research conducted in ten European countries shows that obesity doubles the odds of not being able to live a normal active life. Throughout their lives, health care costs for obese people are at least 25% higher than for people of normal weight and increase rapidly with weight gain. Obesity has been estimated to consume between 2-6% of health care costs in many countries, thereby impairing economic productivity and development.<sup>5</sup> Furthermore, it has been argued that increasing BMI is a pandemic that could reverse life-expectancy gains in high-income nations.

In 2008, 35% of adults were overweight. An estimated 2.8 million people die every year worldwide due to overweight. The worldwide prevalence of obesity has almost doubled between 1980 and 2008. In some regions, such as Europe, the Eastern Mediterranean and the Americas, more than 50% of women are overweight.<sup>6</sup>

## Prevalence of obesity and trends in adults

### *BMI*

In 2011 Finucane and colleagues<sup>3</sup> estimated worldwide trends in population mean BMI for adults 20 years and older in 199 countries using recent national health examination surveys and other sources collecting measured body weight and height. Results from this study show that between 1980 and 2008 age-standardized mean BMI for men increased in every sub-region considered except for central Africa and south Asia. In high-income countries, male BMI rose most in the USA (1.1 kg/m<sup>2</sup> per decade), followed by the UK (1.0 kg/m<sup>2</sup> per decade) and Australia (0.9 kg/m<sup>2</sup> per decade), and least in Brunei, Switzerland, Italy, and France (0.3-0.4 kg/m<sup>2</sup> per decade). In 2008, age-standardized mean BMI in men was highest in North America (28.4 kg/m<sup>2</sup>, 27.9-28.7) and Australasia (27.6 kg/m<sup>2</sup>, 27.1-28.1). Japan and Singapore had the lowest male BMI in high-income countries, both less than 24.0 kg/m<sup>2</sup>.

Globally, female BMI increased by 0.5 kg/m<sup>2</sup> per decade between 1980 and 2008. The largest rise in female BMI occurred in Oceania (1.8 kg/m<sup>2</sup> per decade), followed by southern and central Latin America (1.3-1.4 kg/m<sup>2</sup> per decade). Female mean BMI trends in central and Eastern Europe and central Asia showed changes less than 0.2 kg/m<sup>2</sup> per decade. The increase in east and south Asia, Asia-Pacific, and Western Europe was also less than 0.4 kg/m<sup>2</sup> per decade. Conversely female BMI increased by about 1.2 kg/m<sup>2</sup> per decade in Australasia and North America. Among high-income countries, women in the USA, New Zealand, and Australia had the greatest gain in BMI (1.2 kg/m<sup>2</sup> per decade), whereas women in Italy and Singapore might have had a modest BMI decrease of 0.1-0.2 kg/m<sup>2</sup> per decade.

Globally, age-standardized mean BMI in 2008 was 23.8 kg/m<sup>2</sup> (23.6-24.0) for men and 24.1 kg/m<sup>2</sup> (23.9-24.4) for women. Male BMI was higher than female in high income subregions, but lower in most low-income and middle-income regions. In 2008, female BMI was highest in North America, North Africa, Southern Africa and Middle East, with mean BMI above 28 kg/m<sup>2</sup>, with the highest estimates in Oceania, Nauru (35.0 kg/m<sup>2</sup>). Women in the USA had the highest mean BMI of high income countries, followed by New Zealand.

### *Prevalence of obesity*

Based on BMI estimates in the study mentioned above, Stevens and colleagues predicted the preva-

lence of obesity in adults 20 years and older in the same 199 countries in all five continents and trends between 1980 and 2008.<sup>7</sup> Overall, the age-standardized prevalence of obesity nearly doubled from 6.4% in 1980 to 12.0% in 2008. Results of the study highlight that the rise has accelerated in the last decade, when half the estimated trend occurred, between 2000 and 2008. The age-standardized prevalence of overweight increased from 24.6% (22.7-26.7%) to 34.4% (33.2-35.5%) during the same 28-year period. In 2008, female obesity prevalence ranged from 1.4% (0.7-2.2%) in Bangladesh to 70.4% (61.9-78.9%) in Tonga and 74.8% (66.7-82.1%) in Nauru. Male obesity was below 1% in Bangladesh, Democratic Republic of the Congo, and Ethiopia, and was highest in Cook Islands (60.1%, 52.6-67.6%) and Nauru (67.9%, 60.5-75.0%).

Worldwide, age-standardized prevalence of obesity was 9.8% (9.2-10.4) in men and 13.8% (13.1-14.7) in women in 2008, which was nearly twice the 1980 prevalence of 4.8% (4.0-5.7) for men and 7.9% (6.8-9.3) for women. By 2008, the prevalence of overweight among women was over 90% in Cook Islands, Nauru, and Tonga. Male overweight in 2008 was also over 90% in the Cook Islands and Nauru.

According to these estimates, in 2008, female obesity reached up to 70.4% (61.9-78.9%) in Tonga and 74.8% (66.7-82.1%) in Nauru. The prevalence of male obesity was above 60% in Cook Islands (60.1%, 52.6-67.6%) and Nauru (67.9%, 60.5-75%). The countries with the most overweight people were China (241 million) and the United States (158 million). These two countries experienced the largest absolute increase in the number of overweight and obese, followed by Brazil and Mexico.

In 2008, the regions with the highest obesity prevalence were North Africa and Middle East, Central and Southern Latin America, Southern Sub-Saharan Africa, and high-income North America, with prevalence ranging from 27.4% to 31.1%. Western Sub-Saharan Africa which remained a low-obesity region until 2000 experienced a relatively large rise in BMI in the next 8 years.

According to an OECD report age-standardized rates of obesity show significant differences across countries in obesity levels and in trends over time. The analyses carried out for eleven OECD countries (Australia, Austria, Canada, England, France, Hungary, Italy, Korea, Spain, Sweden and the United States) considering self-reported national data collected between 1989 and 2005 (age range 16-65 yr) showed that obesity rates have been increasing in all these countries in men. A similar increase was observed in women in Australia, Austria, Canada, England, France, Hungary, Sweden, and the USA whereas in Italy, Korea and Spain show minimal increases over time. Overweight rates have been increasing in all countries in men except in Canada and France where rates appear to level off. Overweight rates in women show an increasing trend over years except for Italy, Korea, and Spain. Obesity rates in England and the USA are substantially

higher than in the other countries, and over five times those observed in Korea.<sup>8</sup>

Projected trends in this report show important differences between Australia, Canada, England and the USA on one hand, and Austria, France, Italy and Spain on the other. A substantial further increase in obesity rates is projected in the former group of countries, with stable or slightly declining rates of overweight. Conversely, obesity rates are projected to grow at a relatively slow pace in Austria, France, Italy and Spain over the next ten years, while overweight rates in the same countries are projected to grow at a faster rate, especially in Korea.<sup>8</sup>

OECD projections suggest that more than two out of three people will be overweight or obese in some OECD countries by 2020.<sup>5</sup> Updated data provide evidence that the progression of the epidemic has effectively slowed for the past ten years in countries such as Korea, Switzerland (obesity rate 7-8%), Italy (obesity rate 8-9%), Hungary (obesity rate 17-18%) and England (obesity rate 22-23%). The latest data show modest increases (2-3%) in obesity over the past decade in countries like Spain and France and larger increases in Ireland, Canada and the United States (4-5%). The prevalence of obesity today varies nearly tenfold among OECD countries, from a low of 4% in Japan and Korea, to 30% or more in the United States and Mexico.

In the USA the prevalence of obesity in 2007-2008 was 32.2% among adult men and 35.5% among adult women. Thus the increases in the prevalence of obesity previously observed do not appear to be continuing at the same rate over the past 10 years, particularly for women and possibly for men.<sup>9</sup>

Table I shows the prevalence of obesity in adults based on measured data in different countries near 2009. Latest figures from the Health Survey for England 2009-11 shows that one quarter of men and women are obese and two thirds of adults are obese or overweight. In the last 20 years, the number of morbidly obese adults (BMI over 40) has more than doubled to over one million people in the UK.

Obesity rates in adults in Spain are higher than the OECD average. Two out of 3 men are overweight and 1 in 6 people are obese in Spain. Considering the most recent data, the OECD updated projections for 2010-2020 point that overweight and obesity rates are expected to grow by 7% during that period in Spain. The prevalence of obesity (self-reported) in population aged 18 yr. and older based on the latest Spanish National Health Survey (2011-2012) is 17% (18% men; 16% women) and overweight 37%. Thus 54% of the population 18 yr. and older is either overweight or obese. According to the same source, obesity rates in 1987 were 7.4%. The upward trend is more pronounced in men than in women.

Higher obesity rates have been estimated based on measured body weight and height in the ENRICA study, a cross-sectional study on a sample aged 18 yr. and older (n = 12,883; data collection 2008-2010): 22.9%

**Table I**  
Prevalence of obesity among adults in different countries based on measured data, 2009 (or nearest year)

	Year	Total	Females	Males
Korea		3,8	4,1	3,6
Japan		3,9	3,5	4,3
<b>OECD</b>		<b>17,2</b>	<b>16,6</b>	
Slovak Republic	2008	16,9	16,7	17,1
Czech Republic	2005	17,0	17,0	18,0
Finland	2007	20,2	21,1	19,3
Luxembourg		22,1	19,0	24,5
Spain	2008-2010	22,9	21,4	24,4
Ireland	2007	23,0	24,0	22,0
United Kingdom		23,0	23,9	22,1
Canada	2008	24,2	23,2	25,2
Australia	2007	24,6	23,6	25,5
Chile		25,1	30,7	19,2
New Zealand	2007	26,5	27,0	26,0
Mexico	2006	30,0	34,5	24,2
United States	2008	33,8	35,5	32,2

Sources: OECD Health Data 2011; national sources for non-OECD countries. Obesity BMI  $\geq$  30.

for obesity and 39.4% for overweight.<sup>10</sup> Self-reported body weight and height are systematically biased and estimated rates appear to under-estimate obesity compared to individually measured rates. Similar observations have been made regarding self-reported data in the USA (NHIS) and measured data (NHANES), but the time trends projected based on either data are the same.

In Spain previous measured data in the adult population (data collected 1990-2000; (25-65 yr) in the DORICA pooled study estimated a prevalence of obesity 15.5% (13.2% in men; 17.5% in women).<sup>11</sup> This observation suggests a considerable increase over the past 20 years in the country, in line with that referred based on self-reported data.

## Gender, age and socioeconomic factors

### Gender

A systematic review of studies reporting prevalence of obesity rates based on measured body weight and height in European countries, with data collected 1990-2008 showed that in Europe, the prevalence of obesity in men ranged from 4.0% to 28.3% and in women from 6.2% to 36.5%.<sup>12</sup>

According to the global estimates by Stevens et al, male and female obesity prevalence differed most in Southern Sub-Saharan Africa, where the prevalence of

obesity was 18.7% (15.6-21.5%) for men and 36.7% (33.0%-40.2%) for women in 2008. The regions with the largest increase in the prevalence of female obesity were Central Latin America (8.5 percentage points per decade), Oceania (8.2 percentage points per decade), and Southern Latin America. The regions with the largest increase in male obesity were North America (6.9 percentage points per decade) and Australasia. In Western, Central, and Eastern Europe, and in the high-income Asia Pacific countries, the prevalence of obesity increased more among men than women in 41 of 47 countries.<sup>7</sup>

In the USA, the prevalence of obesity is high, exceeding 30% in most age and sex groups except for men aged 20 to 39 years. Among men, age adjusted obesity prevalence was 32.2% and within racial and ethnic groups ranged from 31.9% among non-Hispanic white men to 37.3% among non-Hispanic black men. For women, the age adjusted prevalence was 35.5%, ranging from 33.0% among non-Hispanic white women to 49.6% among non-Hispanic black women.<sup>9</sup>

The prevalence of obesity in Korean males increased during the past 12 years from 25.1% to 35.7%, and the trend for an increase in obesity was significant in all age groups. In contrast, no significant trend over the past 12 years was identified for females. In Korean women aged 30-59 yr the prevalence of obesity decreased significantly but not in women aged 60 yr and older the obesity prevalence increased significantly. A gradually widening gender disparity was observed due to an increase in the prevalence of male obesity and a decrease in the obesity prevalence among young and middle-aged women in Korea.

In Spain both data from the National Health Survey (self-reported) and the DORICA study (measured data) reported higher obesity rates in women than in men. However, in recent years the situation has changed. According to the latest National Health Survey (2011-2012) the prevalence of obesity was 18% in men and 16% in women (fig. 1). The ENRICA study (measured data) reports a prevalence of obesity of 24.4% in men and 21.4% in women, with higher obesity rates in women than men in people aged 65 yr. and older.

Interactions between gender, education and socioeconomic level have been reported. The demographic, educational and socioeconomic changes occurred in the last decades may have played a role in these changes. Gender differences in obesity are important per se, because they may suggest possible pathways through which obesity is generated.

### Age

The prevalence of overweight and obesity increase with age in adults up to a certain age. However, the age at which population rates of obesity start to decline varies in different countries, ranging from the late sixties to the late seventies in industrialized countries.

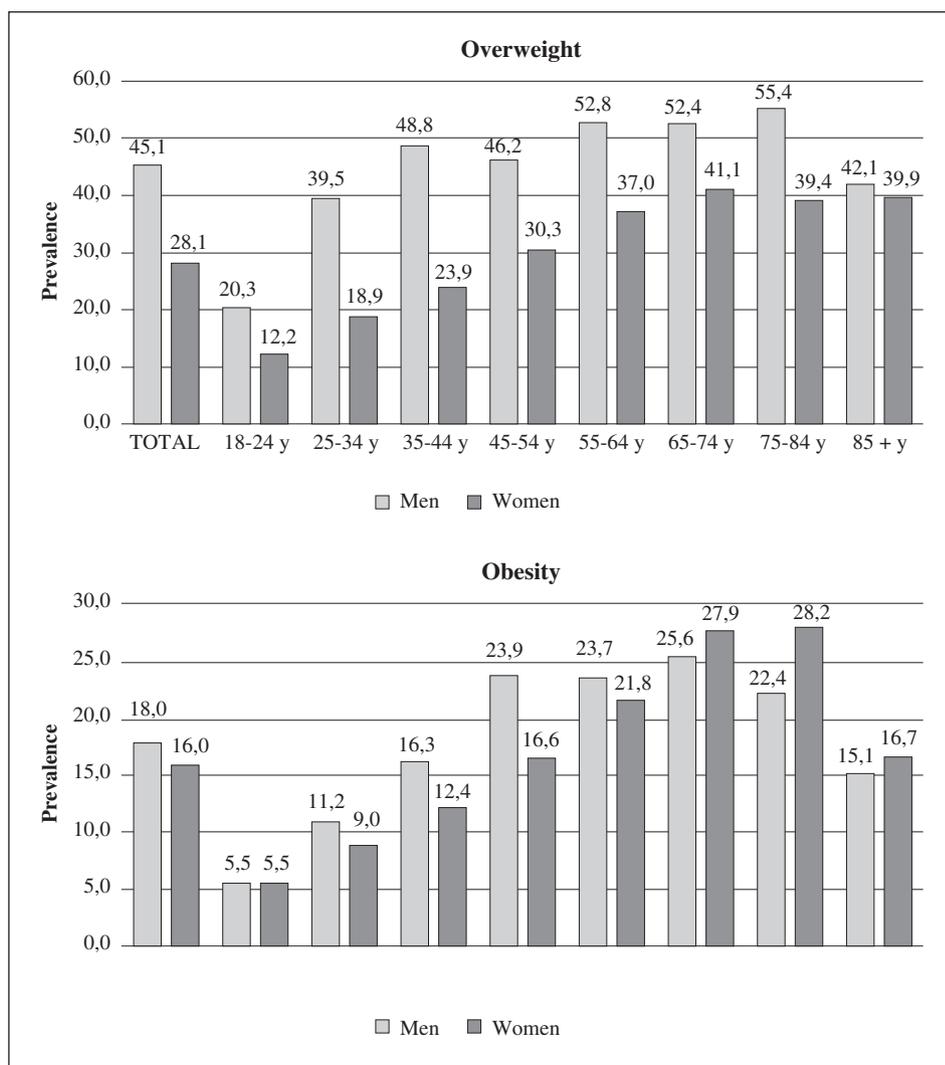


Fig. 1.—Prevalence of overweight and obesity in Spanish adult population by gender (self-reported data). National Health Survey 2011-2012. Overweight BMI  $\geq 25 < 30$ ; Obesity BMI  $\geq 30$ .

The analysis conducted by Doak et al in data from WHO European Region taking into account differences related to the aging of the population showed that the 50-64-year-olds had higher prevalence of overweight and obesity as compared to the 25-49-year-olds, a pattern that was similar in every country, by male and female. Age-standardized overweight prevalence was higher among males than females in all countries.<sup>13</sup>

In Spain data for adults aged 60 yr. and older between 2000 and 2010 show that in men the distribution of BMI did not vary in the period, but in women there was a reduction in both mean BMI (from 29.3 to 28.8 kg/m<sup>2</sup>) and the prevalence of obesity (from 40.8 to 36.3%). This decline was greatest in women aged 60-69 years.<sup>14</sup>

#### Socioeconomic and educational level

In low-income countries obesity is generally more prevalent among the better-off, while disadvantaged

groups are increasingly affected as countries grow. Many studies have shown an overall socio-economic gradient in obesity in modern industrialized societies. Rates tend to decrease progressively with increasing socio-economic status (SES). The overall socio-economic gradient in obesity observed in many countries is an average of a strong gradient in women and a substantially milder gradient in men. Several reports concluded that socioeconomic status and women's obesity tended to be inversely related in developed populations and directly related in developing populations.

Women in certain ethnic minority groups are substantially more likely to be obese than other women, even after controlling for differences in socioeconomic conditions, but not for men in the same minority groups. In the USA, obesity prevalence among men is generally similar at all income levels, however, among non-Hispanic black and Mexican-American men those with higher income are more likely to be obese than those with low income. Higher income women are less likely to be obese than low income women, but most

obese women are not low income. There is no significant trend between obesity and education among men. Among women, however, there is a trend; those with higher education are less likely to be obese compared with less educated women.<sup>15</sup>

Social disparities in obesity are very large among Spanish women as shown in previous reports<sup>11</sup> and persist according to updated data. Women with poor education in Spain are 3.2 times more likely to be overweight than more educated women. Disparities are substantially smaller in men. The degree of socio-economic inequality has remained virtually unchanged in recent years. In fact, the most recent data available show a low prevalence of obesity among highly educated women aged 18-44 yr. in Spain.

An inverse relationship between household income and BMI has been reported in women in nine European countries, but mixed patterns for men. A later study comparing inequalities in obesity and overweight across 11 OECD countries, including several European countries, Australia, Canada, Korea and USA showed consistently larger education-related inequalities in women than in men, except in Austria. Obesity and overweight tend to be more prevalent in disadvantaged socioeconomic groups, and inequalities are consistently larger in women than in men. In most of the countries a gradient is observed: the lower the education attainment, the higher the likelihood of being obese or overweight. For men, lower education is strongly associated with a higher likelihood of being overweight or obese except in Korea where the gradient seems in the opposite direction. Generally, gradients observed in women are substantially stronger than those observed in men. Considering evolution trends over 15 years, social inequalities in obesity and overweight remain virtually stable with minor variations.<sup>16</sup> In a country such as China with a rapid economic change, urban residents have a much higher prevalence of overweight/obesity than their rural counterparts.

### **Prevalence of obesity and trends in children**

The concern with childhood obesity arises from its association with poor psychological and social outcomes, as well as physical health problems in the short and long term. Among other, obesity in children is linked with low self-esteem, depression, and obese children can suffer from social discrimination. Childhood obesity is associated with a range of physical health problems including type 2 diabetes, liver disease, impaired mobility, asthma, sleep apnea, and risk factors for cardiovascular disease. Most of these health problems arise in later life, although some of them are increasingly being seen in children. In addition, research conducted in different countries indicates that overweight and obese children are at higher risk than normal weight children of becoming overweight and obese adults.<sup>17,18</sup>

Estimates of the prevalence of overweight (including obesity) in OECD and emerging countries among children and youth aged 5-17 years show average rates in OECD countries of 21.4% for girls and 22.9% for boys. One-in-five children are affected by excess body weight across all countries, and in Greece, the United States and Italy the figure is closer to one third. Overweight affects 10% or less of children only in China, Korea and Turkey. In most countries, boys have higher rates of overweight and obesity than do girls. Girls tend to have higher rates in Nordic countries (Sweden, Norway, Denmark), as well as in the United Kingdom, the Netherlands and Australia. The prevalence estimated in Brazil is 21.1% in girls and 23.1% in boys.

Children obesity rates in Spain are amongst the highest in the OECD. One in 3 children aged 13 to 14 are overweight. Using IOTF's cut-offs, the estimated prevalence of obesity based on body measurements in 1998-2000 was 6.3% (7.9% boys; 4.6% girls), while overweight and obesity affected to 24.4% (19). Regarding socio-demographic factors sex, age group, region, size of locality of residence, mother's level of education and family SES level were significant predictors for obesity in children and adolescents under 14 yr.

Evolution trends observed in a Spanish region according to the Study of Cuenca in the period 2004-2010 reported that the prevalence of overweight and adiposity has continued to increase among boys but no change in overweight and percentage body fat (BF%) in girls, or in underweight and obesity in either sex.<sup>20</sup>

Comparison of obesity and overweight rates in cross-sectional studies conducted in the same regions and age groups in 1998-2000 (enKid study) and 2009 (PERSEO) suggests an increase in prevalence rates in school children between 1.5 and 4 percentage points in most regions in the country, except for the Canary Islands, where the prevalence of overweight and obesity remains stable at high rates, 21%. According to the ALADINO study based on measured body weight and height the prevalence of obesity in school-aged children is 19.1%, 22% in boys and 16.2% in girls, overweight and obesity add up to 48.3% for boys and 42.1% in girls, similar estimates to those observed in the intervention project PERSEO. In the National Health Survey 2011-2012, based on self/parent-reported body weight and height, the estimated prevalence of overweight plus obesity was 29% in boys and 26.5% in girls aged 2-17 yr, with higher rates in the 5-9 yr subgroup (fig. 2).

Increasing attention is being given to obesity in children under 5 years of age. The incidence of overweight in infants and young children has increased dramatically in recent decades and is expected to increase further. Although the highest incidence of overweight in infants and young children is observed in the upper middle-income countries, the fastest growth occurs in the group of lower middle-income countries. Cattaneo et al. in a recent review reported prevalence rates of overweight plus obesity at 4 years ranging from 11.8% in Romania (data collected in 2004) to 32.3% in Spain

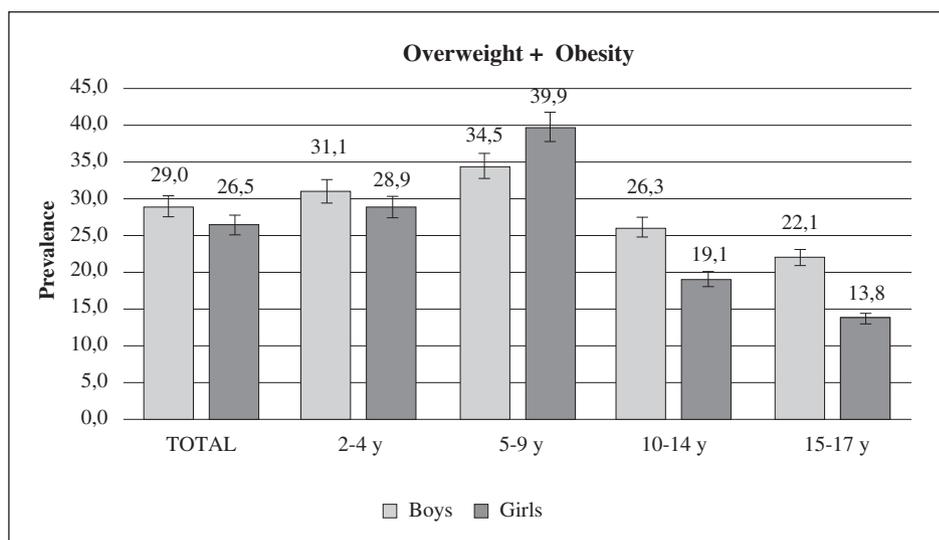


Fig. 2.—Prevalence of overweight plus obesity in Spanish boys and girls (2-17 y). National Health Survey 2011-12. Self /parent reported data. Overweight and obesity defined according to IOTF criteria.

(1998-2000). Countries in the Mediterranean region and the British islands showed higher rates than those in Middle, Northern and Eastern Europe. Reported rates were generally higher in girls than in boys.<sup>21</sup>

However, high quality evidence has emerged from several countries suggesting that the rise in the prevalence has slowed, or even plateaued. New data on child obesity from four OECD countries (England, France, Korea and United States) show that rates evolved according to previous OECD projections or even below those projections, in all four countries. Child obesity rates have effectively remained stable (at 6-8%) over the past 20 years in France. A review including high quality data from nine countries (Australia, China, England, France, Netherlands, New Zealand, Sweden, Switzerland and USA), from 467,294 children aged 2-19 years evidenced that the mean unweighted rate of change in prevalence of overweight and obesity was +0.00 (0.49)% per year across all age×sex groups.<sup>22</sup>

Similar findings were reported by Rokholm et al. supporting an overall levelling off of the epidemic in children and adolescents from Australia, Europe, Japan and the USA. Some evidence for heterogeneity in the obesity trends across socioeconomic status (SES) groups was found. The levelling off was less evident in the lower-SES groups, but no obvious differences between genders were identified. It is worthwhile to keep in mind that previous stable phases have been followed by further increases in the prevalence of obesity.<sup>23</sup> This was the case in England, where childhood obesity and overweight prevalence among school-age children has stabilized in recent years, but children from lower socio-economic strata have not benefited from this trend. In France, the prevalence of overweight in the disadvantaged group increased between 1996 (12.8%) and 2001 (18.9%) and was stable between 2001 and 2006 (18.2%). Thus in France there have been some signs of levelling off but also indications to the contrary, illustrated by a renewed rise in obesity in French children, after ten years of stabilization.<sup>24</sup>

The standardized prevalence of obesity in Chinese children increased rapidly during the past 25 years from 0.2% in 1985 to 8.1% in 2010. The increasing trend was significant in all age subgroups. Although the prevalence of obesity continuously increased in both boys and girls, the changing pace in boys was faster than that in girls. The prevalence of obesity in boys was significantly higher than in girls in all age-specific subgroups from 1991 and after. The gradually expanding gender disparity suggests the prevalence of obesity in boys contribute to a large and growing proportion of obese children.<sup>25</sup>

#### *Socioeconomic inequalities in childhood obesity*

There is a growing body of evidence for an inverse association between SES and child obesity in developed countries, with estimated Odds Ratios (OR) ranging from 1.26 to 1.95 for low SES compared to high SES neighbourhoods for varying measures of child obesity. Figure 3 shows the prevalence of obesity in Spanish children and youth (2-17 yr) by family SES level estimated based in the National Health Survey 2011-12.

Knai et al. report on a review including data from 22 European countries that greater inequality in household income is positively associated with both self-reported and measured child overweight prevalence. Several studies from four countries reported on the influence of socioeconomic factors on the distribution of child overweight over time. Although the prevalence of overweight has increased across the population of these countries, the rise has not been as severe among the wealthiest parts of the population, leading to widening social disparities among adults.<sup>26</sup>

Parental weight appears to be the most influential factor driving the childhood obesity epidemic in different countries and is an independent predictor of child obesity across SES groups. Children with at least one obese parent are 3-4 times more likely to also be obese.

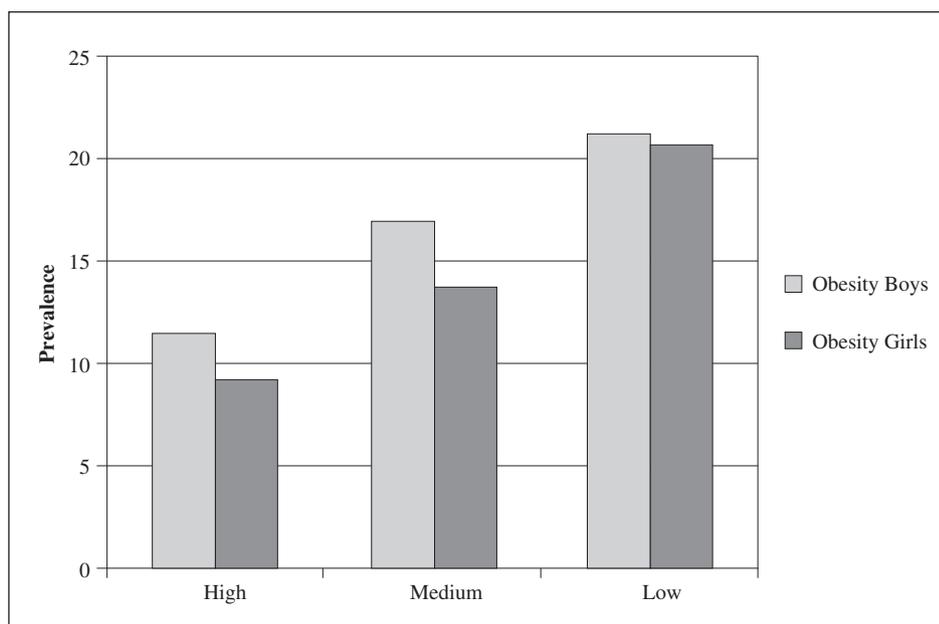


Fig. 3.—Prevalence of obesity in Spanish children and youth (2-17 yr) by family SES level. National Health Survey 2011-12. Self-parent reported data. Obesity defined according to IOTF criteria.

This is partly genetic, but children often share dietary habits and sedentary lifestyles of their parents, influences that have played a major role in the spread of obesity. In fact, the inverse relationship between SES level and obesity is evident in adults in high income countries as well.<sup>5</sup>

The increases in obesity prevalence have been attributed to environmental changes that promote excessive food intake and discourage physical activity. Research also has found that child and adult risk of obesity is related to individual socioeconomic status (SES) factors, such as household income and educational level, as well as race/ethnicity. The widening social inequality gap in child obesity suggests a particular vulnerability to environmental factors that confer obesity risk among people who face social disadvantage, including lower SES and certain race/ethnicity groups.

Based on information collected using Geographical Information Systems (GIS) to assess the structural aspects of obesity and obesity-related behaviours at the neighbourhood (or larger) level, in adjusted spatial models, child obesity risk has been significantly associated with lower household income, lower home ownership, and for each 10% increase in less educated women, and single parent households, as well as non-white residents. Greves Grow et al. observed in a spatial model that SES/race variables explained approximately 24% of geographic variability in child obesity.<sup>27</sup>

There are a number of plausible neighbourhood contextual factors likely related to SES that may explain how the environmental variables influence diet and physical activity behaviours and create “*obesogenic environments*”. These variables include low walkability, lack of recreation sites for physical activity, lack

of grocery stores offering affordable fresh fruits and vegetables, and higher density of fast food outlets. The correlation between geographic area of residence and obesity is of particular interest in identifying the social determinants of obesity, especially factors that may be modifiable in communities most severely affected by obesity.<sup>28</sup>

According to the report *Mapping the childhood obesity epidemic* published in the USA, the community indicators most influential in determining a child’s probability of being obese were demographic characteristics, household structure and the education and English language proficiency of the population in the child’s community (table II). The conclusions of this report emphasize that communities where childhood obesity is predicted to be highest face disadvantages across

**Table II**  
*Socioeconomic inequalities in childhood obesity. Communities where childhood obesity is predicted to be highest are more likely to have:*

- Minority residents
- Higher unemployment rates
- Higher proportions of children living in households headed by a non-parent
- Higher proportions of children living in households that are single-parent
- Higher poverty rates
- Lower female labour force participation
- Lower education and income levels

Source: Long S, Hendeny L, Pettit K. Mapping the Childhood Obesity Epidemic: A Geographic Profile of the Predicted Risk for Childhood Obesity in Communities Across the United States. The Urban Institute, Dec 2007.

multiple dimensions. These communities are more likely to have minority residents, higher unemployment rates, higher proportions of children living in households headed by a non-parent, higher poverty rates, lower female labour force participation, lower education and income levels, lower home ownership rates.

The plausible neighbourhood contextual factors that may mediate the SES determinants through environmental variables are now increasingly emerging. A review of built environment factors related to obesity among disadvantaged populations, defined by poverty and race/ethnicity, found that important factors are access to healthy foods in supermarkets, places to exercise, and neighbourhood safety. Zick et al. as well as other researchers have found strong association between neighbourhood retail food options and BMI/obesity risk with the magnitude of the effects varying by neighbourhood income.<sup>29</sup> Research conducted by Richardson et al. in the USA concluded that socio-demographic inequities in neighbourhood food resource availability were most pronounced in low-density urban (suburban) areas. In high-density urban areas, higher neighbourhood poverty was associated with greater availability of all food resources.<sup>30</sup>

The conclusions of a social experiment to assess the association of randomly assigned variation in neighbourhood conditions with obesity and diabetes highlighted that the opportunity to move from a neighbourhood with a high level of poverty to one with a lower level of poverty was associated with modest but potentially important reductions in the prevalence of extreme obesity and diabetes.<sup>31</sup>

## Research gaps

Despite the efforts devoted in recent years, there is a need for continuing collection of information based at least in measured body weight and height to monitor obesity trends over time in children and adult populations that are comparable across countries. Increased investment in population obesity monitoring would improve the accuracy of forecasts and evaluations.

Increasing attention is being given to obesity in children under 5 years of age. The IOTF reference and the WHO standard yield different results in terms of prevalence of overweight and obesity in children 24-60 months of age in the same population. IOTF curves for girls tend to overestimate overweight and obesity as a result of a problem with the backward tracking of the BMI centiles from 18 years of age. This is probably due to a sex bias at 18 years, because the BMI plateaus earlier in girls than in boys. An additional problem with the WHO cut-offs for overweight and obesity is the transition at 5 years between the standard for children 0-5 years of age and the one for children and adolescents 5-19

years of age. Overweight and obesity are defined with 2SD and 3SD cut-offs in the former, and with 1SD and 2SD cut-offs in the latter, and in the transition between 60 and 61 months of age the prevalence of overweight and obesity will be different depending on whether the first or the second dataset and cut-offs are used. This problem deserves further research.<sup>32</sup>

Over the past few decades, the global emergence of overweight and obesity is confounded by the simultaneous aging of the population. High prevalence for overweight and obesity occur in older adults and hence population aging may contribute independently to the rising prevalence of overweight and obesity in adults. Population aging may differ by country, and over time. Therefore age-adjusted prevalence for overweight and obesity are needed to allow for comparisons of prevalence and trends across countries. Age adjustment is important in documenting emerging overweight and obesity trends, independent of demographic changes. Ideally, nationally representative surveys in countries would be repeated at regular intervals, measure height and weight to objectively estimate overweight and obesity prevalence.<sup>13</sup>

Following the United Nations General Assembly High-Level Meeting on the Prevention and Control of Non-communicable Diseases in September 2011 request to develop targets for key non-communicable disease indicators, WHO drafted the comprehensive global monitoring framework and targets for the prevention and control of non-communicable diseases to be discussed and approved in the context of the Sixty-sixth World Health Assembly in May 2013. The document includes as indicators in relation to obesity monitoring the prevalence of overweight and obesity in adolescents (defined according to the WHO growth reference for school-aged children and adolescents, overweight —one standard deviation body mass index for age and sex and obese— two standard deviations body mass index for age and sex) and age-standardized prevalence of overweight and obesity in persons aged 18+ years (defined as body mass index  $\geq 25$  kg/m<sup>2</sup> for overweight and body mass index  $\geq 30$  kg/m<sup>2</sup> for obesity).

## Conclusions

The prevalence of overweight and obesity is high in all age groups in many countries, but especially worrying in children and adolescents in developed countries and economies in transition. Some evidence suggests a tendency to stabilize the growth rate of the problem. However, this finding should not divert attention from the problem, since in some countries the plateau or decline has been followed by a rebound.

There are significant differences in the prevalence of overweight and obesity among different population groups, with inequalities in disadvantaged

groups in terms of socioeconomic status, education and social environment, which tend to increase even more in the current economic crisis. These differences contribute to increase health inequalities, because this situation adds up to the burden associated with obesity on physical health, psychological and social wellbeing.

In relation to childhood obesity, it would be desirable to reach a consensus on the reference curves and cut-off points used for surveillance and monitoring purposes of excess weight, at least to enable international comparisons.

It is required to develop and implement a monitoring and evaluation system with a set of minimum indicators that allow the collection of comparable high quality information on the evolution of the problem. Based on current evidence available it is necessary to further coordinate and standardized the collection of epidemiological information on anthropometric measurements, weight gain, physical activity and dietary habits in pregnant women during lactation and related to infant weaning and diet diversification.

It would be desirable to identify social environments, geographical areas and population groups whose situation are at increased risk and therefore prevention strategies are necessary and require specific priority attention.

This mapping of the problem is influenced by different interrelated factors framed in distal social level, close social environment such as school, work or community, the family and individual level.

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