# Physical Activity, Physical Fitness and the Health of young people

***Chapter objectives:***

- To describe the relationship between dosage (amount) of physical activity performed and health status.
- To describe the health benefits of physical activity for young people.
- To provide statistics on physical activity and physical fitness in Spanish young people.
- To define and describe overweight and obesity.
- To describe the causes and consequences of childhood overweight and obesity and their relationship with physical inactivity.
- To talk about the incidence of childhood overweight and obesity in Spain.
- To briefly outline the Strategy for Nutrition, Physical Activity and Prevention of Obesity (NAOS initiative) in Spain.
- To describe safety issues related to participation in physical activity for young peoples.

## 1. Dose-response issues concerning physical activity and health

As described in the section above, the dose (or amount) of physical activity that an individual receives is a function of the factors contained within the F.I.T.T. principle – in other words it is a function of the frequency, intensity, time and type of activity that a person undertakes. There is still doubt about the optimal amount and the minimal amount of physical activity for health benefits, and in particular the effects of intensity (*eg.* light vs. vigorous) on health status. However, it is clear that there is a curvilinear relationship between physical activity and health status, such that increases in physical activity and fitness will lead to additional improvements in health status [5, 11, 12] (see figure 5). Stated another way, the most physically active individuals have the lowest

risk of chronic diseases. Figure 5 also illustrates another important point – that the greatest gains in health status can be expected when the most sedentary individuals begin to become physically active. This has extremely important public health implications, both for young people and adults.

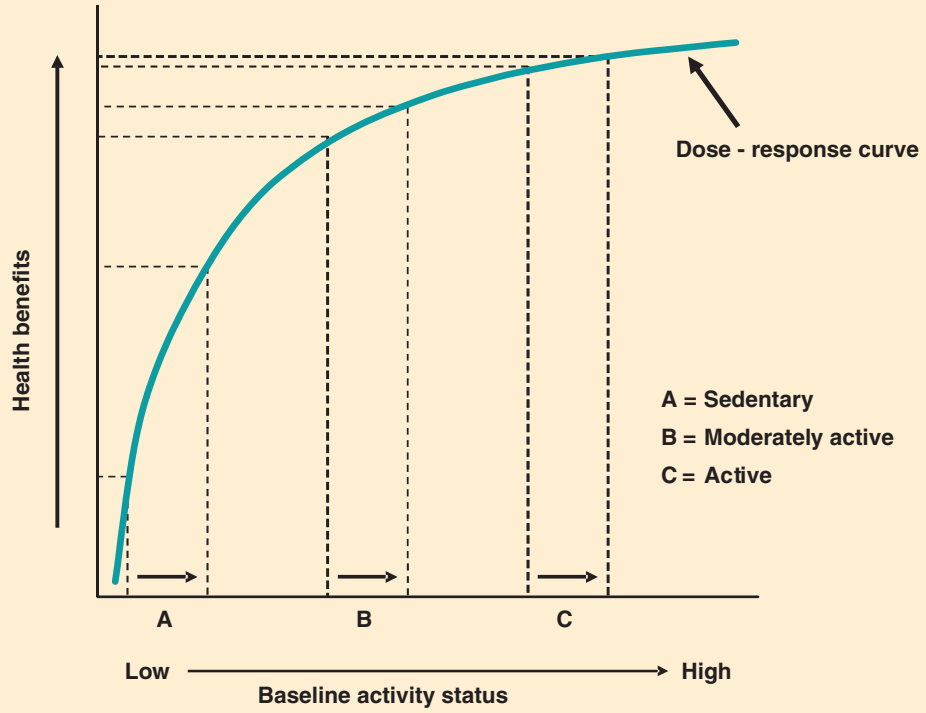


**Figure 5:** Relationship between amount of physical activity and health benefits

The intensity of physical activity may be a particularly important aspect of the exercise dosage, with evidence to suggest that activities of greater intensity (at least moderate-to-vigorous) are particularly beneficial in terms of health status [11, 13-16]. Also, it is important to note that physical activity should be *regular* to have a beneficial effect on health. This underlines the importance of frequency within the F.I.T.T. principle. It is a wiser practice to engage in moderate amounts of physical activity on all or most days of the week than to engage in very large amounts of physical activity on a sporadic basis.

## 2. The importance of physical activity for the health of young people

The benefits of physical activity for children and young adults are numerous and can be broadly placed into three categories (see figure 6):

1. Physical, mental and social health benefits during childhood.

2. Health benefits of childhood activity that carryover to adulthood.
3. Behavioural carryover of healthy physical activity habits into adulthood.

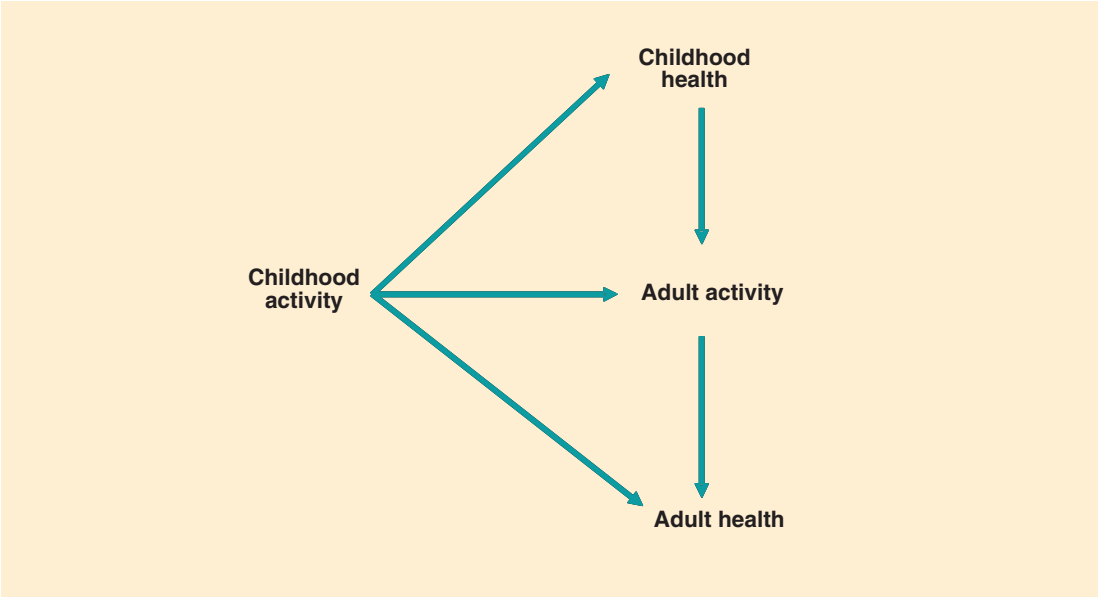


**Figure 6.** Interrelationships of childhood and adult activity and health.

## 2.1. Health benefits during childhood:

Physical activity in childhood has a range of benefits during childhood including healthy growth and development of the musculoskeletal and cardiorespiratory system, maintenance of energy balance and thus a healthy weight, avoidance of cardiovascular disease risk factors such as hypertension and high blood cholesterol, and the opportunity for social interaction, achievement and mental well-being.

The degree to which inactivity is contributing to the rising levels of obesity in children has not been clearly defined. However, there is strong evidence to suggest that inactive children are more likely to have excess fat [17], even as early as late infancy [18]. There is also convincing evidence that children who spend more time engaged in sedentary pursuits such as television watching and computer games are more likely to have excess fat [19, 20]. Further information on overweight and obesity can be found later in this section.

There is strong evidence that physical activity is important for children's psychological well-being [21]. Children with lower activity levels have a higher prevalence of psychological and emotional distress. Sport and exercise provides an important medium for children and teenagers to be successful and this helps to improve social well-being, self-esteem and self perceptions of body image and competence, with a stronger effect for those already low in self-esteem. Moreover, children with higher physical activity levels are also more likely to have better cognitive functioning [22]. It is

logical to speculate also that higher levels of participation in sport and physical activity may be associated with lower levels of juvenile delinquency (*eg*. involvement with gangs, drug use, *etc*.) but the research is currently equivocal.

Generally, cardiovascular disease is not a disease of childhood, but research has shown that less physically active children and those with lower cardiovascular (aerobic) fitness are more likely to possess risk factors for this disease such as a lower levels of "good" cholesterol (high density lipoprotein cholesterol, HDL), higher blood pressure, raised insulin levels and excess fat [23, 24].

It is highly likely that physical inactivity is contributing to the increasing appearance of obesity, increased insulin resistance, disordered lipid profile and elevated blood pressure in children. This in turn is probably responsible for the increasing prevalence of type 2 diabetes in children and adolescents [25], a disease that until recently was usually only found in overweight and obese adults.

## 2.2. Childhood activity and health as an adult:

Studies have shown that childhood obesity tracks into adulthood [26]. In fact, the risk of adult obesity is at least twice as high for obese children as for non-obese children [26]. Therefore, physical activity during childhood seems to be somewhat protective against obesity later in life. In addition, adults who were obese as children carry a risk of poorer health and increased mortality compared with adults who were not obese as children. By maintaining childhood aerobic fitness, physical activity during childhood reduces the adult risk of cardiovascular disease [27].

During the growing years (especially adolescence), boys and girls rapidly gain bone mineral density. This is important as attainment of as high a skeletal mass as possible during one's youth reduces the chances of excessive loss of bone mass later in life (known as osteoporosis). It has been clearly shown that physical activity during early puberty, especially weight bearing activities that stress the bones to a greater extent, can result in the attainment of greater bone mass which is protective against osteoporosis in old age [28]. Examples of beneficial activities include those that involve jumping, dancing, aerobics, gymnastics, volleyball, handball, racquet sports, soccer and mountain biking. It should be noted that low-impact activities like swimming are not effective for stimulating improvements in bone mass. Peak bone mass is achieved by the age of 20-30 and so attempts to enhance it must concentrate on childhood and adolescence [28].

## 2.3. Establishment of lifetime activity patterns:

Similar to the research that has shown that obesity tends to track from childhood into adulthood, there is also a large body of evidence that suggests that the physical activity habits established during one's younger years also tend to track into young adulthood and later life [29-32]. It makes sense that children who emerge from their school years feeling confident about their physical skills and bodies, and who have had

positive experiences of physical activity, are more likely to be active through adulthood.

It is important to note that stronger associations between physical activity in childhood and physical activity in adulthood are found when the quality of the physical activity experience in childhood, rather than simply the quantity, is taken into account [33]. Clearly, the way exercise and sport are experienced in childhood and youth impacts on subsequent participation as an adult. Negative attitudes gained as a young person may persist into adulthood and affect people's willingness to take part in physical activities.

**Table 3.**
Summary of the major benefits of childhood physical activity.

1. **Health benefits during childhood:**
   - Maintenance of energy balance and prevention of overweight and obesity.
   - Promotes healthy growth and development of the musculoskeletal and cardiovascular system.
   - Reduces risk factors for:
     - → cardiovascular disease.
     - → type 2 diabetes
     - → hypertension
     - → hypercholesterolemia.
   - Improves mental health and psychological well-being through:
     - → reduced anxiety and stress
     - → reduced depression
     - → higher self-esteem
     - → improved cognitive function.
   - Improved social interaction.

2. **Improved health during adulthood:**
   - Reduced probability of becoming obese during adulthood.
   - Reduced morbidity and mortality from chronic disease during adulthood.
   - Improved bone mass reduces likelihood of osteoporosis in later life.

3. **Establishment of lifetime activity patterns:**
   - Improved likelihood of becoming an active adult.

## 3. Physical activity, sedentary behaviour and physical fitness in Spanish young people

In the 1997 National Health Survey, statistics showed that for children 6-15 years old, only 36.7% of boys and 19.7% of girls reported doing some form of sport or physical training several times a week [34]. When boys and girls were pooled, less than 30% of young people were found to be active in their leisure time several times per week [34].

In the 2001/2002 Health Behaviour in School Aged Children (HBSC) survey (conducted every four years by the World Health Organization), it was determined that the proportion of young people in Spain that met the guidelines (outlined in further detail in Chapter 3 of this guide) of at least 60 minutes of moderate-to-vigorous physical activity on five or more days of the week was 40.5% (boys) and 27.0% (girls) in 11 year olds, 39.7% (boys) and 28.6% (girls) in 13 year olds and 38.2% (boys) and 22.7% (girls) in 15 year olds [35]. These results are somewhat consistent with those presented above and reinforce the low participation and marked gender difference in physical activity in our country.

Further data from the 2001/2002 HBSC revealed sedentary behaviour patterns in Spanish young people. On weekdays, approximately 22% of Spanish 11-15 year olds watched more than four hours of television, with girls and boys demonstrating very similar values. This value doubled on weekend days with approximately 42% watching more than 4 hours of television. Regarding computer use in 11-15 year olds, a marked discrepancy was seen between boys and girls. On weekdays 6.6% of girls and 13.4% of boys reported using the computer for more than 3 hours a day. On weekends these values doubled to 14.8% and 30.1% respectively [35]. A trend is also clearly seen for greater computer use with increasing age.

Recent data has indicated that Spanish adolescents possess lower physical fitness in comparison to other countries [36], a finding almost certainly linked to low participation in physical activity. When these findings were interpreted as an indicator of future cardiovascular health, it was estimated that approximately 20% of Spanish adolescents have an increased risk for future cardiovascular disease [36]. The findings of low physical fitness and low participation in physical activity in Spanish young people should come as no surprise given that the Spanish adult population takes less physical activity than people in other countries [37]. Further research has also shown that the proportion of Spaniards with a poor attitude toward changing their level of physical activity was higher than in other countries in Europe, and Spanish citizens were less perseverant in achieving positive changes in their physical activity status [38]. Overall, it appears that Spanish young people find themselves in an environment that is not as conducive to increasing their physical activity levels as it should be. This situation can and must change.

## 4. The linkage between physical inactivity and childhood overweight and obesity

The mechanism of obesity development is not fully understood. It is a complex multifactorial issue which means that the rising prevalence of obesity can therefore not be explained or addressed by a single factor. However, it is clear that obesity occurs when energy intake exceeds energy expenditure (see Figure 7). Genetic factors influence the susceptibility of a given child to an “obesogenic” (obesity promoting) environment. In other words, some children are more prone to obesity than others as a result of hereditary factors. In the vast majority of cases environmental factors, lifestyle pref-

erences and cultural environment are the significant factors that influence obesity. While changes in the diets of children have undoubtedly contributed to increasing global levels of pediatric overweight and obesity, most experts now believe that decreased physical activity is the major contributor.

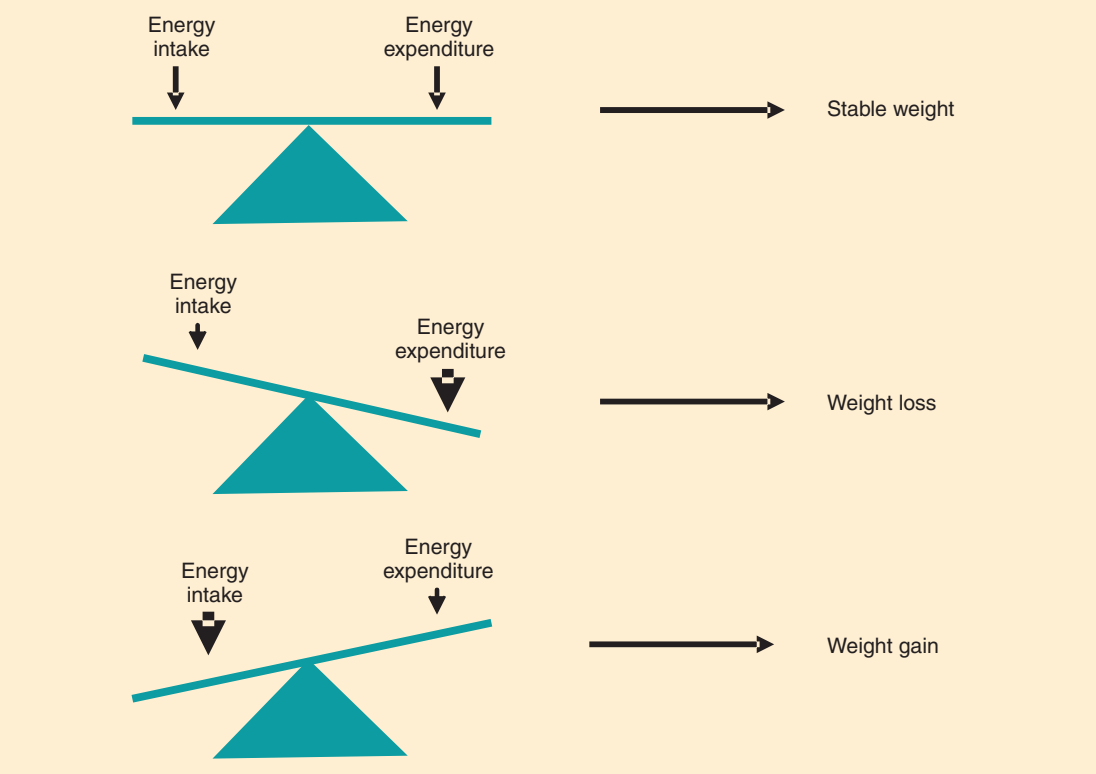


**Figure 7.** Changes in body weight are determined by a balance of energy intake (food calories) and energy expenditure (calories burned).


When the growing problem of overweight and obesity was first recognized in the 1980's and 1990's, obesity was first viewed as a personal disorder or abnormality that required treatment. While this may be partially true, strategies to curb the obesity epidemic using this philosophy failed. Now there is more of an "ecological" approach to the problem of obesity where it is seen as a normal consequence of an increasingly abnormal (obesogenic) environment [39]. One important aspect of this abnormal environment is the changing physical activity environment, which affords progressively less opportunities for spontaneous physical activity, both in adults and young people. The key to success in tackling the problem of obesity now lies in understanding, measuring and altering this obesogenic environment.

In May 2004, a report by the International Obesity Taskforce (IOTF) to the World Health Organization (WHO) highlighted examples of problematic social trends that are believed to be contributing to the childhood obesity epidemic [40]. These included:

1. An increase in the use of motorized transport, *eg.* to school.
2. Reduced opportunities for recreational physical activity.
3. Increased sedentary recreation.
4. Multiple TV channels around the clock.
5. Greater quantities and variety of energy dense foods available.
6. Rising levels of promotion and marketing of energy-dense foods.
7. More frequent and widespread food purchasing opportunities.
8. More use of restaurants and fast food stores.
9. Larger portions of food offering better 'value' for money.
10. Increased frequency of eating occasions.
11. Rising use of soft drinks to replace water, *eg.* in schools.

Therefore, lack of sufficient physical activity (points 1-4) is strongly indicated as a contributor to the rising problem of obesity. It is now widely accepted that increasing physical activity participation and decreasing sedentary behaviour should be the major focus of strategies aimed at preventing and treating overweight and obesity in young people [41].

The IOTF report also concluded that the domination of obesity-promoting environmental factors meant that treatment would be unlikely to succeed without strategies to deal with the prevailing environment through a broad-based public health programme, and urged policy-makers to develop strong policies to address the rising problem. Spain was one of the first countries to respond to this challenge by developing a national strategy for prevention of obesity through nutrition and physical activity (the NAOS initiative, described in further detail below)..

## 5. Definition and measurement of overweight and obesity

The most basic definition of obesity is an excess of body fat that increases health risks. There are many different techniques that can be used to assess body fat, some with greater validity than others. Examples of such techniques include sophisticated laboratory techniques such as magnetic resonance imaging or dual energy X-ray absorptiometry and simpler methods such as measurement of subcutaneous fat using skinfold callipers. Unfortunately, the ideal definition of obesity based on percentage of body fat is impractical for epidemiological use. Therefore, for simplicity, population statistics regarding obesity use a measure that relates the weight of a person to their height termed the body mass index (BMI: weight [kg] / height [$m^2$]). The major disadvantage of BMI is that, on an individual level, it may give highly misleading information regarding body composition as it is merely an expression of weight in relation to height, with no means of distinguishing fat mass from lean body mass. For example, a short young muscular male may be deemed to be overweight or even obese using BMI when in fact his body composition is perfectly healthy. On a population (or epidemio-

logical) level, however, BMI can give useful statistical information regarding prevalence of obesity.

In adults, overweight can be defined as excess weight relative to a desirable body weight (>120% of desirable weight) or, more accurately, a BMI of between 25 and 30 kg/m$^2$. Overweight is considered to be the precursor of obesity, the latter of which is defined as a BMI of over 30 kg/m$^2$ [42]. In children overweight and obesity are more difficult to define because BMI and body composition change substantially during growth and development. Two major approaches have been taken to address this problem. The first is to define overweight and obesity in terms of percentiles of BMI for age. Using this approach, overweight and obesity have been defined as at or above the 85th percentile and at or above the 95th percentile of BMI for age, respectively [43]. The second approach is an international classification that is directly linked to the adult BMI cut off points of 25 and 30 kg/m$^2$, with adjustments for the growth and development of children included [42]. Both techniques have been used in the research literature.

## 6. Health consequences of obesity in young people

The negative consequences of obesity during the early years of life are both physiological (medical) and psychosocial. Probably the most widespread consequences of childhood obesity are psychosocial. Obese children become targets of early and systematic discrimination and tend to develop a negative self-image that appears to persist into adulthood [44]. In addition, there are numerous health complications that become apparent during youth including [44, 45]:

1. Disturbances in blood lipids (*ie*. elevated triglycerides, elevated low-density lipoprotein (LDL) cholesterol and lowered high-density lipoprotein (HDL) cholesterol).
2. Glucose intolerance (*ie*. insulin resistance) and type 2 diabetes.
3. Atherosclerotic changes within arteries (coronary heart disease).
4. Hepatic problems such as cirrhosis.
5. Hypertension.
6. Sleep problems.
7. Orthopaedic complications, especially of the hips and lower extremities.

Those studies that have investigated the long-term effects of childhood or adolescent obesity on adult morbidity and mortality have shown greater adult all-cause mortality, coronary heart disease, atherosclerotic cerebrovascular disease, hypertension, colorectal cancer, diabetes, gout and arthritis, amongst other medical conditions. The rates of morbidity and mortality from these diseases increase with higher degrees of obesity. In addition, a large body of research evidence has shown that once a child has become obese, there is a high probability that this obesity will continue into adulthood [26]. Therefore, there is general acceptance that children should be considered

the priority population for intervention strategies aimed at treating or, ideally, preventing the onset of obesity. Physical activity must be a major component of interventions designed to prevent or treat childhood obesity.

It is important to note that the distribution of body fat in young people, as in adults, is potentially a more important correlate of cardiovascular risk factors than the percentage of body fat. Studies in young people have shown that fat accumulation in the central (abdominal) region is associated with increased risk factors such as excessive blood triglycerides, low HDL cholesterol, hypertension, insulin resistance, endothelial dysfunction and arterial wall stiffness [44, 46, 47]. In comparison, fat accumulation around the lower body region (hips and thighs) is far less dangerous. Recent studies on Spanish children and adolescents [48, 49] have shown strong trends towards increased central fat distribution in this population, results that have worrying future health implications.

## 7. Overweight and obesity in Spanish young people

In Spain, research in 2003 indicated that the prevalence of overweight and obesity in the adult population was 38.5% and 14.5% respectively [50], and these values continue to increase [51]. However, of even greater concern are the statistics regarding overweight and obesity in Spanish children and adolescents. From 1998 to 2000, the prevalence of overweight and obesity was 26.3% and 13.9% respectively in this population [52] and the trend towards greater fatness in our youth shows no sign of slowing. The problem is especially pronounced in those aged 6-13 years of age. The statistics also reveal that the prevalence of overweight and obesity is higher in Spain in young males than young females (see Figure 8). From the mid 1980's to mid 1990's the incidence of obesity in those aged 6-7 years old in Spain increased from 23% to 35%, a value higher than that of the United States [53].

In comparison with other European countries, Spain is in an intermediate position in terms of adult obesity. However, our country has one of the highest rates of childhood overweight and obesity in Europe as shown below in Figure 8.

The burden of obesity-related illnesses to modern society is immense, both in terms of economic costs to health systems and, on an individual level, reduced quantity and quality of life. In Spain alone, it has been estimated that the direct and indirect costs associated with obesity comprise about 7% of total health expenditure, or approximately 2.5 billion euros per year.

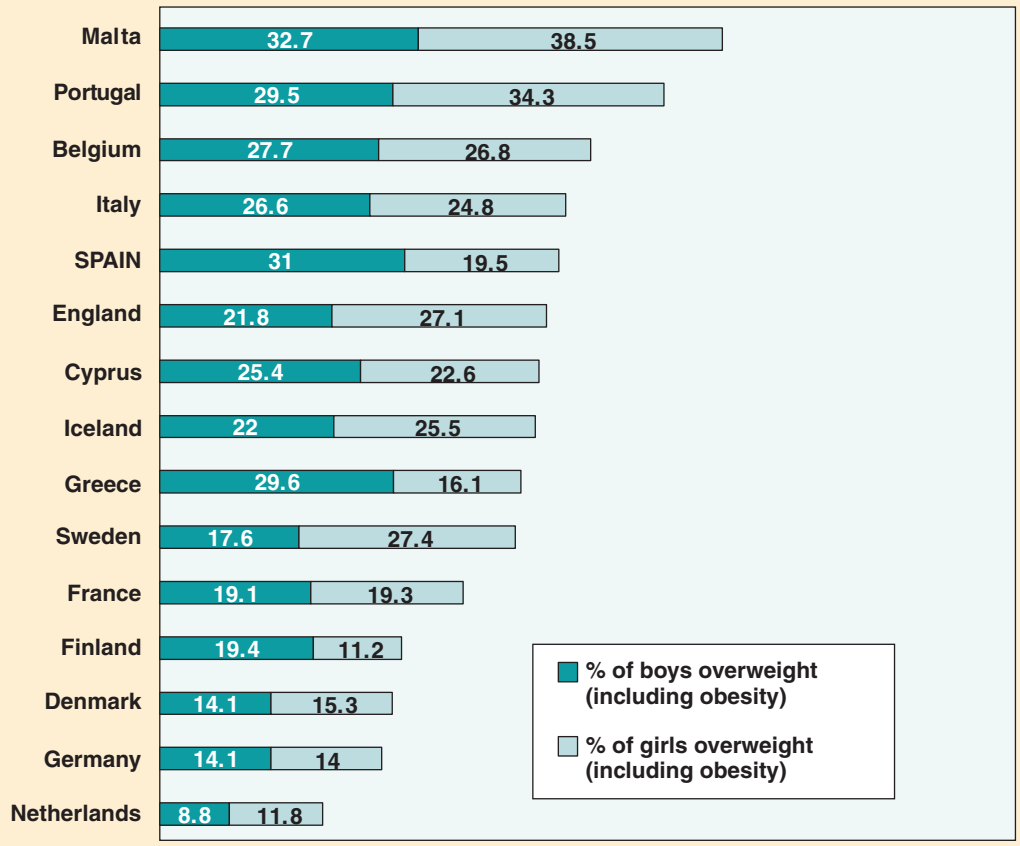


**Figure 8.** Incidence of childhood overweight (including obesity) in both boys and girls within selected European countries. (data obtained from the website of the International Obesity Taskforce: http://www.iotf.org/database/ChildhoodTablebyRegionFeb06.htm)

## 8. Obesity and the NAOS initiative in Spain

The NAOS initiative (Strategy for Nutrition, Physical Activity and Prevention of Obesity) was launched in Spain on February 10 2005 by the Spanish Ministry of Health and Consumer Affairs in response to the WHO's request for member states to adapt the Global Strategy on Diet, Physical Activity and Health to their social and cultural environments [54]. It is the first strategy of its kind in Europe.

The NAOS initiative is anchored on the core goal of adopting a lifelong perspective in the prevention and control of obesity and encompasses recommendations for action in four fields:

1. Families and communities – action focuses on information and media campaigns, and the production and distribution of materials aimed at promoting improved eating habits and active lifestyles in children and adolescents.

2. Schools – actions comprise the inclusion of knowledge and skills related to diet, nutrition and physical activity in the academic curriculum, standards for menus served in dining rooms, and the products offered by, as well as location and advertising of, vending machines.
3. The private sector – collaboration agreements have been signed between the Ministry of Health and Consumer Affairs and the private sector.
4. The health system – actions have been designed to strengthen the leading roles played by paediatricians and other health staff in the prevention and early recognition of excessive weight gain.

More information on the NAOS initiative can be obtained from the Ministry of Health and Consumer Affairs, Madrid, Spain (http://www.msc.es/).

## 9. Further safety issues regarding physical activity in young people

### *9.1. Risk of traumatic or overuse injury:*

A potential disadvantage of physical activity in youth is the possibility of injury. This presents several potential problems:

1. the short term negative consequences of injury for the child,
2. the possibility of injury recurrence,
3. the possibility of long term physical damage,
4. the possibility that injury sustained during sport or physical activity during childhood may leave a lasting negative impact on levels of physical activity during adulthood.

Injury usually occurs either when the activities themselves are inappropriate for the children concerned or are performed in a manner (eg. excessive intensity, lack of safe technique or equipment) that is inappropriate. From 6 to 12 years old the nature of physical activity revolves for most children around fun and joyful play. During this phase of life a child is learning about their body and about the principles of fair and safe play within sport and physical activity. It is important that these values are adhered to and that parents and teachers do not treat their children as mini adults, pushing them into competitive sports or activities that are not appropriate or enjoyable for them [55]. Excessive training or overuse injuries during this critical phase of life can compromise healthy growth and result in long term physical and psychological damage.

From 12 to 18 years of age, children's focus within sports and physical activity often shifts more towards competitive sports and situations. Sports injuries during this phase of life are usually due to the behaviour of the children themselves and are often due to inadequate or inappropriate education from 6 – 12 years. Therefore, it is

important that at an early age children are made aware of their risky behaviours (*eg.* dangerous tackling in football, failing to wear a helmet while biking or skating, *etc.*) and that they take personal responsibility to reduce the risk during their teenage years. If good values are taught at a younger age, when sport is still more about play than competition, sportsmanship and safe play in adolescence will represent a natural progression.

Fear of the risk of injury should never be a factor preventing a child from being physically active. In fact, the risk in ***not*** performing physical activity during one's youth far outweighs the risk of injury from participation in appropriate sports and physical pursuits. Sports and exercise injuries are, for the most part, entirely avoidable through attention towards the behaviour and attitudes of children and the adults who influence them [56]. The responsibility for instituting this change lies with parents, trainers, coaches, teachers and health professionals involved with physically active youth.

## 9.2. Risk of heat or cold injuries:

In Spain during the hotter months there is a real possibility of heat injury in children during outdoor play time. Such injuries include dehydration, heat exhaustion and sun burn. Common sense regarding the provision of sufficient fluids and water to children and also use of sun creams, protective clothing and hats can help to reduce the risks involved. Similarly, provision of sufficient clothing for children during outdoor play in winter time will reduce the possibility of cold injuries such as hypothermia.

## 9.3. Risk of drowning and other water injuries:

Given the high proportion of young people who engage in water-based leisure activities, especially during the summer months, this represents a real risk in terms of drowning, near drowning or other forms of injury related to play in or near water. Close adult supervision of children in an aquatic environment is obviously of critical importance.

***Key points:***

- There is an almost linear relationship between amount of physical activity performed and health status such that those who perform the most physical activity have the lowest risk of chronic disease.
- Activities of greater intensity (at least moderate intensity) may be particularly beneficial for health.
- Physical activity is critical for the health of young people as: (i) it enhances physical, mental and social health during childhood, (ii) there are health benefits of childhood activity that carryover to adulthood, and (iii) physical activity habits established during childhood tend to carryover into adulthood.

- Spanish young people, especially girls, are insufficiently physically active for health benefits and possess lower physical fitness in comparison to young people in other countries.
- Decreased physical activity is probably the major contributor to increasing levels of obesity in young people both in Spain and worldwide.
- Slowing or stopping the growing levels of childhood obesity within society will require broad-based public health changes that result in major changes in young people's physical activity and nutritional environments.
- Body mass index (BMI: weight [kg] / height [$m^2$]) is the most widely used method of estimating overweight and obesity in the population. It is not a good method of assessing body composition on an individual level.
- Obesity is defined as an excess of body fat that increases health risks. During childhood, obesity is associated with negative psychosocial health and increased risk factors for cardiovascular diseases, some cancers, diabetes and arthritis, amongst other medical conditions.
- Overweight is excess weight relative to a desirable body weight. It is often viewed as the precursor to obesity.
- Overweight and obesity are difficult to define precisely in young people because large changes in body weight, height and composition occur as a normal consequence of healthy growth and development.
- Spain currently has one of the highest rates of childhood and adolescent obesity in Europe.
- The NAOS initiative (Strategy for Nutrition, Physical Activity and Prevention of Obesity) in Spain was launched in 2005 to combat the rising levels of obesity in our country.
- If physical activity is performed responsibly in young people, there are minimal injury or safety concerns. The risk of young people not participating in physical activity far outweighs the risk associated with participation.