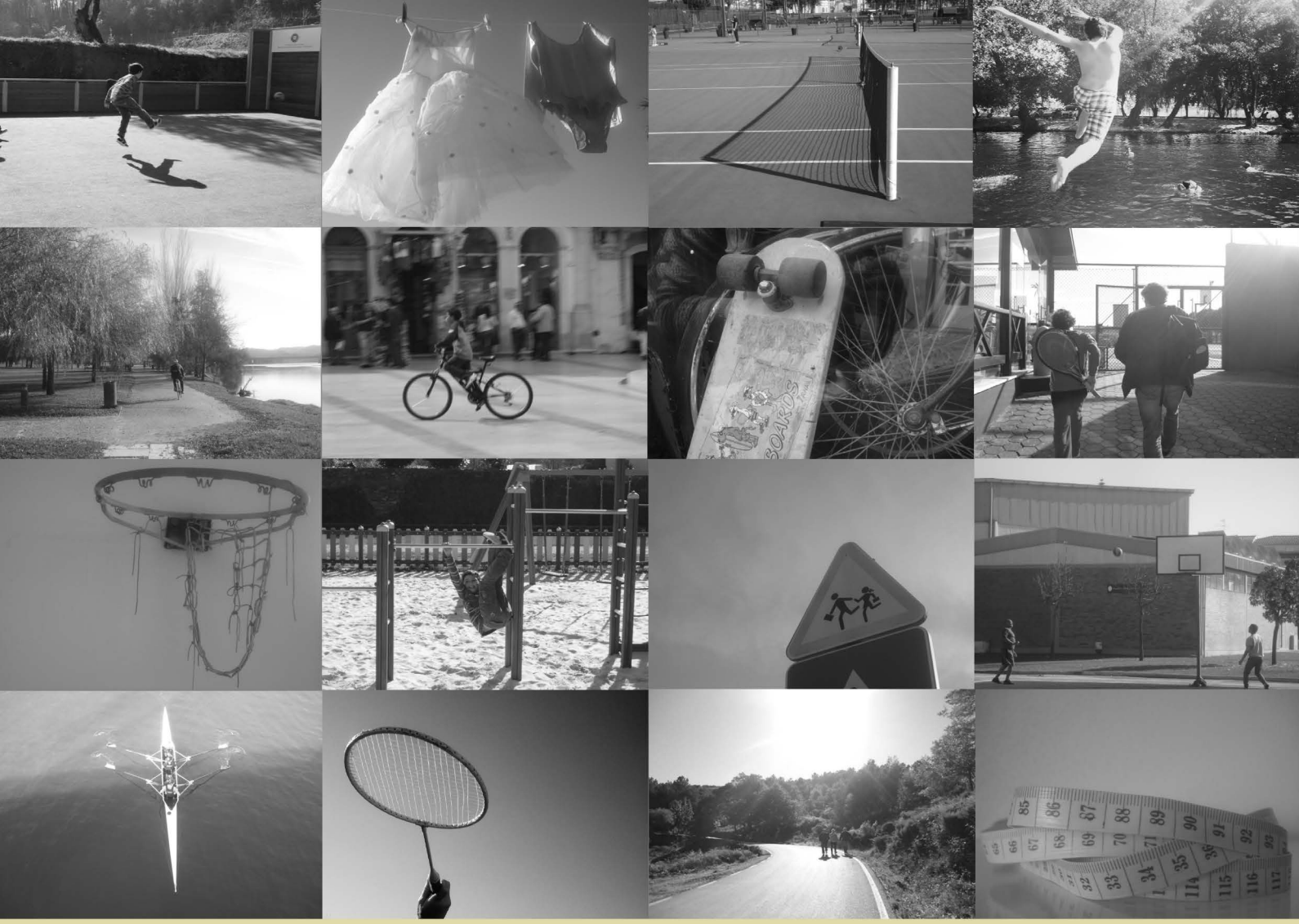

Daniela Rodrigues da Costa

ASSOCIATION OF SOCIAL, CULTURAL AND ENVIRONMENTAL FACTORS WITH PARTICIPATION IN EXTRACURRICULAR SPORT AND OBESITY INDICATORS IN 6-10-YEAR-OLD CHILDREN LIVING IN URBAN AND NON-URBAN SETTINGS

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Association of social, cultural and environmental factors with participation in extracurricular sport and obesity indicators in 6-10-year-old children living in urban and non-urban settings

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"Sports have the power to change the world. It has the power to inspire, the power to unite people in a way that little else does. It speaks to youth in a language they understand. Sports can create hope, where there was once only despair. It is more powerful than governments in breaking down racial barriers. It laughs in the face of all types of discrimination."

Nelson Mandela, remarks at Laureus World Sports Awards, 2000

ABSTRACT

Introduction: Extracurricular sport has the potential to increase total physical activity (PA) which plays an important role in the prevention of a number of health problems, including obesity. However, most children do not achieve the recommended guidelines. Sport participation may be influenced by a number of factors, but little is known how those risk factors may vary according to children's sex and place of residence.

Objectives: This study aims to: (1) estimate the prevalence of PA in girls and boys living in urban and non-urban settings and observe the factors that may predict participation in extracurricular sport and, (2) to assess the prevalence of childhood general and abdominal obesity, and identify the underlying risk factors related to the respective obesity rates, namely intrapersonal, social, and physical environment factors.

Methods: A cross-sectional study was done in 2013-2014. The sample comprised 793 children aged 6-10 years, and 834 parents, living in an urban (Coimbra) and a non-urban (Lousã) setting, both situated in central Portugal. PA behaviours (including sport participation), socio-economic, family factors, and parental opinions of sport were assessed by a questionnaire. Children's opinions about sport were collected through a semi-structured interview. Weight, height, and waist circumference were measured. Overweight (O) and obesity (OB) were defined using the World Health Organization (WHO) and the International Obesity Task Force (IOTF) cut-off points. The cut-off point of ≥0.5 in the waist-to-height ratio (WHtR) was used to define abdominal obesity (AOB). Different statistical procedures were conducted to analyse associations among aforementioned variables.

Results: Majority of children practiced at least one extracurricular sport (67.7%), usually sports that are socially associated with their own gender or have a tradition in their community. Children from bigger families, with lower family income, whose parents had lower education and reported more barriers, more gender-role notions on sport, and perceived less available facilities/sports in the neighbourhood had lower odds of participating in a sport. A positive association was found between father-son and mother-daughter physical behaviours, with mothers' participation in organised PA being a strong predictor of girls' participation in an extracurricular sport. Both sexes reported that boys are better at sport than girls and that sport is more important for boys than it is for girls. Boys, more than girls, reported an interest in

pursuing a career in sport. Children from the non-urban setting reported more places to be active during winter but urban children reported more parental role-modelling than non-urban children. Not being interest in pursuing a sport-related career was the intrapersonal factor more negatively associated with sport participation, in both sexes and settings. A great number of children were overweight (WHO: 20.7%/IOTF: 15.9%) or obese (WHO: 7.7%/IOTF: 6.1%), with girls having significantly higher prevalence of obesity than boys (IOTF). Moreover, girls had higher prevalence of abdominal obesity than boys, and it was found that a large proportion of children that were classified as having normal weight or overweight were abdominally obese. Family income, parental education, parental BMI (particularly mothers) were predictors of childhood obesity. Also, obese children were less physically active than non-obese children. Being a girl and living in the urban setting were significantly associated with higher odds of having general and abdominal obesity.

Conclusion: This study shows that participation in sport is associated with both intrapersonal and social factors, and that those factors may varied according to the level of urbanization. Boys and girls participate in sport in similar rates, but efforts should be made to change the notions that parents and children have about sport. By identifying barriers in different domains, this study reinforces that actions to promote PA are most effective when they enable alterations in different factors and include multiple levels of influence, starting in the nuclear family, but including teachers, schools, and government policies.

Key-words: children, extracurricular sport, risk factors, intrapersonal, socio-economic, physical environment, obesity

RESUMO

Introdução: A participação em desporto extracurricular está positivamente associada com incrementos nos níveis de atividade física (AF), que por sua vez tem um papel protetor importante em vários problemas de saúde como a obesidade. Contudo, a maioria das crianças não segue as recomendações relativas à AF. A participação em desporto extracurricular pode ser influenciada por vários fatores, mas pouco se sabe como é que esses fatores variam de acordo com o sexo e a ambiente físico.

Objetivos: Este trabalho tem dois objetivos: (1) estimar a prevalência de AF em rapazes e raparigas que vivem em ambientes distintos (urbano e não-urbano) e observar como diferentes fatores intrapessoais, sociais, e ambientais podem influenciar a prática de desporto extracurricular e (2) avaliar a prevalência de excesso de peso e obesidade abdominal e identificar possíveis fatores de risco relacionados.

Material e métodos: Um estudo transversal foi feito em 2013-2014. A amostra inclui 793 crianças (6-10 anos) e 834 pais, a viver numa área urbana (Coimbra) e numa não-urbana (Lousã), ambas situadas na zona centro de Portugal. Os dados sobre AF (incluindo desporto extracurricular), fatores socioeconómicos e familiares, e a opinião dos pais sobre desporto foram recolhidos através de um inquérito. A opinião das crianças sobre desporto foi obtida através de uma entrevista semiestruturada. O peso, a altura, e a circunferência abdominal das crianças foram medidas. O excesso de peso (O) e a obesidade (OB) foram definidos aplicando os pontos de corte da Organização Mundial de Saúde (OMS) e da International Obesity Task Force (IOTF), enquanto a obesidade abdominal (AOB) foi calculada como WHtR≥0.50. Diferentes técnicas estatísticas foram usadas para testar os objetivos supramencionados.

Resultados: A maior parte das crianças pratica um desporto extracurricular (67.7%), geralmente desportos socialmente atribuídos ao seu sexo e que existem na área de residência. Mais irmãos, menor rendimento familiar, educação parental mais baixa, e pais que identificaram mais barreiras, mais estereótipos de género, e reportaram menos locais/desportos na área de residência têm menor probabilidade de ter um filho(a) a praticar desporto. Uma relação na AF entre pai-filho e mãe-filha foi registada e a prática de AF organizada por parte da mãe aumenta a hipótese de a filha praticar desporto. Ambos os sexos afirmaram que os rapazes são melhores desportistas que as raparigas e que fazer desporto é

mais importante para rapazes do que para raparigas. Mais rapazes do que raparigas mostraram interesse em ter uma carreira profissional relacionada com desporto. As crianças reportaram diferentes barreiras consoante o local onde vivem. Não ter interesse numa carreira desportiva foi o fator mais negativamente associado com a participação em desporto extracurricular. A prevalência de excesso de peso (OMS: 20.7%/IOTF: 15.9%) e obesidade (OMS: 7.7%/IOTF: 6.1%) foi elevada, principalmente nas raparigas. A prevalência de obesidade abdominal também foi mais elevada nas raparigas do que nos rapazes, e um grande número de crianças que foram classificadas como tendo peso normal ou excesso de peso, tinham obesidade abdominal. O rendimento mensal, a educação dos pais, e o BMI do pai e principalmente da mãe influenciaram a obesidade infantil. Ser rapariga e viver na área urbana aumentou significativamente o risco de obesidade infantil.

Conclusão: Este estudo mostra que a participação em desporto está associada com fatores intrapessoais e sociais, e que estes fatores podem variar consoante a área de residência. Tanto rapazes como raparigas participam em desporto em números semelhantes, mas é necessário alterar a forma como os pais e filhos olham para o desporto. Ao identificar diferentes barreiras, este estudo reforça a necessidade de promover a AF através de intervenções que incluem múltiplos níveis, começando na família e incluindo professores, escolas e politicas governamentais.

Palavras-chave: crianças, desporto extracurricular, fatores de risco, intrapessoais, socioeconómicos, ambiente físico, obesidade

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Chapter 1. General Introduction

1.1. Physical activity

1.1.1. Physical activity, exercise, and sport

Although physical activity (PA), exercise, and sport are often used interchangeably, they are not synonymous. Physical activity (PA) is defined as "any bodily movement produced by skeletal muscles that results in energy expenditure" (Caspersen et al., 1985: 126). PA is a complex behaviour and can be subdivided into categories such as sports, exercises, household tasks, work tasks and other activities. In children and adolescents, in-school PA, including recess (break-time) and physical education (PE), out-of-school PA, and PA in specific behavioural settings (e.g., after-school programs) may also be considered important domains.

Sports and exercise are subcategories of PA with exercise being typically defined as PA that is planned, structured and repetitive, whose main objective is to maintain or improve physical fitness, exercise performance, or health status (Caspersen et al., 1985; Warburton, 2010). Sport participation takes place in leisure and organised sports as well as in physical education classes and is used to improve and maintain components of physical fitness, which may include cariorespiratory, muscular, flexibility, coordination and speed (Caspersen et al. 1985; WHO 2007). On the other side, some authors refer to sport participation as just the competitive and supervised component of PA (Wickel and Eisenmann, 2007). Moreover, a study carried among Brazilian adolescents, assessed sport practice during leisure time and considered regular engaging if they had participated in moderate to vigorous activities for more than four hours per week in the four months prior to the study (Fernandes et al. 2012).

Physical activities may be categorized according to type (eg, running, swimming, etc.), duration, frequency, and intensity, which refers to the rate at which the activity is being performed and may vary between light (e.g., walking slowly, making the bed, preparing food), moderate (e.g., sweeping the floor, walking briskly, slow dancing, shooting a basketball) or vigorous (e.g., running, swimming, jumping rope). According to the World Health Organization (WHO) the intensity of PA depends on an individual previous exercise experience and their relative health (WHO 2016b). Moderate to vigorous physical activity (MVPA) usually leads to an increase in breathing and heart rate, a feeling of increased warmth, possibly accompanied by sweating (WHO 2016b). When studying PA, one should have in mind the various

components of this multi-dimensional variable, and specifically that there is a continuum of behaviour rangind from being inactive to being very physically active (Warburton 2010). Actually, at the lower end of this continuum, sedentary behaviour refers to a number of activities that have energy expenditure levels that approximate resting (Tremblay 2010). Watching television, working on a computer, or playing video games, often refered as 'screen time', are a commonly used indicator of sedentary behaviour.

1.1.2. Methods for the assessment of PA in children

PA is particularly complex to assess in children, mainly due to its sporadic nature. Furthermore, it is generally assumed that no single measurement technique accurately reflects all dimensions of PA (Welk 2002). Despite some limitations, measures of PA have improved over time (Cumming and Riddoch 2008), and more than 30 different methods have been used for the assessment of PA and energy expenditure. PA assessement techniques must be socially acceptable, should not burden the child with cumbersome equipment and should only minimally influence the person's normal PA behaviour (Armstrong and Welsman 2006). Changes in PA behaviours may occur when the subject becomes aware of the presence of an observer or the subject must wear an instrument to monitor the activity (Malina et al., 2004).

Methods for measuring PA can be broadly divided into subjective and objective methods, which assess different aspects and may be combined in the same study (Corder et al. 2008). Developments in technology over the past two decades have resulted in an increase in the use of objective methods to assess habitual PA which include heart rate, accelerometers, pedometers, and global positioning devices (GPS) (Corder et al. 2008; Duncan, Scott Duncan, and Schofield 2008). The accelerometer is one of the methods more amply used, particularly for the quantification of the amount of PA, intensity of PA and amount of sedentary behaviour in children and adolescents (Reilly et al. 2008). While these methods are preferable to estimate the duration and intensity of PA, since they provide reliable, empirical, and valid information, they are expensive, outputs recorded by devices with different brands may not be comparable, children may be nervous during calibration of the devices such as heart rates, or they may forget to use the device for some time period which will affect the accurate assessment of PA (Corder et al. 2008). The lack of standardized procedure for handing out and summarizing data

from objectively methods has led to the use of a variety of strategies on PA assessement among children and adolescents (e.g., cut-points to estimate the amount of time spent in MVPA). Another fundamental question, which is essential to understand the meaning of PA assessed by accelerometry, is how to translate and interpret the accelerometer signal into meaningful data linked to physiological outcomes or, in some cases, behavioural patterns (Freedson, Pober, and Janz 2005; Rowlands 2007).

Subjective measures of PA include questionnaires, self-report diaries and direct observation (Kohl, Fulton, and Caspersen 2000; Trost 2007). Direct observation is the most inexpensive and practical criterion measure of PA but, the total observation time required to attain acceptable day to day stability is not clear, and include invasion of study participant privacy that may affect PA behaviours (Kohl et al. 2000). Activity diaries have been successfully used in adolescents but are impractical for younger children who cope less well with the complex task of recording activity type, frequency, and duration (Sirard and Pate 2001). Questionnaires may have limited reliability and validity, rely on the ability to record information, and may be influenced by social desirability (Kohl et al. 2000), but are commonly used, a low cost and easy alternative to objective assessments, particularly in large scale studies, and have practical value in indicating conditions and risk factors associated with PA (Shephard 2003). The selection of self-report measures always depend heavily on the scope and aims of a project or study, and instruments vary considerably in the specificity with which type, duration, frequency, and intensity are evaluated. In addition, while using self-report measures it is possible to record activity type and the context in which PA ir performed capturing qualitative and quantitative information which is very important for describing PA behaviour in children. Commonly used questionnaires for assessing PA in large samples of children and adolescents include the *Physical Activity Questionnaires* for children (Crocker et al. 1997), *weekly checklist* (Sallis et al. 1996), and the *Baecke questionnaire* (Baecke, Burema, and Frijters 1982).

1.1.3. Recommended guidelines for children's PA and the importance of extracurricular sport participation for MVPA levels

Extensive research has resulted in clear PA guidelines for optimizing health and functional capacity in children (Oja et al. 2010). Guidelines are typically population-targeted consensus statements on the general course of actions and strategies that inform how best to implement successful interventions to realise the health potential of PA. These guidelines are not static, being adapted over time as new information is discovered on the relationship between PA and health. There are specific health-related recommendations for children and adolescents which are distinct from those for adults. Current Department of Health and Children and WHO guidelines recommend that children aged 5-17-years participate daily in at least 60 minutes of MVPA, in activities that should be developmentally appropriate and enjoyable, whereas less active children should achieve at least 30 minutes of moderate activity (WHO 2016b).

Physical education (PE) classes, free play activities and extracurricular sport have the potential to promote and increase children's daily MVPA (Hebert et al. 2015; Meyer et al. 2013; Trudeau and Shephard 2005). In fact, organized sport participation as a leisure-time activity has been promoted as one of the most effective strategies to increase PA among children (Geidne, Quennerstedt, and Eriksson 2013). A study carried among primary school students in Denmark found that, dependending on participation frequency, extracurricular sport equated to 5-20 minutes more MVPA on the average day (Hebert et al. 2015). Another study concluded that sport was the mainly source of 6-12-year-old children's total MVPA (23%), compared with PE (11%) and recess (16%), and that the additional amount of MVPA accumulated on a sport day (approximately 30 minutes) was not maintained on a non-sport day (Wickel and Eisenmann 2007). A longitudinal study, in which baseline examinations were conducted in 5 years old children, found that sport participation was critical to avoid a consistently inactive pattern through childhood and adolescence, since children who were engaged in an organised sport were more likely to remain physical active through the years (Kwon et al. 2015). Nevertheless, research suggests that not all sports contribute equally to providing PA and children that practice golf are expected to accumulate less MVPA than children playing football or hockey (Leek et al. 2011).

1.1.4. The benefits of PA and sport in children's health

The health enhancing properties of PA are evidence-based, widely accepted and can be broadly placed into three categories: 1) physical, mental and social health benefits during childhood, 2) health benefits carryover to adulthood, and 3) behavioural carryover of healthy PA habits into adulthood.

1.1.4.1. Physical, mental and social health benefits of PA during childhood

PA in childhood benefits children's healthy growth, development of the musculoskeletal and cardiorespiratory system, and avoidance of cardiovascular disease risk factors such as hypertension and high blood cholesterol (Kohl and Cook 2013). It contributes to the maintenance of energy balance and thus a healthy weight; and children who are physically active are less likely to become overweight or obese (Loprinzi, Davis, and Fu 2015). Obesity, increased insulin resistance, and elevated blood pressure in children may very well be responsible for the increasing prevalence of type 2 diabetes in children and adolescents (Association 2000; Rush and Simmons 2014), a disease that until recently was usually only found in overweight and obese adults.

There is a strong evidence that PA is important for children's psychological well-being, since children with lower activity levels have a higher prevalence of psychological and emotional distress (Donaldson 1997). PA may improve social well-being, self-esteem and self perceptions of body image and competence (Kohl and Cook 2013; Liu et al. 2015), and some studies suggest that physically active children may have better cognitive functioning (Gomez-Pinilla and Hillman 2013; Sibley and Etnier 2003).

1.1.4.2. Health benefits of PA carryover to adulthood

Health related behaviours and disease risk factors track from childhood to adulthood (Kohl and Cook 2013). It has been shown that PA during early puberty, especially weight-bearing activities such as jumping, dancing, and gymnastics 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 (Bass 2000). Multiple studies have shown the association of pediatric obesity with obesity in adults (Biro and Wien 2010; Guo and Chumlea 1999; Serdula et al. 1993). A study from 2006 found that almost half of overweight adults were overweight as children, and two-thirds of children in the highest body mass index (BMI) quartile transitioned into the highest BMI quartile as young adults (Deshmukh-Taskar et al. 2006). In addition, childhood obesity may be related with many metabolic, cardiovascular, and oncological problems in adulthood (Biro and Wien 2010).

1.1.4.3. Behavioural carryover of healthy PA habits into adulthood

There is a large body of evidence that suggest that the PA habits established during childhood tend to track into young adulthood and later life (Janz, Dawson, and Mahoney 2000; Malina 1996; Telama et al. 2005). This association is particularly strong when the quality of the PA experienced in childhood, rather than simply the quantity, is taken into account (Taylor et al. 1999). It makes sense that negative attitudes regarding PA gained in childhood may persist into adulthood and affect people's willingness to take part in PA and sport. In consequence, adults engaged in regular PA have lower rates of chronic disease (like cardiovascular disease, type 2 diabetes, coronary heart disease, hypertension, osteoporosis, and some cancers) and are less likely to die prematurely (Bauman 2004; Kohl and Cook 2013). On the other side, the WHO estimates that approximately 3.2 million adults die each year with health problems attributable to insufficient PA (WHO 2016b).

1.1.4.4. Mental, social, and physical health benefits of organised sport participation in children

Research focusing more specifically on extracurricular sport is limited but there are demonstrable beneficial effects. Parents report benefits for their children in personal and social development from sport participation (Holt et al. 2011). Social benefits included positive relationships with coaches, making new friends, developing teamwork, and social skills while personal benefits included children enjoying new things, having confidence and discipline, and even performing well academicly. Furthermore, there is a general consensus that participation

in sport, particularly team sports, during childhood is associated with improved psychological and social health, above and beyond other forms of leisure-time PA (R. M. Eime et al. 2013). Together with mental health, involvement in extracurricular sports can improve body composition and cardiorespiratory capacity, and reduce weight gain (Beets et al. 2009). A longitudinal study starting with 7 year old children, observed that the ones who participated in extracurricular sports accumulated less body fat mass and increased their lean body mass and the bone mass more than the children from the same population who did not participated regularly in sports (Ara et al. 2006). In Portugal, a study carried among 11-18-year-old children, concluded that participation in sports at club level was more effective than other organised or non-organised sports to reach healthier levels of cardiorespiratory fitness (Silva et al. 2013).

1.1.4.5. The burden of physical inactivity

The burden of physical inactivity at less than the recommended levels (60 min per day) on the economy and healthcare cost – including those to the health system, days of absence from work and loss of income due to premature death - has become an increasingly prevalent issue. In developed countries like the United States, it is estimated that health problems related with physical inactivity account for 1.5-3.0% of total direct healthcare costs (Oldridge 2008).

1.1.5. Children participation in physical activities and sport

In the past it was generally assumed that children were naturally physically active, though in recent years there has been a worldwide trend towards less total daily physical activity and in clearly defined contexts such as active transport, PE, and extracurricular sports (Dollman, Norton, and Norton 2005; WHO 2016b). However, those findings are not entirely consistent with some studies observing a slight overall increase in the number of school-aged children who achieved at least 1 hour of MVPA per day between 2002 and 2010 (Kalman et al. 2015). Data from Portugal, indicates an increase in boys MVPA from 2002 to 2010 but stable numbers among girls (Kalman et al. 2015).

In most European countries, fewer than 50% of children complied with the recommended levels of 60 min per day of MVPA, regardless of the measurement method (Van

Hecke et al. 2016). However, there is a large variation between countries. Results from the Health Behaviour in School-aged Children (HBSC) study from 2016, obtained by self-reported data, indicates that among 11 years old children from Italy (13%), Denmark (15%) and Greece (16%) had the lowest prevalence of children meeting recommended PA levels, while Finland (41%), Ireland (38%), and Bulgaria (36%) had the highest prevalence (Inchley et al. 2016). Based on objective measures (i.e., accelerometry) among 9 years old, 75.2% of the girls and 90.5% of the boys met the Norwegian PA guidelines of 60 minutes of moderate-intensity PA every day (Kolle et al. 2010). In contrast, in the USA, a study using objective measures found that only 42% of children and an alarming 6-8% of adolescents achieved the recommended levels of PA (Troiano et al. 2008). Data obtained from accelerometers worn for four consecutive days indicate that 36% of Portuguese children aged 10-11-years-old were achieving the recommendations of 60 min per day of PA (Baptista et al. 2012). Another study using the same methodology, observed that only 3.1% of Portuguese children (aged 9-11 years) met the recommended daily 60 min of MVPA for all seven days of the week, and 17.5% did not attain the recommendations on any of the seven days (Borges et al. 2015). A more recent study, accounting for overall PA levels, organized sport participation, active play, and active transportation revealed that between 20-39% of Portuguese children and adolescents were achieving at least 60 min per day of MVPA (Mota et al. 2016).

Studies using objective measurements also found differences within the same country. When reporting the average daily counts per minute (CPM), a study reported an average CPM of 711 for 9-10-year-old Norwegians (Ekelund et al. 2012), whereas another study reported an average CPM of 804 for Norwegians 9-years-olds (Riddoch et al. 2004). Results from Denmark indicate an average CPM of 670 which is significantly lower compared with Norwegian children (Riddoch et al. 2004). “Minutes of MVPA per day” is one of the most common outcome reported while using objectively measured methodologies. However, different intensity cut-offs while converting accelerometer-based CPM to minutes per day of MVPA may lead to different result across articles. For instance, Riddoch and colleagues (Riddoch et al. 2004) reported 179 min per day of MVPA, compared to 29 min reported by Ekelund et al. (Ekelund et al. 2012), both using a sample of Portuguese 9-16-year-old children.

PA may vary over the week, usually being higher during week days compared with weekend days. In the study of Nilsson and colleagues (Nilsson et al. 2008) where children (aged 9-15 years) used accelerometers during 2 weekdays and 2 weekends days, results indicate that

only 4 to 31% accumulated at least 60 minutes of MVPA either during weekdays or weekends. Another study using pedometer step counts and accelerometer concluded that more children (8-12 years of age) achieved the 60 min of MVPA on school days than on the weekend (Telford, Telford, Cunningham, Cochrane, Davey, Dezateux, et al. 2013). The same pattern was observed in a sample of 10-year-old Portuguese children that also used accelerometers, with daily MVPA being lower during the weekend compared to weekdays (Pereira et al. 2015). During weekdays, school context characteristics, such as recess time, playground environment, accessibility to games equipment, and PE classes, affect children's PA, contributing to the achievement of 60 min of daily MVPA (Ridgers et al. 2007; Verstraete et al. 2006) whereas during the weekend children have more leisure time which could be spent in less active pursuits (Nilsson et al. 2008).

Along with the decline in PA referred above (Dollman et al. 2005), mixed results have been found for organized sport participation among children. Sport has high social valence and is a primary context for PA for the majority of children, invoked as a potentially important provision of regular PA (Malina 2009), and may be the only way to attain a vigorous level of exercise. Curiously, the number of children competing in sports seems to have increased in several countries around the world. Approximately 40 millions of U.S. children participated in organised sport in 2008, meaning that about 76% of the kindergarten through grade 12 (high school) enrolments in some organised sport (NCYS 2010). National reports from England observed a significant increase in the percentage of 6-16-year-old children taking part in extracurricular sport between 1994 and 1999 (from 36% to 45%) (Rowe and Champion 2000). In Australia, almost two-thirds of children and adolescents aged 5-14 years participate in organised sports outside of school hours (Hardy et al., 2010), and reasonable regular participation in sport is characteristic of children in many European countries (Seabra et al., 2007; Telama and Yang, 2000). In Germany, 70.2% of 7 to 10 year old children are involved in sports clubs (Lampert et al. 2007). Another study in the same country revealed that 60.2% of children (7-8 years) participate in organized sport once or twice a week (Drenowatz et al. 2013).

Data on Portuguese children sport participation is less common, but the latest Portuguese report card on PA in children and adolescents indicates that 85% were participating in organized sports (Mota et al. 2016), in part by a tendency for more participation in competitive sports (23.2%) between 2008 and 2012 (DGE 2012) and an increase of 31,000 children engaged in sport federations from 2010-2014 (IPDJ 2015). Data collected among 10-

and 11-year-old Portuguese children revealed that approximately 58% reported to be engaged in some extracurricular sport (Seabra et al. 2007). Moreover, participants who engaged in organised PA reported more moderate-intensity and engagement in team activities, whereas adolescents in non-organised PA reported more low-intensity, and participation in individual activities (Santos, Esculcas, and Mota 2004). Differences in the prevalence of PA and sport participation across countries, and even within the same country, may partly be due to differences in sampling and in assessment methods, but may also be partly caused by true differences in national PA levels, accessibility and costs of sports, seasonal timing, or sampling age range (Atkin et al. 2016; Van Hecke et al. 2016).

1.1.6. Factors associated with children physical activity and sport participation: intrapersonal, social, and environmental factors

PA in children is a complex, highly variable behaviour determined by a number of factors that often interact between them. Social ecological models depict reciprocal interactions among factors in multiple domains, including intrapersonal (perceptions, characteristics), behavioural (risk and health behaviours), environmental (school, built environment), and policy (funding of schools, parks and other recreational facilities) (Owen et al. 2004). Overall, risk factors influencing children's PA may be divided into three major domains: intrapersonal or individual (e.g., inherent to the individual like, sex, age, psychological, intrinsic motivation), social (e.g., number of siblings, parents education, economic status, family and peer support, modelling, parents' perceived barriers), and environmental (e.g., available facilities, traffic, accessibility) (Sallis and Owen 1999).

1.1.6.1. Intrapersonal factors influencing children's PA: age

The proportion of North American children meeting at least 60 min of daily MVPA declines with age, with more elementary school children than middle and high school students achieving the goal (Kohl and Cook 2013). Also in the United States of America, at age 9, children engaged in MVPA approximately 3 hours per day on both weekends and weekdays but by age 15, adolescents were only engaging in MVPA for 50 minutes per weekday and 36 minutes per

weekend day (Nader et al. 2008). The same tendency has been found across European countries, including in Portugal (Van Hecke et al. 2016). For instance, Riddoch and colleagues registered an average 680 CPM per day in 9-year-old children and 559 CPM in 15 year old adolescents (Riddoch et al. 2004). The same data were corroborated by accelerometer based MVPA, even if some differences across studies were found in consequence of the use of different cut-offs: 179 min/day in 9 year old and 95 min/day in 15 year old (Riddoch et al. 2004), 79 min/day in 9 year old children and 63 in 15 year old adolescents (Nilsson et al. 2008).

On the other side, studies regarding trends in organised sport participation are not that common. A study among Australian children observed that self-reported participation in organised sports start to decline in late childhood and continue to decline with age, with an estimation of up to 35% dropouts every year (D.H.A. 2007). Portuguese data, also obtained through a questionnaire, observed that extracurricular sport participation were similar across age ranges, varying from 58.92% in 10-12-year-old children, 57.77% in 13-to 15-years-old, and slightly increasing in the group of 16-18-years-old (62.19%) (Seabra et al. 2007).

Data from cross-sectional and prospective studies indicate the decline is steepest between the ages of 13 and 18 (Sallis 2000) and at around 15 years of age, 70-80% of former young athletes are no longer engaged in sport (Merkel 2013). Other studies indicate that the age bracket of 10 to 11/12 years is critical because it also marks the onset of adolescence and in several countries children marks the transition shift from elementary to secondary education (Kimm et al. 2000; Micallef, Calleja, and Decelis 2010). This is also a period when parental licence for children to engage in PA without adult supervision tends to increase however, parents tend to restrict activity to close to home and usually place time limits on those activities (Jago et al. 2009). Because of this decline in PA, late primary school years are an important period for health promotion interventions. In addition, this age range seems a particularly important time to adopt healthy lifestyles that can be maintained though adulthood.

The age related decreases in vigorous-intensity PA throughout adolescence appear greater for certain population subgroups, like girls (Corder et al., 2016). Also, significantly more girls than boys living in Australia dropped out of organised sport between the ages of 8 and 10 (Vella et al. 2014). The same pattern was found in Ireland with non-participation rates for 12-13-years-old, 14-15-years-old and 16-18-years-old females being 14%, 20% and 30%, respectively, while values for boys in each age group were 8%, 10%, and 15% respectively (Woods et al. 2010).

The causes for the decrease in PA and sport participation at the age of 10-12, particularly among girls, it is not clear. Some studies suggest that girls may receive less parental support compared to boys (Vella et al. 2014). Transition from childhood to adolescence may expose another type of factors in which teenagers are more exposed to peer pressure and do not want to be associated with some activities described as "childish", thus choosing activities were they can be more independent (Allender, Cowburn, and Foster 2006; Coakley and White 1992). At the same time, there seems to a be some biological basis, probably in the dopamine system, that regulates motivation for locomotion (Sallis 2000), which may vary according to sex.

1.1.6.2. Intrapersonal factors influencing children's PA: sex

Literature has shown that boys engage in more PA and sport than girls but, while the magnitude of the difference in the amount of PA performed by one sex and the other differs across studies, a large pooled investigation of European children and adolescents aged 4-18-years, indicates that girls perform on average around 17% less total daily PA (Ekelund et al. 2012). Similar findings have been found in many countries such as England (Pearce et al. 2012), United States (Trost et al. 2002), Brazil (Dumith et al. 2010), Norway, Netherlands or Spain (Inchley et al. 2016). A study in Denmark observed that through grade 1 to grade 4, girls had lower concordance with the recommended 60 min/day of MVPA compared to boys (grade 1: 64.3% and 88.8%, grade 2: 50.0% and 76.2%, grade 3: 41.4% and 77.6%, and grade 4: 37.8% and 71.8%, respectively for girls and boys) (Hebert et al. 2015).

In fact, girls (aged 8-10 years) are less likely to be active during unstructured time such as recess, than boys (Mota et al. 2005), 11-12-year-old boys are more likely than girls to actively commute to school (Harten and Olds 2004), and boys seem to have more independent mobility than girls (aged 8-15-years), at least on weekends, which may translate in more outdoor play (Cordovil, Lopes, and Neto 2015). Overall, a study measuring PA via accelerometry found that in a normal school day, 8-11-year-old girls seem to accumulate less MVPA than boys and fewer achieve the recommended 60 min/day of MVPA, either during recess, lunch time, and PE classes (Nettlefold et al. 2011).

Sex differences are also present in participation in organised sports. An Australian study with children below 11 years found that only 45% of girls participated in organised sport compared to 55% of boys, and that sports participants were more likely to be boys (Vella et al. 2014). Participation among Canadian young children (aged 5-12-years) was 74% in 2010-2011, with higher prevalence among boys (81%) than girls (70%) (C.F.L.R.I. 2013). Data from Portugal is consistent with worldwide studies, with girls practicing less organised sport (Freitas 2012; Seabra et al. 2007). Results from Freitas (Freitas 2012), collected in central Portugal, show that 6-11 year old boys were practicing more sport than girls (64.8% and 56.8%). The study of Seabra (Seabra et al. 2007) presented a bigger disparity between boys and girls aged 10 and 11, with 68.52% of boys being engaged in an extracurricular sport compared with 44.21% of the girls. Nevertheless, although boys are more likely to participate in sports than girls of the same age, the gap may be narrowing over the last few years (C.F.L.R.I. 2013).

Differences between sexes are not only in numbers but also between the type of sports. Among 10-and 11-year-old Portuguese children, swimming was the most popular sport practiced by girls (10.4% and 10.1% at 10 and 11 years, respectively) while football was the most practiced by boys (43.1% at age 10 and 41.0% at 11-years-old) (Seabra et al. 2007). Differences in the percentages may suggest that girls are more likely than boys to take part in a wide array of sports whereas boys tend to stick with more traditional sports. Also, girls participate more in individual sports such as gymnastics or dance than in team sports, while boys tend to participate in team sports such as football and basketball (Jacobs, Vernon, and Eccles 2005). However, sports favoured by girls may fail in delivering a good amount of MVPA. A North American study examined dance classes and found that objectively measured PA during dance classes varied dramatically depending on the dance type, but that in general only 8% of children (aged 5-11-years) met the 30 minutes guidelines recommended by the Center for Disease Control and Prevention for after-school activities (Cain et al. 2015).

Research indicates several possible explanations as to why girls are less physically active than boys: girls tend to participate less in organised sports (Vella et al. 2014), and may receive less social support to engage in PA (Edwardson et al. 2013). Differences between boys and girls may also be related to the opportunities available and the choices made by parents and children whether to engage in sport activities or not (Jacobs et al. 2005). Girls may perceive less enjoyment when taking part in PE (Cairney et al. 2012) and Mulvihill and colleagues (Mulvihill, Rivers, and Aggleton 2000) found that many girls (5-15-years) were disappointed

with the lack of variety in PE and would rather play other type of sports like dance. When girls (9-15-years) are denied the opportunity to play their favourite sports and unable to demonstrate competency of a skill to peers in class, they may feel uncomfortable and avoid future displays of PA (Allender et al. 2006). Gender roles may also still be part of the explanation because the male role implies instrumental activities involving physical strength and exertion, and competitive sport activities whereas the female role implies care-dominated activities involving social and emotional skills (Malina, 2009). The relationship between physical and social environment and PA, which may translate in barriers and constraints to engage in PA and sport, may differ between boys and girls (Justin B. Moore, Beets, Kaczynski, et al. 2014). Biological reasons may also contribute to sex differences in PA and sport participation, since most studies have compared boys and girls of the same chronological age without considering sex differences in biological age which could contribute to sex differences in activity (Eagly 1995; Wickel, Eisenmann, and Welk 2009). More recently, a multilevel cross-sectional and longitudinal approach found that lower PA among 8-12-year-old girls in comparison to boys were explained, in part, by weaker influences on PA at school, through parent's support and through lower participation in sport (Telford et al. 2016).

1.1.6.3. Intrapersonal factors influencing children's PA: children's motivation and perceived stereotypes

Children have multiple motives for participating in sport – improving physical and social skills, being with friends, having fun, becoming physically fit, enjoying the challenges, and experiencing success. Similarly, multiple reasons for discontinuing sport, like negative coaching, skills not improving, feeling pressure, lack of fun, and wanting to try other things (Weiss and Petlichkoff 1989). Over the past 25 years, four theories have been especially productive for advancing the knowledge base in youth PA motivation: the competence motivation theory, the self-determination theory, the expectancy-value theory, and the achievement goal theory (Horn 2004; Weiss 2013; Weiss, Amorose, and Kipp 2008, 2012). What all four theories have in common is that they identify perceptions of competence as contributors to motivation, that social support through peer acceptance and adult approval

have a central role and that PA should be a happy and pleasurable experience in order to be maintained.

Two variables in particular have been studied in relation with children's participation in an activity: his/her expectations of success in the activity and the value he/she places onto it (Boiche et al. 2014; Chalabaev, Sarrazin, and Fontayne 2009; Fredricks and Eccles 2002; Gråstén 2016). Expectations of success are associated with the chances of success estimated by the individual in a given situation, and may result in different perceptions of ability, competence, and difficulty of the task (Fredricks and Eccles 2004). The value accorded to PA and sport involvement comprises of four components: attainment value, intrinsic value, utility value, and cost, which may be translated into the importance of doing well in an activity, the inherent interest in that activity, and the potential positive outcome of that activity as well as what the individual has to give up to do a task, the opportunity cost if you will (Eccles and Harold 1991). Children who do not expect to do well in sport, or do not perceive positive outcomes of participating in it, may have less interest in being physically active and have higher probability of dropping out of sport (Bois, Sarrazin, Brustad, Trouilloud, et al. 2005; Fontayne, Sarrazin, and Famose 2001; Guillet et al. 2006). Fredricks and Eccles (Fredricks and Eccles 2005) found that children's intrinsic and attainment value in school sports decreased with age, with the transition from elementary to secondary school being one of the most important period in regard to the development of expectancy beliefs and values, which may in part explain the decreased levels of PA and sport participation around 10-12-years of age referred to above.

Previous research has found differences in the levels of perceived competence and value in sport between boys and girls. For example, sixth-grade girls considered sport as less important, useful, and enjoyable and rated themselves as less able in sports, compared to boys (Eccles and Harold 1991). Similar differences according to sex were observed among North American kindergarten and elementary school children (Fredricks and Eccles 2005) and in a sample of French 9-11-year-old children (Bois, Sarrazin, Brustad, Trouilloud, et al. 2005). In Portugal, it was found that 8-to 10-year-old boys and girls differed in perceived attractiveness of PA and perceived physical competence, both of which influenced level of PA (A. C. Seabra et al. 2013).

Overall, literature has found that boys, when compared to girls, hold higher perception of sport competence, are more motivated to participate in sport and PE classes, values sport more, and have a greater expectancy of success while performing sport and PA (Biddle et al.

2011; Bois, Sarrazin, Brustad, Trouilloud, et al. 2005; Chen and Darst 2002; Eccles and Harold 1991; Fredricks and Eccles 2005; Gråstén 2016; Guillet et al. 2006; Knisel et al. 2009). In contrast, sex differences in task values have not been observed in some other studies (F.S.F. 2010; Xiang, McBride, and Bruene 2006). According to a Finnish study, school-aged girls were most likely to participate in gymnastics and dance classes, while boys tended to prefer ball games, such as football (F.S.F. 2010). Another study concluded that boys and girls did not differ in their expectancy beliefs because both were involved in running and considered that activity as appropriate for both sexes (Xiang et al. 2006). Those findings suggest that sex differences may result, in part, by the participation in gender appropriate activities, since girls and boys will often value activities that they perceive as appropriate for their sex (Shen et al. 2003; Solmon et al. 2003).

Posterior studies have reinforced that gender stereotypes in sport are likely to impact self-perceptions and behaviours. While sex is related with biological differences between boys and girls, gender is related with the endorsement of traits and behaviours that characterize boys (e.g., independent, competitive) and girls (e.g., sweet, sensitive) (Bem 1981). Stereotypes may be defined as shared beliefs about the personal characteristics (or traits) but also behaviours of a group of persons (Leyens, Yzerbyt, and Schandron 1994), and it generally transmits the idea of what is considered more appropriate for males, females, or both. For instance, it was observed that the more female adolescents agreed with the stereotypes that soccer is masculine, the less they felt competent in that sport (Chalabaev, Sarrazin, and Fontayne 2009). The same phenomenon was observed among children, in which girls who considered hockey as masculine performed lower than girls perceiving it as neutral (Fredricks and Eccles 2005; Solmon et al. 2003).

Gender stereotypes about sport in which activities either are feminine, masculine or neutral, are highly shared in western countries (Fontayne et al. 2001; Hardin and Greer 2009; Koivula 1995; Metheny 1965; Riemer and Visio 2003) and internalized early during childhood (Riemer and Visio 2003). Worryingly, sport is considered a male domain in which girls are underrepresented (Ekelund et al. 2012), masculinity is positively related to endorsement of athletic identity (Chalabaev et al. 2013) and a majority of boys and girls draw a male character when they are asked to draw a sportsperson (Colley, Berman, and Millingen 2005).

Because competence, value beliefs, and gender stereotypes play such an important role in children's motivation and decision to engage in PA and sport, it is important to identify

the factors that influence their development. Several members of the social environment may contribute to the transmission of those beliefs, such as teachers (Chalabaev, Sarrazin, Trouilloud, et al. 2009), and peers (Wachs 2005). Media, particularly television (TV), is also a powerful tool by which gender roles are learned by children (Johnson and Young 2002). However, more studies have focused on the link between parents' and children's perceptions of sport (Bois, Sarrazin, Brustad, Chanal, et al. 2005a; Jacobs and Eccles 1992), particularly at younger ages, where children spend most of their time in the family environment and are dependent of family members to engage in some activities.

1.1.6.4. Intrapersonal factors influencing children's PA: children's perception of physical and social barriers

Barriers refer specifically to obstacles that individuals encounter in "undertaking, maintaining, or increasing physical activity" (Dambros, Lopes, and Lopes 2011). Apart from the biological, psychological, cognitive, and emotional barriers such as the ones referred above, children may perceive cultural, social, and physical environmental barriers. Most studies regarding perceived barriers have been carried among adolescents since they are more likely to understand the full meaning of the questions and their answers (Dias et al. 2015; Kahn et al. 2008; Sirard, Pfeiffer, and Pate 2006). Nevertheless, a longitudinal study observed that for younger children (aged 8-10) the physical environmental domain was prominent, such as a lack of suitable club or a sport favoured by the child, and lack of permission or transport (Basterfield et al. 2016). However, by adolescence (11-13-years-old), the barriers were predominantly of intrapersonal and a socially environmental nature, and the respondents displayed a general lack of interest to engage in sports (Basterfield et al. 2016). Lack of time was an issue at both ages as well as children describing themselves as not sporty or disliking sport.

Lack of time, importance of friends, and parental support were also mentioned by Australian children aged 10-13 as barriers to engage in PA, highlighting a degree of generalizability of studies in this age group (Stanley, Boshoff, and Dollman 2012, 2013). While lack of time due to homework or social activities could be considered an objective barrier to PA participation, the perception that there is not enough time may be due to the low level of

priority in which PA is perceived in relation to other competing demands (Biddle et al. 2011; Sterdt, Liersch, and Walter 2014).

Body consciousness and negative body image perceptions has been shown to be a barrier for female adolescents to engage in PA (Martins et al. 2015), but these perceptions may also restrict overweight children from engaging in sports and PE, since they may try to avoid behaviours in which their body and abilities can be judged and compared unfavourably with others. In fact, it was observed that overweight (BMI≥95th) 8-16-year-old children, particularly girls, reported significantly more barriers than normal weight children, not only in body-related barriers but also regarding resources (lack of places, equipment, skills, or knowledge) and social (lack of peer support, being teased) (Zabinski et al. 2003).

1.1.6.5. Social factors influencing children's PA: parents' perceived competence, sport value, and gender stereotypes

Parents are the primary proponents or inhibitors of their children's participation in PA (Beets, Cardinal, and Alderman 2010). Parental support may come via direct and indirect ways - that often work in conjunction to shape both parent and child behaviour – and not only impact children's initial sport involvement but may also predict future sport activity choices (Fredricks and Eccles 2005). Parental indirect reinforcement of children's sport involvement may be through different processes, including social modelling, perceptions of their child's sport competence and ability, the value they put on their children's sport participation, or the emotional support and positive sport experiences they may provide to their children (Bois et al. 2002; Fredricks and Eccles 2005). Several studies have confirmed that this type of parent involvement is positively related to both enjoyment and participation levels in sport (Brustad 1993, 1996; Fredricks and Eccles 2005). The beliefs and subsequent socialization activities of parents are so powerful, especially during the initial stages of children's sport participation, that they have been shown to significantly influence and shape children's own beliefs. For instance, parents' perception of their child's ability have been consistently found to be positively associated to their child's self-perceptions of ability, either directly (Jacobs and Eccles 1992) or indirectly through reflected appraisals (Bois, Sarrazin, Brustad, Chanal, et al. 2005b). Also, there is a positive correlation between the value attached to children's sport

participation between parents and their children (Fredricks and Eccles 2002), in which parental positive behaviour towards children's sportive activity, specifically characterized by praise and understanding, and a low degree of pressure exerted is associated with children's acceptance of parental sport values.

There is also evidence that parents' beliefs are predictive of parents' provision of support, opportunities and experiences to their children that, in turn, affect their children's motivation (Eccles et al. 1983; Fredricks and Eccles 2004; Kanters, Bocarro, and Casper 2008). Common sense suggests that parents who perceive their child as less physical competent will invest less money and time in their child's physical activities. Moreover, too high or low parental expectations may result in less enthusiasm from children who participate in sport and physical activities (Côté and Hay 2002). Children benefit from moderate levels of parental involvement, both emotional and logistic support, whereas children may not engage or dropout of sport if their parents are excessively involved (Na 2015).

Fathers and mothers might not share similar appraisals of their child's abilities and it is likely that one parent may be more influential in shaping their child's beliefs than the other (Bois, Sarrazin, Brustad, Trouilloud, et al. 2005). Because children typically spend more time with their mothers, most research has focused in mothers'-child's shared beliefs (Jacobs and Eccles 1992). Lately, father' beliefs were found to be more strongly associated with children's sports competence and value beliefs, maybe because fathers tend to report more involvement, investment, and significantly more time on athletic activities than mothers (Fredricks and Eccles 2002). In the end, it is expected that both parents affect their children's PA involvement but the influence may be manifested in different ways and done by different processes (Bois, Sarrazin, Brustad, Trouilloud, et al. 2005). For example, in the referred study by Bois and colleagues, mothers' perceptions of their 9-to 11-year-old child's physical competence correlated with the child's self-perceived competence, while father's perceptions of their child's abilities related to the child's actual activity level.

In the past, several studies reported differentiated perceptions of parents according to their child's sex, which will influence children's own perception of gender stereotypes (Brustad 1993; Fredricks and Eccles 2005; Jacobs and Eccles 1992). For example, parents often perceived boys as being more competent than girls, attribute more value of sport performed by boys compared to girls, and typically report that sport is more important for their sons than it is for their daughters. Similarly, boys often view sport as more important, useful, and

enjoyable than girls, and girls perceive significantly lower levels of sport competence than boys (Bois, Sarrazin, Brustad, Chanal, et al. 2005a; Eccles and Harold 1991). In addition, regarding the social transmission of gender stereotypes, previous studies observed that the more mothers tended to see sport as a masculine domain, the more they tended to display lower ability beliefs for their daughters and higher beliefs for their sons (Jacobs and Eccles 1992). Bois and colleagues (Bois, Sarrazin, Brustad, Chanal, et al. 2005a; Bois, Sarrazin, Brustad, Trouilloud, et al. 2005) consider that such differences among parents are less likely to be found nowadays and both parents tend to reinforce children's PA and sport participation, even if by different processes. Those findings suggest that, since the early 1990s, there may be less gender stereotypes related to sport, the stereotypes may be less pro-masculine or more subtle now (Boiche et al. 2014). Also, over the last decades, a number of sporting opportunities have become available for girls and women, including into many sports that are not considered "feminine" (Hardin and Greer 2009), thus influencing the way both mothers, fathers and even children, see women in sport. Nevertheless, it is almost impossible to observe if parents' gender-role stereotypes perceptions are an accurate reflection of true gender differences or either talent and competence between boys and girls, since it is quite likely that their male and female children have already had different opportunities to develop their athletic skills.

Across generations, starting as early as in the kindergarten, there seems to be a clearly division of sports as masculine (e.g., football, rugby), feminine (e.g., dance, gymnastic), and neutral (e.g., swimming, running) or more appropriate for boys, girls, or both respectively (Hardin and Greer 2009; Koivula 2001; Metheny 1965; Riemer and Visio 2003). Perceptions of the 'best' sports for girls seem to be expanding to include sports that once were considered masculine (like basketball). However, the opposite does not seem to be true (Riemer and Visio 2003). This classification may inhibit children to participate in the sport that they want, or do not participate at all.

1.1.6.6. Social factors influencing children's PA: parents' role modelling and engagement in PA

Another indirect form of parental support is modelling. Parents who attribute more importance to PA are more likely to be physically active and have more physically active

children (Dollman 2010). A study by Moore and colleagues (Moore et al. 1991), using accelerometers in mothers, fathers and respective 4-7-year-old children, found that children of active mothers were shown to be twice as likely to be active as children of inactive mothers, while children of active fathers were more than three times more likely to be active than children of inactive fathers. Also, when both parents were active children were significantly more active compared with children with one active parent, or both inactive parents. A study carried in 9-year-old girls registered that 30% of girls who reported PA had inactive parents, but the percentage increased when having one active parent (56%) or both parents where physically active (70%) (Davison, Cutting, and Birch 2008). In fact, this positive association between parent and child participation in PA has been found numerous times in previous studies, using questionnaires and objectively measured PA, either among kindergarten children (Zecevic et al. 2010) and children under 15-years-old (Cleland et al. 2005; Fuemmeler, Anderson, and Mâsse 2011; Gustafson and Rhods 2006; Trost et al. 2001). Nevertheless, some studies found no association between the time that parents and children spend engaged in PA (Jago et al. 2010).

Differences among studies related with the association of parents' and their children's PA have been found according to children's sex. One study found that in families with two active parents, boys were 7.2 times more likely to be active and girls were 4.5 times more likely to be active than children of the same sex with inactive parents (Moore et al. 1991). Other studies have pointed that parental PA influence physical activity behaviours of 7-12-year-old girls to a greater extent than boys (Davison et al. 2008; Fogelholm et al. 1999).

As mentioned above, both parents should influence children's PA while using different strategies (Bois, Sarrazin, Brustad, Trouilloud, et al. 2005). Data collected in Belgium, Greece, Hungary, Germany, and Norway found that maternal, but not paternal, participation in sport were associated with higher participation in sport in children aged 10-12 (Schoeppe et al. 2017). A study of Davison et. al. (Davison et al. 2008) observed that mothers provide higher levels of logistic support, like enrolling their child in sport and driving them to events, while fathers were more likely to use their own behaviour (i.e., be physically active) to encourage children's participation in organised sports. In the end, both approaches had a positive contribution in the child activity practices. Those different strategies may reflect the differences in general parenting in which mothers generally adopt a nurturing and organizational role and fathers adopting a more hand-on, playful method (Parke 1995).

1.1.6.7. Social factors influencing children's PA: transportation, spectating, and purchasing equipment

Parents do not need to be active themselves in order to motivate their children to be physically active as long as sedentary parents provide children with opportunities and encouragement (Trost et al. 2003). Parental reinforcement may be provided by transportation, spectating or supervising, purchasing equipment for engagement in PA, and paying sport club fees (Beets et al. 2010; Cleland et al. 2011; Jago et al. 2011; Pearson et al. 2009). The physical environment within the home (e.g., number of equipment items) may be particularly important to encourage child's PA (Timperio et al. 2013). Has shown by Timperio and colleagues (Timperio et al. 2013), an increment of more than 30 min/week of PA was associated with the number of equipment at home in 10-12 years old children from seven European countries. Findings suggest that parents who provided those type of support are as effective as active parents in positively impacting their children's PA, both with regards to motivation for PA and activity levels but also on whether children decide to remain in sports and PA (Côté and Hay 2002; Trost et al. 2003).

1.1.6.8. Social factors influencing children's PA: parents' perceived barriers

Generally, parents are concerned about the safety of the neighbourhood environment and the opportunities for their children, regardless of the sex, to have access to safe places where they can be physically active. Research indicates that increased parental safety concerns have reduced opportunities for children's PA (Veitch et al. 2006) since children who are allowed to play anywhere in the neighbourhood have been found to be more physically active (McMinn et al. 2013).

The neighbourhood characteristics commonly reported by parents and associated with PA in children (12-years-old and younger) are related with build-up environment, like high traffic streets or highways, and the non-existence of sidewalks, night light, parks and other recreational facilities (Alton et al. 2007; Jago et al. 2009) but also with social aspects. Previous studies have found that parents who perceive higher levels of social cohesion in their

neighbourhood have been shown to have more active children (aged 11-15-years) than parents who perceive lower levels of social cohesion (Pabayo et al. 2011). A study among 11-12-year-old Portuguese children, found that parental perception of their neighbourhood as dangerous accounted for 13% less of children's outdoor play and autonomous active transport (Santos et al. 2013).

Although some physical activities and sports occurred indoor, climate and weather conditions were cited to inhibit PA, particularly in neighbourhoods where there is a lack of sport facilities apart from parks or during school hours (Chan and Ryan 2009; Pawlowski et al. 2014). Other barriers reported by parents and significantly associated with children's and adolescents' PA and sport participation are lack of time and money (J. Dwyer et al. 2008; Hardy et al. 2010; Ling, B. Robbins, and Hines-Martin 2016; Stenhammar, Sarkadi, and Edlund 2007). Time as a barrier may be related with parents' lack of time to transport and supervise their children's PA but may also be a consequence of parents viewing other activities (academic or not) as having greater importance. On the other side, in order to support children's participation in sports, parents may have to spend money on sport equipment, transportation to sport events, club memberships and competition entry fees. Reported barriers may differ according to the type of the PA. For instance, parental perception of neighbourhood safety and traffic may be a barrier for active commute to school (e.g., walking or biking) while time and money may be more reported as barriers to organised sport involvement.

1.1.6.9. Social factors influencing children's PA: parent's education level and household income

Parental education levels are closely linked to family income and both may be used to define socioeconomic status (SES). Previous studies have pointed out that children and parents from lower SES experience multiple barriers from different domains, including time management, financial barriers, family obligations, lack of adult involvement, and lack of environmental barriers (e.g., poorer neighbourhoods with lack of sport facilities and safety issues) (Brockman et al. 2009; Holt et al. 2011; Kimbro and Schachter 2011; L. V Moore et al. 2008; Stenhammar et al. 2007; Veitch et al. 2013). Data derived from the Italian National Health Interview Survey (15216 individuals aged 6-17-years) showed that children and adolescents whose parents held

a middle of high educational degree were 80% more likely to practice moderate or vigorous PA (OR=1.80; 95% CI: 1.40-2.33) than subjects whose parents had a lower level of education, while children with unemployed parents had 0.43 less odds of practicing moderate or vigorous PA than children whose parents belonged to the top job occupation category (Federico, Falese, and Capelli 2009). More specifically, mothers with higher levels of education are more likely to engage in health-promoting behaviour; thus, children' PA could be positively related to maternal education (Desai and Alva 1998).

Household income and parental education may be particularly important for sport participation, in comparison with other forms of PA, such as an active commute and outdoor play, since it is highly dependent on financial possibilities (Cairney et al. 2015). A high parental education level may be related with higher knowledge of the health benefits of children's sport participation and low educated parents may lack the awareness of existent funding opportunities (Spence et al. 2010; Wijtzes et al. 2014). In fact, research has pointed toward an association between lower SES (defined as income or education) and less PA, including sport participation, among 6-year-old children living in the Netherlands (Wijtzes et al. 2014), 5-years-old and 9-10-year-old children from the United Kingdom (Brophy et al. 2011; Fairclough et al. 2009), in Danish school-aged children (Nielsen et al. 2012), and in 7-10-year-old children from Australia (Smith et al. 2010; Vella et al. 2014). The same pattern was reported in Portugal, either in 3-10 and 10-18-year-old children and adolescents and their participation in PA and sport (Nogueira et al. 2013; Seabra et al. 2008), showing that in general, Portuguese data shows that lower SES is associated with less active children.

However, findings have not been entirely consistent. For instance, Wagner and colleagues (Wagner et al. 2004) observed that family SES was not related with reported extracurricular sport participation by 12-year-old French students. Similarly, SES was also unrelated to objectively measured PA in 3-6 and 8-10-year-old children from Germany, England, and other European countries (Kristensen et al. 2008; Steele et al. 2010; Vorwerg et al. 2013). On the other side, studies such as the one from Borges and colleagues (Borges et al. 2015) carried out among 9-11-year-old Portuguese children, observed a negative association between household income and the compliance with the MVPA guidelines (60 min/day; measured by accelerometry), which is line with other studies carried among 5-12-year-old children from Australia (Lloyd et al. 2014) or 9-11-year-old Brazilians (Matsudo et al. 2016).

1.1.6.10. Environmental factors influencing children's PA: physical and social environment in urban and non-urban settings

Together with intrapersonal and social (interpersonal) factors, research has focused on environment and community level (e.g., aesthetics, safety, or social) as factors shaping PA. Urbanization, has the concentration of people in towns/cities and associated changes – migration, transformation of economic and physical organisation of the city, and social changes (Ezzati et al. 2005), are periodically highlighted as a factor that influences PA, particularly among children who, when compared with adults, are limited in deciding their daily routines and in gaining access to sport facilities without transportation and guidance from an adult (Loucaides, Chedzoy, and Bennett 2004; Moore et al. 2010). A number of studies have focused on the association between physical environment and adults PA (Ding et al. 2011; Sallis and Kerr 2006; de Vet, de Ridder, and de Wit 2011). However, this association is less understood among children. To date, findings regarding PA participation by children and the build-up environment revealed complex patterns and inconsistent associations, maybe due to different definitions of urbanization, observing overall or domain-specific PA, and mode of measurement of both PA and environmental variables (Davison et al. 2006; Ferreira et al. 2007; Sallis, Prochaska, and Taylor 2000).

In general, environmental attributes positively associated with objectively measured and reported PA in children (aged 3-12-years) are: proximity to parks and recreation facilities, land-use mix, residential density and street connectivity, transportation, low traffic density, crime-related safety, and especially pedestrian safety structures, such as traffic lights, crosswalks, and sidewalks (Davison et al. 2006; Ding et al. 2011). Because urban neighbourhoods usually include those characteristics, many have assumed that PA would be more favourable in urban settings (Dunton et al. 2014; Lopez and Hynes 2006). However, urban areas typically have higher rates of violence, crime, and traffic danger that discourage children participation in PA (Lopez and Hynes 2006).

Although differences related with lifestyle, educational and economic variables according to the level of urbanization of places are recognized, most studies regarding correlates of PA in children and adolescents have been done in urban settings (Barreto 2000; Davison et al. 2006; J. B. Moore et al. 2008; Saelens, Sallis, and Frank 2003; Wiggs, Brownson,

and Baker 2008). The findings obtained in urban settings may be invalid in suburban, semi-urban and rural environments, since physical and social characteristics as well as the way people use the physical space are likely to differ between settings (Lopez and Hynes 2006; Moore et al. 2010). For instance, while urban and rural settings share characteristics that may hinder children's PA, like inadequate recreational resources and their distance, unsafe streets and fear of crime (Findholt et al. 2010; Yousefian et al. 2009), community sport participation and the natural environment of the rural settings were seen as some of the most important factors promoting PA in children (Findholt et al. 2010; Pate et al. 1996; Trost et al. 1997).

Physical home environment, for instance available space in close proximity, can also enhance or limit opportunities for PA, especially in young children, as they depend on other people for their transportation to recreational facilities. In a study of 6-to 8-year-old children living in Hong Kong, limited availability of outdoor play areas after school hours resulted in children spending 72.4% of their time sitting and lying down (Johns and Ha 1999). In addition, a systematic review revealed that outdoor time accounted for 4% to 55% of the variance in 3-12-year-old children's PA and that higher amounts of outdoor time increased the likelihood of achieving higher amounts of MVPA (Gray et al. 2015). Urban parents and children usually report little or no yard and safe space adjacent to the house (Loucaides et al. 2004) which was seen to negatively influence the PA among Australian 9-13-year-old children (Maitland et al. 2014), 11-12-year-old Greeks) (Loucaides et al. 2004), and 6-8-year-old children living in Japan (Johns and Ha 1999).

Research comparing the impact of the level of urbanization on children's PA has not been entirely consistent. The majority of studies have found that rural children participate in more PA than their urban peers. For instance, a study from Australia found that rural children (aged 9-11) were more likely to meet the recommendation of 60 min/day of MVPA than their urban peers (Bell et al. 2016). Similarly, a study from the United States observed that urban children (8-12-years) were the least active overall while the children living in small cities reported the highest levels of PA (Joens-matre et al. 2008). Another study carried out among North American children observed that rural residence was supportive of MVPA in 10-15-year-old girls, but not boys (Justin B. Moore, Beets, Morris, et al. 2014), and that 2-11-year-old children living in rural settings reported more PA than their urban peers (Liu et al. 2012). The results are consistent with studies among 10-12 years old Greek children (Tambalis et al. 2013) and 7-10-years-old children from Brazil (Andrade Neto et al. 2014). However, no significant

differences between children's PA from urban and rural settings were reported among 10-12-year-old children from Cyprus (Bathrellou et al. 2007) and North American children aged 2-to 18-years (Davis et al. 2011), while in Taiwan, urban children (aged 10-12) reported more PA than rural children (Sheu-jen et al. 2010).

Another study from Greek-Cyprus found that school aged children from the urban area were significantly more active in winter than rural children and that rural children were significantly more active in the summer compared with urban children (Loucaides et al. 2004), which may indicate differences in the ways PA is accrued by urban and rural children. According to Loucaides and collegues (2004), outdoor activities, like active play, may be more common among rural children, while urban children's activity levels may depend of participation in organised sports.

Research focusing only on organised sport participation in children according to the urban/rural residence are less frequent. It can be intuitively assumed that, because organised sports are often dependent of paying fees, buying equipment, and transportation to specific places, children from urban and high SES neighbourhoods would be more likely to participate, which as been corroborated by previous studies (White and McTeer 2012). A report from Canada, observed that children aged 6 to 9, living in urban areas, were generally more likely than those in rural areas to participate in organised sports but no significantly association was found for children aged 10-13 (Guèvremont, Findlay, and Kohen 2008) which is in line with a posterior study, also in Canada, that found that living in an urban area was found significantly associated with a greater likelihood of weekly sport participation, particularly for girls (aged 4-17) (Findlay, Garner, and Kohen 2009). A study carried among 9-2-year-old children living in Germany, observed that 36% of urban and 20% of rural children continuously participated in a sport club (Golle et al. 2014).

Inverse results were reported by Brown et al. (Brown, O 'keefe, and Stagnitti 2011) and Dollman and Lewis (Dollman and Lewis 2010), in which rurally based children (aged 9-12 and 10-15, respectively) were engaged in a broader range of sports and more frequently than urban children. These differences suggest that each setting should be carefully observed as different from the other, regarding their individual characteristics. For instance, some rural communities are more likely to be supportive of their sport and recreation clubs (both financially and with in-member support) and may offer community organised sport (less

expensive) which makes participation for children more inviting and financially manageable for rural families than urban ones (Dollman and Lewis 2010).

Few studies have addressing PA in Portuguese urban and rural children (Coelho e Silva, Sobral, and Malina 2003) but a study from 2014, carried out among 10-18-year-old children and adolescents observed that the ones living in the rural context spent more time in sedentary activities but, at the same time had higher levels of cardiorespiratory fitness compared with their urban counterparts; urban males were more active than the rural ones whereas urban females were less active than their rural peers (Aristides M. Machado-Rodrigues et al. 2014). Recently, a study carried in 10-12-year-old Portuguese children, observed that 24.4% of the children did not practice any PA other than their PE classes at school (normally three hours a week), with the percentages of extracurricular sport participation being significantly higher in the urban environment (32.4%) than among rural children (14.3%), probably due to the fact that less sporting opportunities were available in the rural setting (Morais Macieira, Saraiva, and Santos 2017).

1.2. Obesity

1.2.1. Definition of overweight, obesity and abdominal obesity in children

Overweight and obesity are defined by the WHO (WHO 2016a) as excess fat accumulation or adipose tissue that presents a risk of health, and are related with a BMI at or above the 85th percentile and 95th percentile respectively for children of the same age and sex. BMI is a measure of weight in relation to height to quantify body mass index (kg/m^2) and is a generally accepted clinical measure used to determine obesity (including overweight status) in children and adolescents (2-19-years-old) (WHO 2016a). However, BMI presents significant limitations in the assessment of the individual weight status, such as not taking into account the distribution of body fat or exaggerating obesity in large muscular children (Chan et al. 2003). In addition, because sex and age play an important role in the body composition of children and adolescents (Guo et al. 1997), there is no consensus on a BMI cut-off to assess excess weight in those ages. Currently there are three classification systems to infer body composition: the International Obesity Task Force (IOTF) (Cole et al. 2000; Cole and Lobstein

2012), the United States Center for Disease Control (CDC) (Kuczmarski et al. 2002), and the World Health Organization (WHO) (de Onis et al. 2007). Discrepancies were reported between classification systems in several countries (Kêkê et al. 2015; Lopes 2012). In general, the highest sensitivity for classifying obesity is found using the WHO criterion and lowest using IOTF cut-off points however, to confirm the disease, particularly in a clinical context, the IOTF criterion seems to be more accurate to define children's nutritional status and is the most widely used classification system in international settings (Lopes 2012).

Nowadays, several methods and approaches can be used together with BMI for a better assessment of obesity among children, such as waist circumference (WC) (Hu 2008), which, together with height, weight and skinfold thicknesses, remain the most feasible and practical methods for population screening of obesity. Waist-to-Height Ratio (WHtR) has been proposed as an easily measurable, non-invasive and practical anthropometric index for detection of central obesity (when WHtR is equal to or greater than 0.50), that can be applied independently of children's sex and age (Mokha et al. 2010; Savva et al. 2000). The rationale underlying this index is that for a given height, there is an acceptable degree of fat stored on the upper body. The traditional cut-offs for BMI may underestimate the risk of abdominal obesity in normal weight children and overestimate the same in the overweight/obese children, while WHtR may be more sensitive in identifying the children at risk, especially at a population level, and provide a better estimate of the overall risk (Mokha et al. 2010; Schröder et al. 2014).

1.2.2. Prevalence of childhood obesity and abdominal obesity worldwide

Obesity rates in school-aged children have tripled over the last 30 years, reaching alarming rates (Ogden et al. 2012; Troiano and Flegal 1998). In 2007-2008, the National Health and Nutrition Examination Survey (NHANES), estimated that among children aged 2-5-years of age, obesity increased from 5% to 11%, from 7% to 20% among 6-11-years-old, and from 5% to 18% among adolescents aged 12-19, between 1976-1980 and 2007-2008 (Ogden et al. 2012). In 2010, the number of obese (including overweight) children under the age of five was estimated to be over 42 million, of whom 35 million were living in developing countries (WHO 2016a). For instance, in the United States, it is estimated that 17% (using the CDC growth charts) of

children ages 2-19-years-old and 18% of children aged 6-11-years are within the obesity levels (Ogden et al. 2012, 2014). Approximately, 20% and 28.4% (using the IOTF and WHO classification, respectively) European children below the age of 10 were identified as obese by a survey carried out from 2007-2010 (Ahrens et al. 2014).

Those averages reflect a wide range of prevalence levels, with the prevalence of obesity in Africa and Asia averaging well below 10% and in the Americas and Europe above 20% (Lobstein, Baur, and Uauy 2004; Wang and Lim 2012). Over the last decades, reports have found a higher increase rate in developing countries (more 65%) than in developed countries (48%) maybe due to demographic, economic, environmental, and cultural changes that those countries have been experiencing (Monteiro, Conde, and Popkin 2002; de Onis, Blössner, and Borghi 2010). Within Europe, obesity is not uniformly distributed, with studies suggesting that children residing in southern European countries, like Italy, Spain Cyprus, and Greece, show the highest prevalence of obesity (Ahrens et al. 2014; Cruz 2000; Pigeot et al. 2009; Wijnhoven et al. 2013). In contrast, northern European countries, particularly the Nordic ones, tend to have lower rates overall (Samuelson 2000). Even within countries there may be marked variability in rates of obesity. For example, it was found that 9-year-old children living in the northern Italy tend to have lower rates than those observed in the south (Esposito-Del Puente et al. 1996). Some studies carried after the year 2000, suggested that childhood obesity (4-18-years-old) had reached a plateaued or even declined, in developed countries, such as Denmark (Matthiessen et al. 2008), Germany (Blüher et al. 2011), United States (Ogden et al. 2012), Greece (Tambalis et al. 2010), and others (Olds et al. 2011; Wabitsch et al. 2014). Those findings were unexpected since, for example, in the United States, it has been suggested that the prevalence rate of obesity in children will reach 30% by 2030 (Wang et al. 2008).

Sex differences in obesity prevalence are inconsistent with some studies, for example in Italy (Maffeis et al. 1993), Finland (Nuutinen et al. 1991), Spain (Sánchez-Cruz et al. 2013) and Slovenia (Kovač et al. 2014) showing the highest prevalence among boys while the opposite trend was found in 5-17-year-old children from countries like Australia, Ireland, Chile, Mexico, Denmark, and Sweden (Ng et al. 2014; OECD 2014). Whether these data reflect real differences or are artefacts due to biased sampling and differences in definition is not clear. It may be that those differences are the result of biological differences between the bodies of males and females, different PA behaviours (due to social and culture beliefs), or a combination of the two.

Values of WHtR during the past 10-20 years have increased greatly showing that central fatness in children has risen dramatically and to a higher degree than general obesity (Garnett, Baur, and Cowell 2011; Okosun et al. 2006). Using this method, 21.3% of Spanish children aged 6-11-years had abdominal obesity, with boys being more likely to have higher levels than girls (Schröder et al. 2014). Similar findings were observed in Greece, where 25.6% of boys and 20.0% of girls (aged 6-12-years) had abdominal obesity (Tzotzas et al. 2011) but lower rates were found among 11-16-year-old British children (17.0% for boys and 11.7% for girls) (McCarthy and Ashwell 2006) and Swedish children aged 9-15-years-old (Ortega et al. 2008).

1.2.3. Prevalence of childhood obesity and abdominal obesity in Portugal

The prevalence of obesity among Portuguese children may have increased during the last decades (Padez et al. 2004). The results from that study suggest that there were strong increases in BMI among Portuguese children (7-9-years-old) between 1970 and 2002, but especially between 1992 and 2002, when the changes in weight were higher than those of height. Nowadays, Portugal is among the five countries with the highest rates of childhood obesity in Europe (Wijnhoven et al. 2013). A study conducted in 2002-2003 among Portuguese children (aged 7-9-years) observed a prevalence of obesity at 11.3% and of overweight at 20.3%, according to the IOTF cut-offs, with higher rates among girls (33.7%) than boys (29.4%) (Padez et al. 2005). A study from 2000 with 9-11-year-old children and using the IOTF criteria, found higher prevalence of obesity (including overweight) ranging from 47.3% among the 9 year old and 36.6% among the 11-years-old (Cardoso and Padez 2008). In 2006, Mota and colleagues (Mota, Flores, et al. 2006) reported a prevalence of overweight (30.5% and 29.1%) and obesity (13.2% and 12.6%), similar for both boys and girls aged 8-10-years. Another study from 2008, performed within the Childhood Obesity Surveillance Initiative (COSI) in 6-9-year-old Portuguese children, observed that 22.6% were overweight and 15.3% obese, and that 40.5% of boys and 35.5% of girls were either overweight or obese (WHO criteria) (Rito et al. 2011). In a study comparing the three different criteria to estimate obesity in a sample of Portuguese children of 6-8-years of age, it was found that the numbers for overweight and obesity, respectively, differed when using the IOTF reference (28.1% and 8.9%), using the CDC (32.2% and 14.6%), and according to the WHO reference (37.9% and 15.3%) (Rito et al. 2012).

A study of older children (10-18-years-old) from Portugal showed that 20.4% of children were overweight and 10.2% were obese (WHO criteria) (Sardinha et al. 2011). More recently, a study using the IOTF cut-off points observed a prevalence of overweight/obesity of 30.6% for boys, 28.4% for girls, and 30.3% for boys and girls together (Gomes et al. 2014).

Previous studies indicate that over one-third of Portuguese children are either overweight or obese but slight differences have been observed comparing Portuguese regions. For instance, similar obesity (including overweight) rates were observed in central Portugal (38.1%), Lisbon (and Tagus Valley) (38.3%) and the North (38.6%) but significant differences were found comparing with the region of Azores, in which 46.6% of children were overweight or obese (Rito et al. 2011, 2012). Looking specifically for the central region of Portugal, Sardinha et al. (Sardinha et al. 2011) found a prevalence of 21.0% for overweight and 9.2% for obesity in 10-18-year-old children using the WHO criteria. More recently, slightly higher rates were found for the same region (22.3% of overweight and 10.7% for obesity, using the IOTF cut-off points) with significantly higher rates of overweight alone for boys compared to girls, observing children aged 6-12-years (Albuquerque et al. 2012).

Albuquerque et al. (Albuquerque et al. 2012) also observed the prevalence of abdominal obesity using the WHtR≥ 0.50, and found that the value was significantly higher among boys (28.1%) than in girls (19.4%). Nevertheless, data on secular trends in WHtR are scarce in Portuguese children, thus is impossible to compare these results with previous studies.

1.2.4. Health risks associated with obesity and abdominal obesity in children

There are several health implications associated with childhood obesity however, some confusion of the consequences of obesity may arise because researchers have used different methods and cut-off points to define it, and because the presence of many medical conditions involved in the development of obesity may confuse the effects of obesity itself (Kosti and Panagiotakos 2006). Childhood obesity is associated with a range of psychosocial and medical complications that are both immediate and long term (Baur and O'Connor 2004) and have severe economic consequences (Finkelstein, Ruhm, and Kosa 2005).

1.2.4.1. Medical complications associated with childhood obesity

The health implications of childhood obesity include the increased likelihood of having risk factors for cardiovascular disease including high cholesterol, abnormal glucose tolerance, and high blood pressure (Bingham et al. 2009; Flores-Huerta and Klünder 2008). Studies have observed an association between childhood obesity and asthma, hepatic steatosis, and sleep apnea (Daniels et al. 2005; Duarte and Silva n.d.; Egan, Ettinger, and Bracken 2013; Figueroa-Muñoz, Chinn, and Rona 2001). Confined to older adults for most of the 20th century, type 2 diabetes has emerged with acute and chronic complications among obese children and adolescents (Pulgaron and Delamater 2014). Other non-fatal health problem associated with obesity include musculoskeletal pain (Paulis et al. 2014; Smith, Sumar, and Dixon 2014) and earlier puberty and menarche in girls (Biro and Wien 2010).

Although obesity-associated morbidities occur more frequently in adults, significant consequences of obesity as well as the antecedents of adult disease occur in obese children and adolescents (Dietz 1998). The Bogalusa Heart Study, shows that childhood BMI (ages 2-17) is associated with adult adiposity (18-37-years-old), although it is possible that the magnitude of the association depends on the relative fatness of children, and that overweight and obesity during childhood is a determinant of a number of cardiovascular diseases risk factors in adulthood (Biro and Wien 2010; Freedman et al. 2005). The presence of overweight in adolescence was also associated with an increased risk of mortality from coronary heart disease in adulthood (women and men) regardless of the individual's weight in adulthood (Must et al. 1992).

1.2.4.2. Psychological complications associated with childhood obesity

From the psycho-social point of view, a recent study found that weight status was associated with social relationships, school experiences, and psychological well-being (Falkner et al. 2001). Many children with paediatric obesity are unhappy with their body shape and feel they are not good-looking, and there is marked low self-esteem and self-worth noted in obese children (McClure et al. 2010). An obese child is often victimized at school and subjected to bullying and calling of nicknames by his peers because of his body size and fatness (Storch et al. 2006). Girls,

when compared to boys, reported more adverse social, educational, and psychological correlates, and obese girls were more likely to report being held back a grade, consider themselves as poor students, when compared with their average weight counterparts (Falkner et al. 2001).

1.2.4.3. Mental and physical problems associated with abdominal obesity in children

One of the most prevalent topics of discussion regarding excess body fat is the question of abdominal obesity, also known as central obesity and visceral fat, and its early effects on the metabolic changes in young populations (Singla, Bardoloi, and Parkash 2010). Abdominal obesity contributes to an inflammatory state and may cause abnormalities in health, triggering deleterious reactions related to insulin resistance which, together with other factors as lipid abnormalities, fibrinolysis, oxidative stress, hypertension, hyperglycemia, or type 2 diabetes, are positively associated with endothelial dysfunction, leading to early atherosclerosis (Mathieu et al. 2009). A number of studies have shown that surrogate markers of abdominal obesity are independent risk factors for type 2 diabetes, dyslipidemia, hypertension, and coronary heart disease (Kelishadi et al. 2015). Previous findings shown that abdominal obesity, either calculated by waist circumference or WHtR, are better predictors of cardiovascular disease and metabolic risk factors in children than BMI and generalized obesity (Kelishadi et al. 2015; Savva et al. 2000). In addition, abdominally obese children are likely to suffer from the host of psychological and social problems referred above for overall obesity, including reduced school and social performance, less favourable quality of life, societal victimization and peer teasing, lower self- and body-esteem (Latzer et al. 2013; Puder and Munsch 2010).

1.2.5. Aetiology of childhood obesity

Taking into serious consideration the severe consequences of obesity, it is of enormous importance to identify the risk factors. However, this task is not an easy one, since the aetiology for child obesity is not clear. Obesity is multifactorial, meaning that is a complex condition with genetic, metabolic, behavioural, and environmental factors all contributing to its development

(Baur 2002). However, the dramatic increase in the prevalence of obesity in the past few decades must be a result of significant changes in lifestyle influencing children and adults (Baur 2002).

The current changing nature to an obesogenic environment (i.e., obesity-promoting environmental factors) has been described worldwide (Huneault, Mathieu, and Tremblay 2011). The deep changes in the social and economic structures has led to a global improvement of living conditions. In Portugal, these changes have mainly occurred in the last three decades and have had many positive effects on the Portuguese population, such as a positive secular trend in stature (Padez 2003) and in the decrease of age at menarche (Padez and Rocha 2003). Nevertheless, these changes also had some negative effects leading to higher percentages of sedentary lifestyle for adults and a shifting to more caloric and higher of fat dietary patterns (Barreto 2000; Padez et al. 2004). Therefore, apart from genetic factors, obesity seems to be a result of an imbalance between energy expenditure, modulated primarily by PA, and energy intake from foods and drinks (WHO 2016a).

1.2.5.1. Risk factors associated with childhood obesity: diet

Observations on childhood nutrition related to a westernized lifestyle, adopted widely by high- and middle-income countries, point to an increase in consumption of foods prepared away from home, an increase in the consumption of fried and nutrient-poor foods, and an increase in the total calories intake (Ranjit et al. 2015). Also, a decline in fruit and vegetable consumption has been observed (Hall et al. 2009) and because high-fat foods are typically very palatable and less satiating, children are over consuming them (Drewnowski and Almiron-Roig 2010). A recent study carried out among Portuguese children (aged 6-8) observed that the Mediterranean diet (including vegetables, fruits, moderate intake of fish and meat, and lower consumption of sugars) has been slowly replaced by unhealthy food patterns, rich in saturated fats, particularly in low SES families (Rodrigues et al. 2016).

Among children, a healthy diet has important short and long term health effects (Koletzko et al. 2012). For example, fruit and vegetable intake seem to have a protective effect against obesity in 4-12-year-old children (van der Horst et al. 2006), while consumption of sweetened beverages, sweets, meats, and total intake of low-quality foods were positively

associated with overweight status in 10-year-old children (Nicklas et al. 2003). Moreover, worse diet quality was shown to coexist with other unhealthy behaviours such as more hours of watching television (TV) and lower levels of PA in a sample of 6-8-year-old Portuguese children (Rodrigues et al. 2016).

1.2.5.2. Risk factors associated with childhood obesity: sedentary behaviours

The first study to investigate the relationship between a sedentary behaviour (TV viewing) and weight status was published by Dietz and Gortmaker in 1985 (Dietz and Gortmaker 1985). In this study, TV viewing was positively related to the prevalence of obesity, both cross-sectionally and longitudinally, in children and adolescents. This investigation led to a growing body of research examining the relation between TV and weight status, and outcomes from this area informed the development of the recommendation that screen time should be limited to ≤2 hours per day in children (Pediatrics 2001). Several studies have found a positive association between the time spent viewing TV and increased prevalence of obesity in children. For instance, TV viewing was significantly associated with higher levels of BMI and WHtR in 6-16 years old children living in China (Wang et al. 2012), and was significantly related with BMI z-score of Australian children aged 5-1 years (Wake, Hesketh, and Waters 2003), the prevalence of obesity was lowest among 8-16-year-old North American children watching one or fewer hours of TV per day and highest among those watching four or more hours of TV a day (Crespo et al. 2001), and the odds ratio of obesity were 12% higher for each hour of TV viewing per day among 9-16-year-old Mexican children (Hernández et al. 1999). In addition, childhood TV viewing seems to be a better predictor of adult BMI than adult viewing, even after adjusting for adult viewing time (Landhuis et al. 2008).

Sedentary behaviours are sitting behaviours that occur in a variety of domains (e.g., leisure, occupation, transportation, and recreation) and, apart from watching TV, include working/playing on the computer (PC), and using electronic games/devices. Sedentary behaviours among children, especially TV viewing, may reduce energy expenditure, by competing with time to engage in PA, and increase energy intake, by serving as a cue for eating (Leonard H Epstein et al. 2005; Leonard H. Epstein et al. 2005). Higher prevalence of total sedentary time and screen time is correlated with poor weight status in 9-11-year-old children

from different sites including Australia, Brazil, Canada, Finland, South Africa, United Kingdom, and Portugal (LeBlanc et al. 2015).

Among Portuguese children, the odds ratio for childhood obesity increased by television viewing in 7-9 and 2-13-year-old children (Padez et al. 2005; Stamatakis et al. 2013), and more time playing with electronic games was positively associated with BMI both for boys and girls (aged 7-9-years) (Carvalhal et al. 2007). Another study identified a relationship between computer use and weight status among Portuguese adolescents (12-18-years), with those who used computers on weekdays more than four hours per day being more likely to be overweight/obese (Mota, Ribeiro, et al. 2006). Thus, preventing the development of a sedentary lifestyle by reducing TV viewing along with other sedentary activities has been identified as a promising public health message to help prevent childhood obesity and associated long term health consequences (Robinson 1999; Spear et al. 2007).

1.2.5.3. Risk factors associated with childhood obesity: physical activity

It is now widely accepted that increasing PA participation and decreasing sedentary behaviour should be the major focus of strategies aimed at preventing and treating obesity in children and adolescents (Janssen et al. 2005). Several cross-sectional and longitudinal studies have demonstrate that low levels of PA are related to weight status in children (Jago et al. 2005; Moore et al. 2003; Nemet 2016). In a sample of 9-11-year-old children from 12 countries, the time spent in MVPA and vigorous PA was associated with lower odds of obesity independent of sedentary behaviour (Katzmarzyk et al. 2015). Non-compliance with the minimal PA guidelines of MVPA (60 min/day) increased the odds of 5-12-year-old Australian children being overweight by 28% (Spinks et al. 2007).

When looking for different forms of PA, their positive impact in weight status is also visible. For example, in a study with 3-18-year-old children and adolescents, active commuters who lived greater than one kilometre (or a half-mile) from school had 65% lower odds of being overweight/obese when compared with students who did not actively commute to school (DeWeese and Ohri-Vachaspati 2015). Also, 9-10-year-old American boys who actively commuted to school had significantly lower BMI and skinfolds than non-active commuters to school (Rosenberg et al. 2006). A study carried out in 10-to 12-year-old Portuguese children,

observed that walkers had higher odds to have a better waist circumference than non-active commuters, independent of MVPA (Pizarro et al. 2013). Children (aged 5) who played outdoor had an approximately 42% reduction in risk of obesity, compared with children who reported no plays outside (Ansari, Pettit, and Gershoff 2015). Also, physical education lowers BMI z-scores and reduces the probability of obesity among 10/11-year-old children (Cawley, Frisvold, and Meyerhoefer 2013). In addition, analyses of data from the Early Childhood Longitudinal Study showed that PE reduced BMI among 5 and 6-year-old children who were overweight or at risk for overweight in kindergarten and reduced the probability of obesity among fifth-grade boys (Cawley et al. 2013; Datar and Sturm 2004).

Facilitation of participation in organised sports may be a crucial aspect in public health efforts addressing the growing problems associated with childhood obesity. German children (aged 7 and 8) participating in organised sport more than once per week were less likely to be obese (Drenowatz et al. 2013). Similarly, participation in organised sports reduced 11-12-year-old children's BMI by 2-1%, and the likelihood of being overweight and obese by 8.2 and 3.1 percentage points, respectively (Quinto Romani 2011). Greek girls (10-12-years-old) who participated in excess of three hours in extracurricular sport activities were 50% less likely to be obese than their non participating counterparts (Antonogeorgos et al. 2011). At the same time, a study carried among 11-14-year-old children from Spain, observed that boys who participated in at least three hours per week of sports activities were more protected against total and regional fat mass accumulation (Ara et al. 2006). The same pattern among boys was found in another study using a sample of 6-12-year-old of Southern European children (Santiago et al. 2013).

Unfortunately, research has shown that children are spending less time in PA behaviours and few children achieve the recommended guidelines of 60m/day of MVPA (Van Hecke et al. 2016; Konstabel et al. 2014). In addition, the relationship between childhood obesity and low levels of PA may be a little more complicated. For instance, lower participation in PA may be the cause of childhood obesity, but may as well be an outcome of childhood obesity. Obese children are usually less physically active than non-obese children (Ekelund et al. 2002; Lazzer et al. 2003; Maffeis et al. 1996) and time devoted to sedentary activities has been directly associated with adiposity levels (Maffeis, Zaffanello, and Schutz 1997) however, some studies have observed that when PA is expressed in absolute terms it is comparable in obese and non-obese children (Ekelund et al. 2002; Lazzer et al. 2003; Maffeis et al. 1994).

1.2.5.4. Risk factors associated with childhood obesity: parents' BMI

A recent study showed that parental obesity status (including overweight) is an important determinant of whether a child is overweight at 5 or 14-years of age or changes from being not overweight at 5 years to becoming so at 14 years (Mamun et al. 2005). The authors observed that children whose parents were overweight or obese were more likely to change from being not overweight at age 5 years to being overweight at 14 years and were more likely to have excess weight at both ages. Maternal overweight status in particular was associated with these transitions. In fact, maternal pre- or early-pregnancy obesity is related to increased risk of obesity in children born to these mothers (Olson et al. 2010) either by influence of genetics or food habits, while father's BMI may be an important exposer of poor family behaviours (diet and PA) and it has been seen associated with childhood obesity (Brophy et al. 2012). Studies from Germany (in 5-7-year-old children) (Danielzik et al. 2002) or Australia (in children aged 7-15 and 6-13-years-old) (Gibson et al. 2007; Wang, Patterson, and Hills 2002) have shown that parental obesity is associated with increase childhood obesity, which was also corroborated in Portugal (Padez et al. 2005), where the odds ratio for childhood (7-9-years-old) obesity significantly increased by both paternal (OR=3.06) and maternal (OR=9.06) obesity.

1.2.5.5. Risk factors associated with childhood obesity: socio-demographic

The relationship between social and demographic factors and childhood obesity remains equivocal and poorly understood. Factors such as region, season and population density (Dietz and Gortmaker 1984; Hassapidou et al. 2017; Nogueira and Santana 2004) as well as ethnicity and family size (Datar 2017; Zilanawala et al. 2015), have all been associated with adiposity in children and risk of obesity in young adulthood. In developed, high income countries, there appears to be an increased risk of developing obesity among children living in rural areas (Bertoncello et al. 2008; Davis et al. 2011) in contrast to developing countries where urban children seem to be at a higher risk (Adamo et al. 2011; Chen et al. 2011). Recent studies have shown that rural children (e.g., 10-12-year-old Greek children, 6 and 7-year-old Spanish children, or 2-19-year-old children from United States of America) have higher prevalence of

obesity compared with their urban peers, independently of the PA levels (Liu et al. 2012; Moreno et al. 2001; Tambalis et al. 2013). In Portugal, living in a rural environment was not an independent predictor of childhood (aged 10-12) overweight or obesity (rural: 26.8% for being overweight or obese and 16.9% for obesity alone; urban: 33.4% for overweight including obesity and 16.7% for obesity) (Morais Macieira et al. 2017). The prevalence of obesity and abdominal obesity seems higher among children living in large metropolitan areas than in areas with lower population densities (Dietz and Gortmaker 1984; Hassapidou et al. 2017), but having more siblings may be a protective factor of higher BMI and obesity (Datar 2017).

The relation between obesity and the socioeconomic status has been extensively studied, but the associations with childhood obesity are inconsistent (Danielzik et al. 2004; Gordon-Larsen et al. 2006; Jo 2014; Kotian, S, and Kotian 2010). Nevertheless, most studies, particularly in developed countries, have found that lower SES is an independent risk factor of obesity in children (Danielzik et al. 2004; Wu et al. 2015) by influencing their financial capabilities as well as their access to health information and to the correct interpretation of such information while, at the same time, may result in poorer health choices due to the lack of resources. Data from the 1946 British birth cohort show that low socioeconomic background in childhood and a high relative weight at age 14 are associated with higher mean BMI throughout adult life. Moreover, this is only partially confounded by educational attainment and by adult SES, suggesting a long-term impact of biological and behavioural processes on BMI (Hardy, Wadsworth, and Kuh 2000).

In 2008, the world entered one of the most economic severe crises ever. Since then, households in countries like Greece, Ireland, Italy, Spain, and Portugal are likely to have decreased slightly their expenditure on fruits and vegetables. As seen in a study carried among American families, children in families experiencing food insecurity are 22% more likely to become obese than children growing up in other families (Metallinos-Katsaras, Must, and Gorman 2012). Unemployment, social exclusion, and decreasing public and private investments are expected to affect access to a healthy diet, health care, and family's healthy lifestyle and in consequence, increased childhood obesity, particularly among lowest social classes.

Although, obesity is a major health problem in many countries, including Portugal, the size of the problem is obscured by problems of definition and a lack of consensus on methodological approaches used. However, various factors are clearly linked to childhood

obesity but it is highly unlikely that these interact in similar ways in the genesis of obesity in different individuals and population groups. The heterogeneity of socioeconomic conditions throughout European countries, and even within the same country, and the diversity of factors which underscore them, reinforces the need of continued surveillance of their impact, both positive and negative, on childhood obesity.

1.3. Coimbra and Lousã

1.3.1. Geography

The Coimbra district is located in the central part of Portugal. It has a total area of 3 974 km^2 and 434,311 inhabitants, corresponding to 4.1% of the total population of the country. The district consists of 17 municipalities including Lousã and the district capital, Coimbra. Coimbra is the biggest city in the central region and the 6th largest in Portugal (Comissão de Coordenação e Desenvolvimento Regional do Centro, 2008). According to the 2011 census, the population was 143 396 in an area of 319.40 square kilometres (INE 2011).

Lousã is a town with 17 604 inhabitants in an area of 138.40 km^2 (INE 2011) in which 58.6 km^2 is forested, and 17.2 km^2 in use by agriculture (Câmara Municipal da Lousã, 2016). It is a municipality in the district of Coimbra with only approximately 30Km of distance from the city of Coimbra.

1.3.2. The quality of life of adults and children

A research paper that measured the well-being/quality of life of the Portuguese municipalities referring essentially to the year 2010, found that Coimbra was the 5th best in the ICDES ranking (Indicador Concelhio de Desenvolvimento Económico e Social), achieving 60,844 points, while Lousã, with 26,603 points, was in the 251st position (Gonçalves, Matos, and Manso 2012), meaning that Coimbra offers better socio-economic conditions as well as more infrastructures (e.g. medical, culture, school, parks) than Lousã.

In 2015, the birth rate was 8.8% in Lousã and 8.6% in Coimbra while the death rate in Coimbra was 10.5% and 9.2% for Lousã (Pordata 2016b). Data from 2015 revealed that 18.2%

of the population living in Lousã were greater than 65 years old, 60.7% were aged between 20-64-years-old, 11.3% were between 10-19-years-old, and 9.7%% were younger than 10-years-old. In Coimbra, 23.6% had 65 years or older, 59.1% were aged between 20-64-years-old, 9% of the population were between 10 and 19-years of age, and 8.2% had less than 10-years-old (Pordata 2016b).

Most of people, aged 15 years or more, living in Lousã, have Basic education (4 years of school) (28.1%) followed by a Secondary education (9 years) (21.4%). In Coimbra, 26.9% of the population above 15 years, have a High education degree followed by a Basic education (21.5%) (INE 2011). In 2014, most people from Coimbra were working in the tertiary sector (services) (78.0%) followed by the secondary (manufacturing) (20.7%) (Pordata 2016b). The region of Lousã, has seen a decline in agricultural activities, which was always based on local consumption, and a growth in secondary activities such as the pulp and paper industry, electronics, as well as the manufacture of olive oil, wine and liquors. Tourism is also an important industry in the region which is characterized by its mountains (Câmara Municipal da Lousã, 2016). Tertiary activity has helped the region economy, even if many residents in Lousã commute to the city of Coimbra for work or shopping. In 2014, most citizens living in Lousã were working in the tertiary sector (66.3%) or in the secondary (30.6%) (Pordata 2016b).

1.3.3. Environmental conditions for the practice of PA and sport

In 2009, 46 facilities dedicated to the practice of sport (i.e., clearly identified as such, with specific equipment, often depends of financial resources) were counted in Lousã. The majority of the recreational facilities in the municipality were small spaces (47.83%) often used by youths to engage in unstructured physical activities and with standard size to play basketball, futsal (i.e., indoor football), handball or volleyball, followed by large outdoor spaces (19.57%) such as football or rugby fields. Other artificial facilities observed were pavilions, indoor and outdoor pools. Majority of those spaces were situated in the village of Lousã, the largest and most urbanized civil parishes (freguesia in Portuguese) of the municipality (26 of the referred 46 facilities representing more than 50%) (Centro de Estudos Geográficos 2009). The mentioned study observed that within the 16 playgrounds existent in Lousã, only two were in

good state of repair and following the Portuguese law that requires the existence of basic infrastructure as illumination and potable water.

When it comes to natural places to engage in sport and physical activity, Lousã offers three fluvial (i.e., river) pools with good conditions for the practice of recreational activities that are mainly used by the people living in the municipally, as well as natural green mountains that favour the practice of mountain biking, downhill, canoeing, and walking (Centro de Estudos Geográficos 2009). The city hall offers a number of sport programs such as "Active Holidays" in an effort to promote and facilitate children's engagement in physical activities during school breaks and summer vacation, while at the same time sponsors many sport associations such as the Rugby Club da Lousã and the Clube Desportivo Lousanense (CM-Lousã 2016).

Data collected in 2002 and revised in 2005, registered 430 facilities, specifically built for the practice of sport activities, in the municipality of Coimbra, with the majority of them being situated in the city of Coimbra (60.7%). Majority of those facilities observed in Coimbra were small outdoor spaces (47.91%; e.g., for playing basketball or tennis), followed by sport rooms (12.09%; e.g., for martial arts or gymnastic), pavilions (11.63%), athletic tracks (10.93%), large outdoor fields (8.37%), indoor pools (1.86%), and outdoor pools (1.40%) (Centro de Estudos Geográficos 2012). The river allows the practice of nautical sports like canoeing or paddle-boarding, while the surrounded parks are one key resource for encouraging physical activities such as walking or bicycling. Comparing both places, the ratio of the useful sports surface per inhabitant according to the data collected in the last decade, was very similar in both places but slightly better in Lousã (4.12m^2) than in Coimbra (3.30m^2).

1.3.4. Prevalence of physical activity and obesity among children living in Coimbra and Lousã

Freitas (Freitas 2012) reported that 28.7% of 6-11-year-old children living in Coimbra were obese (including overweight), and that girls had a significantly higher prevalence of overweight than boys (32.3% and 25.1%, respectively), using the IOTF cut-offs. Data collected in 2009 from 6-10-year-old children living in the city of Coimbra, found that 29.8% of the children were obese (including overweight) using the IOTF cut-offs (Santana 2013). More recently, Muc (Muc

2014) reported slightly lower values among children (aged 10-12) in Coimbra, with a prevalence of obesity (including overweight) at 24.4% and 5.4% for obesity alone (IOTF cut-offs), with significantly higher prevalence of overweight and obesity in girls compared to boys (28.11% for girls and 20.10% for boys). In Lousã, approximately 29.0%, of 3-11-year-old children were overweight (including obese), with girls having higher rates of overweight (22.9% and 18.9%, respectively) and higher obesity rates (8.3% and 8.0%) than boys (Pronto 2013).

In Coimbra, parents of children (aged 10-12-years) were asked how many times in a normal week they children engaged in vigorous PA and the answers varied from "never or occasionally" (14.0%), "1-2 times per week" (59.7%), and "3 or more times per week" (26.3%) (Muc 2014). Still in Coimbra, data from 2012 indicates that 60.7% of children between 6 and 11-years-old, and more boys than girls (64.8% and 56.8%, respectively) were participating in some organised sport (Freitas 2012). In a study from 2013 among 3-11-year-old children from Lousã (Pronto 2013), parents reported that 58.1% of boys and 51.2% of girls (aged 6 to 9 years), and 61.5% of boys and 55.5% of girls (aged 10 and 11-years-old) were engaged in extracurricular sport.

In the light of the dramatic increasing prevalence of obesity among children during the last decades, the development of scientifically based community intervention approaches to reduce the incidence of children's obesity through increasing PA and sport participation assumes a crucial role. Furthermore, the need to promote regular PA in children has been recognized by numerous agencies and private organizations targeting public health (Strong et al. 2005).

1.4. Objectives of the thesis

The aim of this thesis was twofold. The first aim was to observe the physical activity behaviours in 6-10-year-old Portuguese children living in different settings (urban vs. non-urban) and how intrapersonal, social and environmental factors were associated with extracurricular sport participation in the same studied population. The second aim was to estimate the prevalence of general and abdominal obesity in the same sample of children and identify family, economic, and behavioural factors possible associated with childhood obesity. Several specific objectives were set:

- Observe the prevalence of physical activity behaviours among 6-10-year-old children living in an urban and a non-urban setting;
- Identify family and economic factors associated with extracurricular sport participation in children living in urban and non-urban settings;
- Examine parents' opinions of sport and PA, perceived barriers and proximity to recreational facilities, according to the level of urbanization, and explore how those variables influence children's sport participation;
- Investigate if children's perceived barriers to sport and PA differ between boys and girls and the level of urbanization, and explore which barriers influence children's sport participation;
- Estimate the prevalence of obesity (including overweight), and abdominal obesity among 6-10-year-old Portuguese children, according to sex and urbanization;
- Detect significant differences in behavioural characteristics among normal weight and obese/abdominally obese children and investigate the importance of family, economic, and behavioural factors in predicting the nutritional status of boys and girls living in an urban and in a non-urban setting.

Chapter 2. Methodology

2.1. Study design and sampling

A cross-sectional study was done comprising 834 parents (424 parents of girls, 50.8%) and respective children aged 6-10-years-old, in grades 1 through 4, resident in two different places: Coimbra (53.1%) and Lousã. The place of residence was classified according to its typology following the criteria of the Portuguese Statistical System (Monteiro 2000), in which urban areas are defined as a city with >500 inhabitants/km^2 or >50 000 inhabitants and rural areas are defined as villages with no more than 100 inhabitants/km^2 or with the total population under 2000 people. Coimbra was classified as urban and Lousã as non-urban.

This age group was chosen because it is known that PA levels decline in the end of primary school (Trost et al. 2002), at the same time that children start moving more independently (Jago et al. 2009), and that habits and behaviours adopted around this age may remain in adulthood (Telama et al. 2005). However, most studies have focused on the risk factors associated with PA and sport participation among adolescents and few have observed the intrapersonal, social and environmental factors that may predict children's participation in extracurricular sport.

Ethical approval was given by the Portuguese Commission for Data Protection which requires anonymity and no transmissibility of data, corroborated by the *Direcção Geral de Inovação e Desenvolvimento Curricular* (Portuguese General directorate of the Ministry of Education). After ethical approval, solicitation by email and letters were sent out to school clusters (Agrupamentos in Portuguese) soliciting participants. No pre-selection was applied, apart from the geographical location within both areas and that schools should be situated in central areas of both places as opposed to the peripheries. The study was explained and the clusters received a copy of the ethical authorization of the project, sample questionnaires, and letters addressed to the children's legal guardians. If authorization was granted the same steps were repeated in each school belonging to that specific cluster, and questionnaires were distributed among the parents/legal guardians of the children. In Portugal, like other countries, are now several types of families therefore, for this work, parents refer to the child's primary carer(s) which would usually be the child's biological parent but could also be a foster parent, grandparent or any other legal guardian.

Attached was a brief explanation of the study and the authorization form (Appendix 2) to perform a direct interaction with the children through a semi-structured interview and to

take the anthropometric measurements (height, weight and waist circumference). The school or the teacher was responsible for receiving the completed questionnaires. Parents/legal guardians had approximately one week to return the surveys and the authorization form. Only children with both documents completed were included in the further process. Data collection was carried during the Spring of 2013 and 2014 avoiding extreme weather conditions which can be negatively related with children's PA and spot participation.

2.2. Parental questionnaire

The questionnaire was divided in four segments: 1) information about the child, 2) questions about general sport and PA participation, 3) information about parents, and 4) information about the household. Part 1, 3, and 4 of the questionnaire were adapted from another questionnaire that was previously used in Portugal to study active behaviours in children (Aristides M Machado-Rodrigues et al. 2014; Pronto 2013). Part 2 included a Likert-scale to understand parents' opinions about children's PA, sport participation, and gender stereotypes on sport. The present scale was based on surveys previously validated in other populations (Dwyer et al. 2011; Eccles and Harold 1991), with specific adaptations to achieve our objectives.

2.2.1. Reliability of measures

A small-scale preliminary study was conducted in order to evaluate time and effect size (statistical variability) in an attempt to improve the study design prior to perform a full-scale research project. One school in Coimbra was selected to administrate the pilot study. The control group was formed by 30 parents chosen in a randomly way. Parents were asked if they found any problem with the questionnaire and if they had any doubt regarding the meaning of the questions. Small adjustments were made to the questionnaire design after this phase in order to facilitate the reading. The final questionnaire can be found in the attachments (Appendix 2). Consistency of the survey was tested by using a test-retest (n=30), comparing the answers from the first group and the final data collection. Cronbach's alpha statistic was used to measure internal consistency, with a resulting alpha value of 0.89, meaning that the

items have relatively high internal consistency. An exploratory factor analysis was used to develop construct validity for this new instrument.

The administration of the present study began approximately three months after the pilot study. Questionnaires were delivered in schools and each student took one home. Parents were informed that they had one week to return the questionnaires, in order to keep up with the children's interview and anthropometric measurements. The studied variables collected through the questionnaire and used in the study are presented below.

2.2.2. Children's participation in extracurricular sport

Parents were asked to report if their children were engaged in any extracurricular sport. If yes, they added in how many sport, which sport(s), and how much time (min per weekdays and min per weekend) the child was spending in each sport.

2.2.3. Other children's PA behaviours

Parents also reported how they children were commuting to school, classified into active (if walking or bicycling) and passive (e.g., car, public transportation), if their children practiced physical education (PE) in school (how many minutes per week), and how many minutes on weekdays and weekends their children played in an active way, defined as any form of regular PA, which included moderate to vigorous bursts of high energy, and which raises children's heart rate and leaves them breathing heavily (e.g., running, riding skate, playing unorganized sports, walking pets).

2.2.4. Children's sedentary behaviours: screen time

Parents reported how many minutes, during weekdays, Saturdays and Sundays, their children watched TV, used the PC, and played with electronic games (EG). Answers were classified according to the guidelines stated by the *American Academy of Pediatrics* (APP) (Pediatrics 2001) that recommend limited recreational screen time below 2 hours per day. The cut-point

for PC and EG was defined at 1 hour per day as used in previous studies with Portuguese children (Jago et al. 2012).

2.2.5. Parents' education level

Parental level of education was categorized based on the levels in the Portuguese educational system: No education, Basic Education (4 years), Basic Education (6 years), Secondary Education (9 years), Secondary Education (12 years), and Higher Education (at least a Bachelor degree). Later, education level was divided into three groups: Low = 9 years or less, Middle = Secondary (10-12 years of education), and High = Higher education. Similar procedures have been applied in the Portuguese context, in studies assessing children's physical activity behaviours (Mota et al. 2007; Vale et al. 2014).

2.2.6. Family income

Family monthly income was used as a parameter of socioeconomic status (SES) as seen in previous studies in the Portuguese context (Vale et al. 2014). Parents reported the family monthly income: less than €500, from €500 to €1000, €1000 to €1500, €1500-2000, and more than €2000, which was later divided into three groups: <€1000 per month, €1000-1500 per month, and >€1500 per month.

2.2.7. Number of siblings

Parents reported the number of offspring, which were divided into three groups: no (zero) sibling, one sibling, and two or more siblings.

2.2.8. Parents' PA behaviours

Parents self-reported if they were practicing any physical activities (Yes/No) and the total time per week engaged in different activities (e.g. team sports, walking, running). According to their

responses mothers' and fathers' PA was categorised into three groups, namely: physical inactive, participation in organised PA, and participation in unorganised PA. Organised PA tend to require a coach or an instructor, are structured, and require payment while unorganised activities, in comparison, are more often practiced in a free-pay manner and without a coach or instructor (Bengoechea et al. 2010). Parents also reported if they were ever engaged in an organised sport during childhood and/or young adulthood.

2.2.9. Parents' nutritional status

Mothers and fathers self-reported their weight and height, which were used to calculate BMI (BMI=kg/m^2). Values were classified into thinness, normal weight, overweight, and obese, according to the WHO references (WHO 2016b).

2.2.10. Parents' opinions about sport

Parents' opinions about sport and PA were observed using a 5-point scale between 1 (completely disagree) and 5 (completely agree). Two additional 5-point scale were presented, the first for parents whose children were engaged in an extracurricular sport and the second for parents with children not engaged in any extracurricular sport. Cronbach's alpha was used to identify problematic items in each of the three scales. Items with small loadings were eliminated. First scale (for all parents) originally had 35 items but 12 were deleted. In the end, Cronbach's alpha value was 0.79, mean value 40.64 (±8.55). Second scale (children engaged in extracurricular sport) passed from 19 to seven items, Cronbach's alpha value was 0.74, with a mean value of 23.54 (±4.33). Third and last scale (for children not engage in sport) ended with nine items and had a Cronbach's alpha equal to 0.75 and a mean value of 13.48 (±4.42). An Exploratory Factor Analysis (EFA) using the principal component analysis method was conducted to examine the internal structure of the scales. Using the eigenvalue greater than 1 criterion, the scale generated four factors that accounted for 62.29% of the variance (KMO=0.71), two factors emerged for the "play sport scale" (59.71%, KMO=0.78), and three factors arose in the last scale and accounted for 62.93% of the variance in scores (KMO=0.71). Through the examination of the scree plot, amount of variance accounted for each factor, the

loading of each item onto the first factor, and the high correlations among the factors, three factors were adopted regarding the first scale, which accounted for 51.46% of the variance in scores. Items for the three exploratory analysis can be seen in the Tables below.

Table 2.2.10.1. Items for the first EFA, related with the general scale.

Item		Factor
14	I think sport is a manly activity.	1
16	There are more sports for boys than for girls.	1
24	Social norms exert more pressure among boys than girls to be active and play sports.	1
27	I believe that girls who play sports are more “masculine” than girls who do not do sports.	1
29	There are sport exclusively for girls.	1
31	There are sport exclusively for boys.	1
32	I think sports are more important for boys than for girls.	1
3	I believe my son/daughter has to much weight for its age.	2
4	My child is not interest in doing sport.	2
6	My child does not like outdoor activities.	2
9	My child does not like group activities.	2
17	My child wanted to play a sport that does not exist in our neighbourhood.	2
18	My child prefer to play with electronic devices or watch TV than engage in active plays.	2
19	My child wanted to play a sport that is too expensive.	2
2	I can not think of activities to suggest to my child.	3
8	I do not have time to take my child to the parks or playgrounds.	3
12	I believe it is more useful for my child to engage in other extracurricular activities not sport-related (e.g. theatre, music, foreign languages).	3
13	I think my child does not need extra physical activities besides physical education classes.	3
20	My child does not have time for extracurricular activities.	3
23	I believe that sport’s biggest benefit is the aesthetic one.	3
10	My child does not have friends to play with outside of school.	4
22	My child has little or no sport skills.	4
28	I am afraid to let my child play in the street/open spaces close to home.	4

First EFA, grouped the items in three factors, the first related with gender stereotypes in sport, the second with sports and recreational facilities accessible to children, and the third with children's and parents' lack of time to engage in sports and be active. Second EFA, revealed two factors grouped in benefits in practicing sport and parental motivation for sport participation. The three factors that resulted from the third EFA grouped items as lack of will to be active, health problems, and lack of recreational facilities/sports.

Parents were asked what they thought of their children's sedentary time, physical activity in and out of school. Possible answers were: "little time", "normal amount of time", and "excessive time". Parents were asked how important it was for them that their child were physically active and the answers varied from "Important" to "Very important".

Table 2.2.10.2. Items for the second EFA, related with the "children engaged in sport" scale.

Item		Factors
12	My life changed for better since my child started to play a sport.	1
13	My child is a better person since he/she started to play a sport.	1
14	I spend more time being active since my child plays a sport.	1
15	My child achieve better academic results since he/she engaged in a sport.	1
16	I am proud in my child's sport exhibitions.	2
18	I often tell my child that I am proud of his/her sport performances.	2
19	My child has potential and can develop a sport-related career.	2

Table 2.2.10.3. Items for the third EFA, related with the "children not engaged in sport" scale.

Item		Factors
5	My child already spends a great amount of time in active plays and do not need any more physical activities.	1
10	I wanted my child to play a sport but he/she does not want it.	1
15	My son/daughter does not like sports.	1
2	I do not see any benefit for my child to engage in sport.	2
4	My child has difficulties in making new friends.	2
7	My child has health problems and can not play sports.	2
11	My child feels sick when he/she engages in physical activities.	2
1	I can not find a place that offers the sport my child wants to play.	3
3	I can not find any club/association with the sport I want my child to play.	3

2.2.11. Parents' perceived physical and social barriers for children's sport participation

Parents reported if lack of time, lack of money, lack of places nearby, lack of child interest, and lack of child's health were barriers to the practice of sport. Lack of places nearby resulted from three different variables that were used as a single barrier in the final analyses (location/transportation to infrastructures, infrastructures are non-existent in the neighbourhood, and safety).

Barriers were reported by parents were classified by number: none, one or two barriers, three or more barriers. In addition, parents reported what kind of recreational infrastructures exist close to home (e.g., playgrounds, parks, football field, swimming pool, gymnasium, pavilion, large open spaces, and others).

2.3. Children's semi-structured interview

Semi-structured interviews were conducted to identify children's perceived barriers and opinions about sport and PA. A general interview guide (Appendix 3) was adopted ensuring that the same areas of information were collected from each interviewee but at the same time there was a degree of freedom and adaptability in getting the information since our target were young children. An initial presentation intended to make participants feel more at ease with the interviewer while at the same time the importance of honest, individual answers was stressed.

Participants were informed that they could withdraw from the interview at any stage and were assured that they were not required to respond to each question. Children were provided with a definition and examples of sport. Also, language was adapted to children's age, to ensure that children were aware of the meaning of the question. The interview usually stayed on task, but children would sometimes go off on a tangent. The investigator then focused the group on the question to bring them back on track. At the same time, the children were free to talk about the sports in which they were engaged.

The interviews were made during class time and lasted around 15-to-20 minutes. The school provided a quiet place (e.g., an empty classroom or a laboratory) and the interviews

were conducted by the author to avoid inter-errors. Participants were randomly selected by the teacher based on students who had consented to be in the study. The children were interviewed in pairs, usually of the same sex, as an attempt to ensure that each child was interviewed with a classmate. Students were asked to sit a few feet from each other on the chairs and to avoid parallel conversations or other disruptive behaviours.

Using the socio-ecological model as theoretical framework, a number of questions were developed to prompt information about intrapersonal, social, physical and organizational environment influences. The instrument was adapted from previous works (Brustad 1993; Dias et al. 2015; Harter 1982; Norman, Sallis, and Gaskins 2005), and translated to Portuguese. Children's answers were recorded in paper (one for each child) that were annexed to their respective parents' questionnaire. Variables assessed through the semi-structured interview and used in the study are described below.

2.3.1. Children's perceived barriers and motivators for PA and sport participation

During the interview children reported perceived barriers and motivators for the practice of PA and sport. The instrument evaluated 16 barriers, which were then divided into four themes as presented in previous works (Dias et al. 2015; Marques, Peralta, et al. 2016), namely: (1) psychological, cognitive, and emotional barriers (sport is more important for boys than girls, boys are better at sport than girls, there are sports exclusively for boys, there are sports exclusively for girls, you are good at sports, you like sports, you are interest in making a career in sport, and family tells you to be active), (2) personal organization barriers (you have time to run, jump, ride bicycle, etc. in most days after school, and you have time to go to the parks or playgrounds), (3) cultural and social barriers (you watch women's sport on TV, family is active with you on weekdays, family is active with you on weekends, and friends engage in PA with you during recess), and (4) physical environment barriers (you have places where you can be active during winter and rainy days, and you have spaces at home or nearby where you can be physically active). Children's answers were divided into disagree and agree. When children answered "I do not know" or "I have no opinion", their answers were not taken in consideration for the statistical analyses.

2.3.2. Children's favourite sport

Children reported their favourite sport (to watch or practice). The sports mentioned were divided into masculine, feminine, and neutral, according to the categories of Metheny adapted by Riemer and Visio (Metheny 1965; Riemer and Visio 2003). Masculine sports included football, rugby, martial arts, feminine sports were gymnastics, dance, and volley, while swimming, bicycling, basketball, and running were considered neutral.

2.4. Anthropometric measurements

Three measures – weight, height, and waist circumference (WC) - were recorded in 793 children by the author of the thesis and a small group of well-trained investigators. Children's weight (kg) was measured using digital scales (Seca, United Kingdom, Birmingham, England) and registered with accuracy of 100 grams. Height (cm) was measured with stadiometer (Seca, United Kingdom, Birmingham, England), registered with 5mm accuracy. Height and weight were measured with participants dressed in lightweight clothing and without shoes. Waist circumference (WC) was measured at the mid point between the lowest rib and the iliac crest to the nearest 0.1 cm after inhalation and exhalation. WC was measured using a tape with 5mm accuracy (Seca, United Kingdom, Birmingham, England).

2.4.1. Assessment of childhood overweight and obesity

Using height and weight, Body Mass Index (BMI) was calculated with the formula: BMI=kg/m^2. Overweight and obesity were assessed using BMI z-score based on WHO's methodology (de Onis et al. 2009). BMI z-score is a BMI transformed into gender – and age-specific values in order to access children's nutritional status. The process is standardized for gender and age, and is calculated using WHO reference population. For the purpose of some tests BMI z-score was used both as continuous variable and categorized into groups following WHO's cut-offs: Severe thinness: < -3SD; Thinness: < -2SD; Overweight: > +1SD (equivalent to BMI 25kg/m^2 at 19 years); and Obesity: > +2SD (equivalent to BMI 30kg/m^2 at 19 years) (WHO 2016b).

Apart from the WHO methodology, the International Obesity Task Force (IOTF) (Cole and Lobstein 2012) was also used to defined children's nutritional status. The WHO definition has been shown to be the most accurate and sensitive for classifying obesity in Portuguese children (Lopes 2012). However, the IOTF cut-offs are the most widely used classification system in international and national settings.

In some statistical analysis the children were classified into two weight status groups, normal weight versus overweight (including obese). Although BMI is a good measure of children's obesity it is limited to give an approximation of the total adiposity in the body. The use of other complementary obesity measures can overcome this problem, as it gives a better approximation of overweight and obesity in children.

2.4.2. Assessment of children's abdominal obesity

WC can be defined as an excessive accumulation fat around the organs inside the abdominal cavity. It can also be a good indicator of abdominal fat reported in the development of cardiovascular risk factors (Savva et al. 2000). Recently, waist-to-height ratio (WHtR) has emerged as a good predictor for abdominal obesity and cardiovascular risk factors (Savva et al. 2000). This measure is very simple to use, and it can be applied to both boys and girls and at any age. The formula is calculated dividing waist circumference by the height (both given in cm) and uses a cut-off point of WHtR=0.5 (Savva et al. 2000). Previous studies have shown that values equal and above that cut-off defines an increased risk for cardiovascular diseases and diabetes in both adults and paediatric populations (Browning, Hsieh & Ashwell, 2010).

2.5. Statistical analysis

To compare place of residence (urban vs. non-urban), most of the tests were performed after splitting the file in Coimbra and Lousã. Some of the tests were also performed separately for each sex. All statistical analyses were performed using the Statistical Package for the Social Sciences (SPSS v.23; an IBM Company, Chicago, IL) and a p-level of 0.05 was considered significant. Potential collinearity was assessed amongst significant predictor variables using the

estimated individual variance inflation factor (VIF>10) and tolerance for each predictor (<0.1). Table below shows the statistical tests used in each chapter.

Table 2.5.1. Statistical procedures used in each chapter.

Analyses	Chapter 3	Chapter 4	Chapter 5	Chapter 6	Chapter 7	Chapter 8	Chapter 9
Pearson correlations/X^2-test	X	X	X	X	X	X	X
Student T-test		X		X		X	X
Exploratory Factor Analysis				X			
Univariate logistic regression			X	X	X		X
Multiple logistic regression			X	X	X		X
Kappa coefficient						X	

Chapter 3. Socio-demographic characteristics of the sample

3.1. Geographic distribution

A total number of 1369 questionnaires were distributed and 834 were returned completely filled and with the signed parental consent forms (60.9%) (see Table 3.1.1). In the end, 105 questionnaires were not included in this work because they were not attached to the consent form and it was impossible to identify which children to include in the following procedures (interview and anthropometric measures). Also, parents who reported that their child had a health condition that would hinder their participation in sport activities were not included further in the analysis.

In the urban setting, the participation rate was 60.27% (by school: 81.22% in Montes Claros, 44.5% in João Deus 1, and 53.45% in Solum Sul). A total of 634 questionnaires were delivered in the non-urban setting and 391 received, fulfilled and with the consent form, with a participation rate of 61.67% (by school: 57.79% in Santa Rita, 49.47% in EB1, and 71.72% in EB2). There was no significant difference in response rate between the two settings (p=0.45).

Table 3.1.1. Frequency of parental questionnaires, interviews of the children and anthropometric measurements by school and area of residence.

Area	School	Total by Schools	Parental questionnaires		Interviews of the children		Children's measures	
			N	% of the sample	N	% of the sample	N	% of the sample
Urban	Montes Claros	245	199	23.9	188	23.7	188	23.7
	João de Deus 1	200	89	10.7	89	11.2	89	11.2
	Solum Sul	290	155	18.6	145	18.3	145	18.3
	Total urban	735	443	53.2	422	53.2	422	53.2
Non-urban	Santa Rita	154	89	10.7	88	11.1	88	11.1
	EB1	190	94	11.3	89	11.2	89	11.2
	EB2	290	208	24.9	194	24.5	194	24.5
	Total non-urban	634	391	46.8	371	46.8	371	46.8
Total sample		1369	834	100	793	100	793	100

Interviews were carried in 793 children (422 in Coimbra and 371 in Lousã) (see Table 3.1.1). Differences between the number of parental questionnaires (n=834) and the number of interviews can be explained by a number of reasons like children were not in the city/country when the interview took place, children were sick or not feeling well, or children refused to responded to the questions or participate at all.

3.2. Demographic characteristics of the sample

The sample consists of 424 girls (50.8%) and 410 boys (49.2%). There was no significant difference between the two settings, according to children's sex (p=0.48). The mean age was 8.05 years old ±1.21, with the younger children having 6 years old and the oldest 10. The mean age of children living in the non-urban setting was lower compared with children from the urban place (7.94±1.20 and 8.14±1.21, respectively, p=0.01). Most children had one sibling (52.9%) or none (31.6%), with no significant differences between the two places (Table 3.2.1).

Table 3.2.1. Socio-demographic characteristics of the children by place of residence.

Characteristics		Total		Urban		Non-urban		p-value
		N	%	N	%	N	%	
Sex	Girls	424	50.8	231	27.7	193	23.1	0.48
	Boys	410	49.2	212	25.4	198	23.7	
Age (years)	6	185	22.1	98	11.8	87	10.4	0.01
	7	242	29.0	123	14.7	119	14.3	
	8	191	22.9	98	11.8	93	11.2	
	9	160	19.2	83	10.0	77	9.2	
	10	56	6.7	41	4.9	15	1.8	
Siblings	0 (none)	263	31.6	129	15.5	134	16.1	0.49
	1	440	52.9	251	30.2	189	22.7	
	2 or more	128	15.8	62	7.4	66	8.0	

More than half of the mothers (54.5%) and 41.7% of the fathers had higher education and the differences between places were statistical significant both for mothers (p<0.001) and fathers (p<0.001). Higher education was the most common educational level in mothers from living in the urban (68.9%%) and in the non-urban setting (38.2%). Higher education was also the most common educational degree in fathers living in the urban place (60.1%) while low

education (less than 10 years) was the most common in non-urban fathers (43.6%) (Table 3.2.2). Majority of the families had a monthly income higher than €1500 per month (44.2%). Statistically significant differences were found between both places (p<0.001), with higher incomes being more frequent in urban families (59.4% reported >€1500) than in non-urban ones (42.2% reported <€1000 per month) (Table 3.2.2).

Table 3.2.2. Socio-demographic characteristics of the parents by place of residence.

Characteristics		Total		Urban		Non-urban		p-value
		N	%	N	%	N	%	
Mother's education	Low	149	18.3	44	10.1	105	27.6	<0.001
	Middle	221	27.1	91	21.0	130	34.2	
	High	444	54.5	299	68.9	145	38.2	
Father's education	Low	240	30.1	79	18.4	161	43.6	<0.001
	Middle	225	28.2	92	21.4	133	36.0	
	High	333	41.7	258	60.1	75	20.3	
Monthly income	<€1000	234	29.7	77	18.5	157	42.2	<0.001
	€1000-€1500	206	26.1	92	22.1	114	30.6	
	>€1500	348	44.2	247	59.4	101	27.2	

The present sample managed to gather data from various socioeconomic status and different residential areas. Moreover, according to the latest data, there was a total number of 5992 children matriculated in the 1st-4th grade in 2015, 5296 children in Coimbra and 696 in Lousã (Pordata 2016a), of whom 1369 were contacted to participate in this study, accounting for around 23% of the total population. Further, the study included 834 children, which is 14% of all the targeted population, making it representative for the population of children within this age span living in the area.

Chapter 4. Physical activity behaviours in children

4.1. Introduction

Regular physical activity (PA) in childhood is important for promoting lifelong health and well-being and preventing various health conditions (Janssen and Leblanc 2010). PA is a complex behaviour since it can vary within a range of dimensions (e.g., type of activity, duration, frequency of sessions). PA in children may be acquired by a number of ways, such as physical education (PE) classes, active commute, active plays in and outside school hours, and sport participation. It is generally accepted that children around the globe are failing to meet the WHO guidelines of at least 60 minutes per day of moderate-to-vigorous PA (MVPA) (WHO 2010) but previous studies have reported inconsistent results with respect to the proportion of children complying with the referred guidelines, ranging from 5% to 97% (Crespo et al. 2013; Laguna et al. 2013; Riddoch et al. 2004). In Portugal, the findings have also been inconsistent. In two studies using accelerometers, one found that 36% of the Portuguese children aged 10-11 years old were considered sufficiently active (60 min/day of MVPA) (Baptista et al. 2012) while the other reported that only 3.1% of children (aged 9-11) met the recommended daily 60 min a day for all seven days of the week and 17.5% failed to meet the recommendation on any of the seven days (Borges et al. 2015).

On the other side, sex differences in PA are reasonably consistent across cultures and are independent of research design (cross-sectional or longitudinal) and methods of assessing PA (self-report, accelerometry) (Van Hecke et al. 2016). A large pooled investigation of European children aged between 4-18-years indicates that girls perform on average around 17% less total daily PA (Ekelund et al. 2012). Similarly, in a representative sample of 9-15-year-old American children, boys were more active than girls, spending 18 and 14 more minutes per day in MVPA on the weekdays and weekends, respectively (Nader et al. 2008).

At the same time, the proportion of children and adolescents who walk or cycle to school is declining dramatically (Beck and Greenspan 2008; Loureiro and Matos 2014). A study carried among Australian children (aged 5-9) found that the percentage of children that walked to school decreased from 57.7% to 25.5% in 1971 and 1999-2003, respectively (van der Ploeg et al. 2008). The same negative trend was seen in 11-13-year-old children from Canada (Buliung, Mitra, and Faulkner 2009) and 6-14-year-old Swiss children (Grize et al. 2010).

Decreasing PE programmes in schools, pressure from the school curriculum to reduce time spent in free play, and limited availability of game equipment during recess has been noted worldwide (Lopes et al. 2006; McKenzie et al. 2000; Nader and NICHHD 2003; Verstraete et al. 2006).

A large amount of children's PA occurs in organised, extracurricular sports clubs, and depending on participation frequency, extracurricular sport is a viable strategy to increase overall health and may contribute to international guidelines concordance (Hebert et al. 2015). Participation in school sports reached 85% in Portuguese children and adolescents (Mota et al. 2016) and data shows an increase of sport participation in clubs, with an increase of 66% for girls and 35% for boys under 16 years, registered in sport federations (Silva et al. 2007).

Urbanization has the potential to affect PA (Joens-matre et al. 2008; Lopez and Hynes 2006) however, data relating the level of urbanization to children's PA varied within and among countries and regions. In Portugal, studies regarding urban and non-urban children's PA are limited and the existing ones have focused mainly among adolescents (Coelho e Silva et al. 2003; Aristides M. Machado-Rodrigues et al. 2014). The purpose of this study was to compare PA behaviours (participation in PE, active commute, active play, and extracurricular sport) of Portuguese children (aged 6-10-years) living in an urban and in a non-urban setting.

4.2. Methods

Using a questionnaire, 834 parents reported their children's PA behaviours, including PE participation (minutes per week), way of commute (active or passive), extracurricular sport participation (Yes/No, frequency, minutes per week, and type of sport), and active play (minutes per week). Full study design is given in chapter 2, Methodology.

Descriptive analysis and prevalence of the different PA behaviours were calculated for the total sample as well as according to children's sex and the level of urbanization. The chi-square test and the T-test for independent sample were used for categorical and continuous dependent variables, respectively, to measure the significance of the differences between the groups. SPSS v.23 statistics software was used to process data and to perform statistical analyses and a p-value <0.05 was considered significant.

4.3. Results

Descriptive statistics and significance of the differences in PA behaviours according to children's sex are summarized in Table 4.3.1. Majority of children were commuting in a passive way to school and only 20.8% were traveling by walking of bicycling. In contrast, 67.7% of the children were engaged in an extracurricular sport, particularly during the weekdays. The mean time per week spent practicing a sport was approximately 102 minutes (81 min on weekdays and 20.61 on weekends). Majority of children engaged in sports 1-2 times per week (41.1%) and 26.6% practiced organised sports three or more times per week. Parents reported that, on average, their children had close to 90 minutes of PE per week, and engaged in approximately 693 minutes of active plays per week.

Table 4.3.1. Descriptive statistics and results of X^2 and independent T-tests testing the effect of children's sex on active commute, extracurricular sport participation, PE, and active play.

		Total (n=834)	Girls (n=424)	Boys (n=410)	
		% (n)	% (n)	% (n)	p-value
Commute actively		20.8 (173)	21.3 (90)	20.2 (83)	0.71
Participate in a sport		67.7 (565)	67.2 (285)	68.3 (280)	0.78
Frequency	0 times	32.3 (269)	32.8 (139)	32.0 (130)	
(week)	1-2 times	41.1 (343)	40.6 (172)	41.5 (171)	0.96
	≥3 times	26.6 (222)	26.7 (113)	26.6 (109)	
		Mean (SD)	Mean (SD)	Mean (SD)	p-value
Sport (min/weekdays)		81.09 (35.68)	80.01 (107.15)	82.22 (84.36)	0.74
Sport (min/weekend)		20.61 (40.16)	21.63 (41.62)	19.55 (38.62)	0.46
Sport (min/all week)		101.89 (116.44)	101.64 (129.34)	102.15 (101.56)	0.95
PE (min/week)		92.60 (35.68)	92.75 (36.63)	92.45 (34.72)	0.90
Active play (min/week)		693.55 (496.61)	648.28 (463.31)	739.85 (525.07)	0.01

More girls than boys were commuting in an active way (walking or bicycling) to and from school (21.3% and 20.2%, respectively), but the differences were not statistically significant (p=0.71). Sport participation rates were similar between boys (68.3%) and girls (67.4%) (p=0.78). There was no significant difference between girls and boys and the frequency of sport participation, with majority of girls and boys engaging in 1-to-2 times per week (40.6%

and 41.5%, respectively) (p=0.96). The minutes, both on weekdays and weekends, that boys and girls spent engaged in extracurricular sports were similar and no significant differences were found according to sex (p=0.74, p=0.46, and p=0.95, for weekdays, weekends, and all days, respectively). Nevertheless, slightly more minutes of sport participation on weekdays and in total were reported by parents of boys (82.22 min and 102.15 min, respectively) than by parents of girls (80.01 min and 101.64 min). On the other side, girls seem to engage in slightly more minutes of extracurricular sport during weekend compared to boys (21.63 min and 19.55 min). Minutes per week in PE was similar in boys (92.45 min) and girls (92.75 min) (p=0.90). Parents with sons reported that their children engaged in active plays longer than parents with daughters (739.85 and 648.28 min/week, respectively) and that difference was statistical significant (t=2.69, p=0.01) (Table 4.3.1).

Descriptive statistics by area of residence are shown in Table 4.3.2. Less urban girls (10.0%), compared with non-urban girls (34.9%), engaged in active commuting (X^2=38.93, p<0.001). The proportion of urban and non-urban girls participating in an extracurricular sport was similar (p=0.26) but the minutes spent in that activity, both during weekdays (t=21.74, p<0.001) and across all days (t=17.18, p=0.00), was higher in urban girls than in non-urban ones. No significant differences were found between urban and non-urban girls, regarding the time spent engaged in sport during the weekend (p=0.47). Most girls, independently of the place of residence, engaged in sports 1-2 times per week (urban: 37.2%; non-urban: 44.6%) but significantly more girls living in the urban setting (32.5%) than in the non-urban (19.7%) reported to practice sport three or more times per week (X^2=8.79, p=0.01). Similar results were also found in the time spent by urban girls (659.05 min) and non-urban girls (635.27 min) in active plays (p=0.61). Parents with daughters from the non-urban setting, reported longer or more frequent PE classes per week, compared with their urban counterparts (non-urban: 102.45 min/week and urban: 84.65 min/week; t=0.12; p<0.001).

Non-urban boys (28.8%) adopted more active commute than their urban peers (12.3%) (X^2=17.31, p<0.001). No statistically significant differences were found in the rates of extracurricular sport participation in urban (67.9%) and non-urban boys (68.7%) (p=0.87). No significant differences were also found in the duration of sport participation, either on weekdays, weekends, and across all days (p=0.62, p=0.09, and p=0.33, respectively), with slightly more minutes of sport participation being found in non-urban boys (weekdays: 84.34 min, weekends: 22.94 min, all week: 107.28 min) than in urban ones (weekdays: 80.24 min,

weekends: 16.39, all week: 97.38 min). The number of times engaged in extracurricular sport was similar between boys living in the urban and in the non-urban setting, with most practicing sport 1-2 times per week (43.9% and 38.9%, respectively) (p=0.43). Non-urban boys spent significantly more time in PE classes, compared with their urban peers (102.12 and 83.42 min/week, respectively) (t=0.50, p<0.001). Parents of non-urban boys reported that their children spent on average 760 min/week, which was slightly higher than the time reported by urban parents (719.85 min/week), but the difference was not statistical significant (p=0.44). Differences between places were more visible in girls (transportation, frequency and minutes per week of sport participation, duration of PE) than in boys (transportation and duration of PE).

Table 4.3.2. Descriptive statistics and results of X^2 and independent T-test testing the effect of the level of urbanization on active commute, extracurricular sport participation, PE, and active play, in boys and girls.

		Girls			Boys		
		Urban	Non-urban		Urban	Non-urban	
		% (n)	% (n)	p	% (n)	% (n)	p
Commute actively		10.0 (23)	34.9 (67)	<0.001	12.3 (26)	28.8 (57)	<0.001
Participate in a sport		69.7 (161)	64.2 (124)	0.26	67.9 (144)	68.7 (136)	0.87
Frequency	0 times	30.3 (70)	35.8 (69)		32.1 (68)	31.8 (63)	
(week)	1-2 times	37.2 (86)	44.6 (86)	0.01	43.9 (93)	38.9 (77)	0.43
	≥3 times	32.5 (75)	19.7 (38)		24.1 (51)	29.3 (58)	
		Mean (SD)	Mean (SD)	p	Mean (SD)	Mean (SD)	p
Sport (min/weekdays)		97.86 (130.45)	58.54 (63.45)	<0.001	80.24 (83.94)	84.34 (84.98)	0.62
Sport (min/weekend)		20.30 (43.38)	23.23 (39.46)	0.47	16.39 (35.73)	22.94 (41.33)	0.09
Sport (min/all week)		118.16 (154.81)	81.77 (85.85)	0.00	97.38 (101.40)	107.28 (101.75)	0.33
PE (min/week)		84.65 (35.86)	102.45 (35.25)	<0.001	83.42 (29.91)	102.12 (36.92)	<0.001
Active play (min/week)		659.05 (462.09)	635.27 (465.72)	0.61	719.85 (523.26)	760.57 (527.49)	0.44

Table 4.3.3. shows the type of sports in which the children were engaged, according to their sex. In general, boys and girls practiced different extracurricular sports (X^2=230.79, p<0.001; data not shown), with swimming being the most popular sport among girls (27.0%) followed by dancing (19.4%) while in boys swimming (22.7%) and football (21.5%) were the most preferred. No girls were engaged in rugby and tennis, and in boys, the lowest participation rates were seen in volleyball (0.7%) and in dancing (1.5%). Similar proportion of boys and girls were found in swimming (p=0.65), volleyball (p=0.67), and in the "other" category (p=0.73). Girls, compared to boys, participated more in dance classes (19.4% vs. 1.2%) and in gymnastic (14.4% vs. 2.4%) (p=0.02 and p=0.01, respectively). A higher percentage of boys than girls were engaged in football (21.5% vs. 0.7%; p<0.001), tennis (1.7% vs. 0.0%; p=0.04), martial arts (7.1% vs. 2.8%; p=0.04), basketball (3.9% vs. 0.9%; p<0.05), and rugby (4.9% vs. 0.0%; p=0.04) (Table 4.3.3).

Table 4.3.3. Descriptive statistics and results of X^2 testing the effect of children's sex on the type of extracurricular sport.

	Girls (n=424)	Boys (n=410)	
	% (n)	% (n)	p-value
No sport	32.6 (138)	31.8 (130)	0.70
Swimming	27.0 (114)	22.7 (93)	0.65
Dancing	19.4 (82)	1.2 (5)	0.02
Football	0.7 (3)	21.5 (88)	<0.001
Gymnastic	14.4 (61)	2.4 (10)	0.01
Tennis	0.0 (0)	1.7 (7)	0.04
Martial arts	2.8 (12)	7.1 (29)	0.04
Basketball	0.9 (4)	3.9 (16)	<0.05
Rugby	0.0 (0)	4.9 (20)	0.04
Volleyball	1.4 (6)	0.7 (3)	0.67
Others	0.7 (3)	2.0 (8)	0.73

Note. The group "Others" include sports that had less than 5 participants, namely: golf, yoga, roller skate, hockey, table tennis, and handball.

Overall, urban and non-urban girls and boys differed in the type of extracurricular sports (X^2=26.06, p=0.00 and X^2=26.58, p<0.001, respectively; data not shown). More urban

girls, compared with their non-urban counterparts, were engaged in gymnastics (20.3% vs. 7.3%, p=0.04) and in martial arts (4.3% vs. 1.0%, p=0.04). On the other side, 3.1% of the non-urban girls were engaged in volleyball while no urban girls were taken that sport (p=0.03). Similar rates of participation between girls of both places were seen in swimming, dancing, football and basketball and no girls, independently of the place of residence, were engaged in rugby and tennis (Table 4.3.4).

Significantly more non-urban boys, compared with urban ones, were engaged in dancing (2.5% vs. 0.0%, p<0.05) and in rugby (7.6% vs. 2.4%, p=0.03), while the inverse was seen in martial arts (9.9% of urban boys and 4.1% of non-urban boys, p=0.04) and in the "others" category (urban: 3.3%, non-urban: 0.5%, p=0.04) (Table 4.3.4). No statistically significant differences were found in the proportion of urban and non-urban boys performing football (p=0.98), swimming (p=0.94), gymnastics (p=0.97), tennis (p=0.78), basketball (p=0.68), or volleyball (p=0.62).

Table 4.3.4. Descriptive statistics and results of X^2 testing the effect of the level of urbanization on the type of extracurricular sport performed by boys and girls.

	Girls			Boys		
	Urban	Non-urban		Urban	Non-urban	
	% (n)	% (n)	p	% (n)	% (n)	p
No sport	30.3 (70)	35.4 (68)	0.90	32.1 (68)	31.5 (62)	0.91
Swimming	25.1 (58)	29.2 (56)	0.87	23.1 (49)	22.3 (44)	0.94
Dancing	18.2 (42)	20.8 (40)	0.91	0.0 (0)	2.5 (5)	<0.05
Football	0.9 (2)	0.5 (1)	0.98	21.2 (45)	21.8 (43)	0.98
Gymnastic	20.3 (47)	7.3 (14)	0.04	2.8 (6)	2.0 (4)	0.97
Tennis	-	-	-	2.4 (5)	1.0 (2)	0.78
Martial arts	4.3 (10)	1.0 (2)	0.04	9.9 (21)	4.1 (8)	0.04
Basketball	0.4 (1)	1.6 (3)	0.79	2.8 (6)	5.1 (10)	0.68
Rugby	-	-	-	2.4 (5)	7.6 (15)	0.03
Volleyball	0.0 (0)	3.1 (6)	0.03	0.0 (0)	1.5 (3)	0.62
Others	0.4 (1)	1.0 (2)	0.96	3.3 (7)	0.5 (1)	0.04

Note. The group "Others" include sports that had less than 5 participants, namely: golf, yoga, roller skate, hockey, table tennis, and handball; - means that no girl practiced that sport.

4.4. Discussion

The present study observed the PA behaviours in 6-10-year-old children and found that, although boys tend to engaged in more extracurricular sport and spend more time in it compared to girls, particularly on weekdays and across all days, only the time spent in active play was significantly higher in boys than in girls. Marques and colleagues (Marques, Peralta, et al. 2016) found that, before adjustment, 10-12-year-old girls were almost 50% less likely to participate in organised PA than boys. More Portuguese boys engaged in organised sport compared to girls have also been reported in a sample of 10-18-year-old children (51.3% vs. 28.3%) (Marques, Ekelund, and Luís B Sardinha 2016), and by Seabra et al. (Seabra et al. 2007) in a sample of 10-years (girls: 50.3%, boys: 70.0%) and 11-year-old (girls: 39.8%, boys: 67.7%). These observations are generally consistent with other studies reporting sex differences in PA and sport across the same age range in Portugal (Vasconcelos and Maia 2001), other European countries (Telama and Yang 2000), and in the United States (M. F. Hovell et al. 1999; Pate et al. 2000).

The sex difference in PA might reflect cultural values that encourage participation by males in sports and physical activities, from early in childhood through adolescence into adulthood. It is also possible that a consistent reward system associated with sport participation is more readily available for young males in many cultures (McKenzie et al. 1997). In this study, the different proportion of boys and girls playing an extracurricular sport was not statistically significant, which may be due to the presence of younger children in the present sample. It is known that the transition into and through adolescence, particularly in girls, emphasises the body image favouring linearity/slenderness and relative delicacy, which might not be consistent with the demands of regular participation in sport (Weinberg and Gould 1995). It may also be the case that girls are participating more in sport activities in the last years. Previous data from the same region, collected by questionnaire, may reflect this positive trend: in 2012 (Freitas 2012), 51.2% of the girls (aged 6-10-years) were engaged in organised sport, in 2013 (Pronto 2013), the participation rate was 56.8% for 3-11-year-old girls, and in this study, 67.4% for girls (6-11-years-old) practiced at least one organised sport. This positive trend may be due to more initiatives and campaigns to raise awareness for the importance of PA in many health outcomes, such as childhood obesity.

The significant difference between girls and boys in the reported time spent in active play (±648 min and ±739 min, respectively) is consistent with self-reported unstructured play in children under 12 years old living in Argentina, Brazil, China, France, Ireland, United Kingdom, the United States, and Portugal, where significantly more boys (63%) played outside or on a playground than girls (53%) (Singer et al. 2009). In Portugal, parents of 8-15-year-old children, were seen to give more independent mobility licence to boys, than girls, particularly during the weekends (Cordovil et al. 2015), facilitating outdoor time, which is positively associated with PA levels of children (Sallis et al. 2000). Boys being allowed with more freedom, compared to girls, including in the form of playing outdoor, has been consistently observed in other studies (Ferré, Guitart, and Ferret 2006; Lee et al. 2015; Tranter and Pawson 2001). This difference may indicate that equality of sexes is not entirely evident in daily life practices. In general, parents tend to encourage their children to participate in gender specific activities, which include boys playing sports and engaging in PA, while girls are more encouraged to participate in housekeeping activities (Witt 1997).

Similar participation rate in extracurricular sport was found between urban and non-urban girls and boys. In general, 66.7% (64.2% girls; 68.7% boys) and 68.8% (69.7% girls; 67.9% boys) of children living in the non-urban and in the urban setting, respectively, reported participating in a sport. Few studies have compared sport participation in Portuguese children according to the degree of urbanization, but looking at independent studies (and with different age ranges) a similar tendency may be observed. It seems that urban children either aged 10-12 (Marques, Peralta, et al. 2016) or 6-11-years-old (Freitas 2012) have higher rates of sport participation (60.6% and 60.7%, respectively), compared with 3-11-year-old children living in a non-urban setting (52.9%) (Pronto 2013). Curiously, statistically significant differences in the frequency of sport participation were only found between urban and non-urban girls, and not between boys. While the percentage of girls practicing sport 1-2 times per week was similar between settings (37.2% and 44.6%, in urban and non-urban areas respectively), significantly more urban girls (32.5%) than non-urban ones (19.7%) practiced sport three or more times per week.

Parents of urban girls reported that their daughters spent more time in extracurricular sports (on weekdays and across all days) than non-urban parents with daughters. A study from 2014 measured the MVPA of older children living in Portugal and observed that urban girls spent significantly less time in MVPA compared to rural girls (62.7 min/day vs. 57.9 min/day,

p=0.02) but no information is given about how that PA is achieved (e.g. organised sports) (Aristides M. Machado-Rodrigues et al. 2014). On the other side, a study carried in 11-13-year-old urban and rural Turkish children, observed that a higher proportion of urban girls, rather than rural, participated in team sports (e.g., football, volleyball, basketball), swimming, cycling, and in traditional games, like jump rope, and other touch games (Orhan 2015). Urban parents, often with higher monthly income, may have more opportunities to pay for their daughters to engage in extracurricular sports. Urban parents and children may also have a greater knowledge of the benefits of being physically active. Or it may be the case that non-urban girls have to spend more time helping their family in household chores, gardening or farming, having less time to engage in extra-school activities, including sport.

Interestingly, more differences were observed for PA behaviours by level of urbanization for girls, compared to boys. Moore and colleagues (J. B. Moore, Beets, and Kolbe 2014) found similar results with significant differences between the minutes/day of MVPA between urban and rural American girls but no differences associated with the level of urbanization for boys. Also in the United States, in a sample of 6-to 11-year-old children, rural girls were more likely to meet PA guidelines (five or more times per week to meet CDC recommendations) than urban girls of the same age (19.6% and 31.5%, respectively) while PA levels did not vary significantly by the level of urbanization among boys (Liu et al. 2012). These findings may indicate that although young boys are just as at risk as young girls, the perception of risk is different between the sexes.

Significantly more girls than boys were engaged in dancing classes (19.2% vs. 1.2%) and gymnastics (14.4% vs. 2.4%) as extracurricular activities, while the inverse was seen in football (0.7 vs 21.5%), rugby (0.0% vs. 4.9%), martial arts (2.8% vs. 7.1%), and basketball (0.9% vs. 3.9%). This tendency for girls to participate in sports usually classified as feminine or neutral and boys in masculine sports has been seen before (Riemer and Visio 2003). The authors referred above observed that children, starting in primary school, give many gendered responses in terms of what sport(s) girls and boys should participate in, sex-typing certain sports like aerobics and football. The most preferred sport among girls was swimming (27.0%), while football (21.5%) and swimming (22.7%) were the more preferred sports among boys. Identical results were found in two samples of Portuguese children and adolescents (10-18 and 15-18-years-old) (Coelho e Silva et al. 2003; Seabra et al. 2007). It has been suggested that girls prefer individual sports such as swimming and gymnastics in contrast to team sports with a

high proportion of body contact that are usually favoured by boys (Harrell et al. 2003; M. Hovell et al. 1999). Also, sports recognized as masculine often involve the use of force or heavy objects, devotion to a team, stamina, aggressiveness, and competitive spirit (Hardin and Greer 2009).

Urban and non-urban girls differ in the participation in volleyball, gymnastics, and martial arts, with higher proportion of the non-urban girls in the first sport and a significantly higher proportion of urban girls in gymnastics and martial arts. Among boys, dancing and rugby were significantly more played by non-urban, while martial arts and 'others' had a significantly higher proportion of urban than non-urban boys. Closer proximity to points of interests such as recreational facilities may promote participation in PA (McCormack, Giles-Corti, and Bulsara 2008). It can be intuitively assumed that children's extracurricular activities would varied according to their neighbourhood characteristics (e.g., existence of football field, running tracks), club offers, and family socioeconomic status (e.g., transportation, fees, equipment). For example, the non-urban setting analysed in this study have many sport activities and associations, but the most famous, even at a national level, are the *Rugby Club Lousã* and *Lousã Volley Club*. This can, in part, explain why these sports were most played by non-urban children rather than by their urban peers. In contrast, the urban setting observed in this study has two major clubs offering gymnastic lessons (*Associação Académica de Coimbra* and *Associação Cristã da Mocidade*), which may influence children's preference for this sport. Also, gymnastic and martial arts often involve specific equipment/clothes which may be a barrier for parents with lower incomes, which were significantly more present in the non-urban setting (see chapter 3).

The present data shows that non-urban girls and boys adopt significantly more active ways of commuting and reported more time in PE classes than their urban counterparts. A recent meta-analysis revealed that children accumulate more MVPA on weekdays than weekends days, particularly on school days, much due to PE classes and active travel (Brooke et al. 2014). Non-urban settings are often characterized by less traffic volume, which is an important factor for active commute. For instance, Year 5,6, and 7 children had more than three times the odds of walking to school if they attended school in high walkable neighbourhoods (i.e., high street connectivity and low traffic volume) compared with children from neighbourhoods with high traffic volume (Giles-Corti et al. 2011). Students (11-to 13-years-old) who are driven to school usually have higher-income families (Pojani and Boussauw

2014), which has seen in chapter 3, are more common in the urban than in the non-urban setting, and may help to explain the present findings. More time dedicated to PE may indicate that non-urban schools are involved and promoting more PA among their students or that urban schools may feel more pressured for their students to achieve better academic results, decreasing the curriculum time available for PE.

4.5. Conclusion

In summary, PA behaviours of Portuguese 6-10-year-old boys and girls were similar, apart from the time spent in active play, but area of residence was related to active commute, time in PE and participation in extracurricular sports. Curiously, there were more differences in PA behaviours according to the the level of urbanization in girls rather than in boys. In addition, the type of extracurricular sport practiced by the child varied according to sex and the level of urbanization, suggesting the influence of socially accepted role models and the importance of proximity to available infrastructures and sports. The present results highlighted a need for a better understanding of the details of daily life among children living in urban and non-urban settings. Nevertheless, interventions seeking to promote children's PA should consider the potential impact of socio-geographic factors in both boys and girls.

Chapter 5. Family characteristics and parents' PA as predictors of children's participation in extracurricular sport

5.1. Introduction

Participation in sports makes a substantial contribution to overall physical activity (PA) during childhood (Wickel and Eisenmann 2007) and has important benefits for physical, psychological, and social health (R. M. Eime et al. 2013; Janssen and Leblanc 2010). Although it seems that the number of children competing in sports at national and international levels continues to increase in several countries around the world, including Portugal (Mota et al., 2016; IPDJ, 2015; Hardy et al., 2010) it is important to understand the factors that may influence children's sport participation in order to maximize the public health.

Many studies have focused on the wide range of influences on participation in PA and sport. According to the Socio-Ecological model, these influences or determinants of participation can relate to intrapersonal, interpersonal, organisational, environmental, and policy factors (Mehtälä et al. 2014; Sallis and Owen 1999; Welk 1999). It has been suggested that a comprehensive approach, such as that offered by the socio-ecological model, is essential for examining the multiple level factors that might be determinants of sport participation (Welk 1999).

The family is considered the most important setting for shaping children's PA (Golan 2006). Many studies have found a positive association between family socio-economic status (SES), either measured by family income or parental education, and children's levels of PA and sport (Eime et al. 2015; Rochelle M Eime et al. 2013; Kamphuis et al. 2008; Muthuri et al. 2016; Vella et al. 2014). In Portugal, results have shown both a negatively association between parents' education and children's PA (aged 9-11 and 3-6-years-old) (Muthuri et al. 2016; Vale et al. 2014) and a positive one (within 7-18-year-old children) (Ferreira et al. 2007; Vella et al. 2014). Also in Portugal, children (aged 3-10 and 10-18-years) from low or medium SES were less likely to participate in organised sports activities compared with children from higher SES (Nogueira et al. 2013; Seabra et al. 2008). It is noteworthy that mothers' education level is more often examined and relationships consistently found in these papers (Butte et al. 2014; Ferreira et al. 2007; Zecevic et al. 2010). Different results may be due to definition of SES (e.g., education, income, household SES, neighbourhood SES), measurement of PA (e.g., objectively, self-reported), or the type of PA (e.g., MVPA, organised sport, active commute). For instance,

education may negatively predict children's PA and MVPA (Muthuri et al. 2016; Vale et al. 2014), but families with higher education and possibly higher incomes may positively predict children's participation in organised sport (Vella et al. 2014).

Parents may influence their children's PA and sport participation through a number of ways such as accompanying children to sports training and events, providing money and clothing for activity and encouraging PA (Bradley et al. 2011; Cleland et al. 2011; Jago et al. 2011; Pearson et al. 2009), co-participating in PA and sports with children (Cleland et al. 2011), and role-modelling of PA and sport by actually engaging in those activities (Bradley et al. 2011; Fuemmeler et al. 2011; Gustafson and Rhodes 2006; Pearson et al. 2009; Seabra et al. 2008). A study carried among 10-12-year-old children in seven European countries, observed that children with at least one parent practicing PA, had significantly higher odds of participating in ≥30 min/week of sport (Timperio et al. 2013). Another study observed that 12-year-old French students were more likely to participate in structured PA outside school when both parents practiced sport as compared to neither parent practicing it (Wagner et al. 2004). In Germany, 6-7-year-old children had two times the odds of practicing an organised sport if they had physically active parents (Kobel et al. 2015), reinforcing the notion that their PA behaviours are one of the strongest determinants of children's activity behaviours (Moore et al. 1991).

Some studies have highlighted a relationship of Portuguese childhood sport participation and parental PA, education, and socioeconomic-status (Nogueira et al. 2013; Seabra et al. 2008, 2011; Teixeira e Seabra, Mendonça, and Maia 2004). However, there is a lack of research addressing how those factors may differently predict sport participation in urban and non-urban children. The aim of the present study was to identify family and economic factors associated with children's extracurricular sport participation in Portuguese urban and non-urban settings.

5.2. Methods

Through a questionnaire, 834 parents reported their children's sport participation (Yes/No) as well as their own participation in regular PA. Parents were asked if they practiced PA regularly and which type of activities. Answers were categorised (separately for fathers and mothers) into three groups, namely: 'inactive', 'practice organised PA' and 'practice unorganised PA'.

Parents also reported if they were ever engaged in an organised sport during childhood or young adulthood (Yes/No). Family income was defined as low (<€1000), medium (between €1000 and €1500), and high (>1500). Parents education was divided in three groups: low (9 years of education or less), middle (10-12 years of education), and high (higher education). Number of siblings could be none (only child), one sibling, and two or more siblings.

Variables used as potential predictors of participation in extracurricular sports were mother's and father's PA, mother's and father's participation in organised sport when younger, mother's and father's education level, number of siblings, and family income. All data were analysed using IBM SPSS statistical software (version 23). Sample was divided according to the level of urbanization and children's sex. At the first stage all potential predictor variables were entered individually into an unadjusted binary logistic regression model (crude). Then, the same analysis was done adjusted for possible confounder variables (sex, age, income, and parents' education). Significance at this stage was set at $p<0.05$.

5.3. Results

Table 5.3.1 presents the results of the crude and adjusted analyses used to assess the significant family characteristics predictors of participation in extracurricular sports among children living in the urban and non-urban setting. Urban children from families with lower incomes had lower odds of participating in an extracurricular sport, both in the crude analysis (OR=0.14, $p<0.001$) and after adjustment (OR=0.13, $p<0.001$), than children from higher household incomes. Number of siblings did not predict sport participation in the urban setting, neither before nor after adjusting for children's sex, age, parents' education, and income. Urban children who participated in an extracurricular sport were less likely to have fathers with low education level, even after adjusting for sex, age, and income (OR=0.18, $p<0.001$), and have a mother with low (crude: OR=0.15, $p<0.001$; adjusted: OR=0.14, $p<0.001$) or middle education (crude: OR=0.30, $p<0.001$; adjusted: OR=0.30, $p<0.001$) (Table 5.3.1).

Table 5.3.1. Family characteristics predictors of participation in extracurricular sport in the urban and in the non-urban setting (crude and adjusted).

		Urban						
			Crude			Adjusted		
		n	OR	95%CI	p	AOR	95%CI	p
Family income	Low	77	0.14	0.08;0.24	<0.001	0.13	0.08;0.24	<0.001
	Medium	92	0.33	0.19;0.56	<0.001	0.33	0.19;0.56	<0.001
	High	247	Ref.			Ref.		
Siblings	None	129	1.50	0.80;2.82	0.21	1.53	0.81;2.90	0.21
	One	251	1.65	0.93;2.93	0.09	1.67	0.93;3.01	0.09
	2 or more	62	Ref.			Ref.		
Father education	Low	79	0.18	0.11;0.31	<0.001	0.18	0.10;0.38	<0.001
	Middle	92	0.68	0.40;1.17	0.16	0.68	0.35;1.20	0.16
	High	258	Ref.			Ref.		
Mother education	Low	44	0.15	0.08;0.29	<0.001	0.14	0.07;0.28	<0.001
	Middle	91	0.30	0.18;0.49	<0.001	0.30	0.18;0.49	<0.001
	High	299	Ref.			Ref.		
		Non-urban						
		n	OR	95% CI	p	AOR	95% CI	p
Family income	Low	157	0.17	0.09;0.32	<0.001	0.17	0.08;0.33	<0.001
	Medium	114	0.80	0.40;1.60	0.53	0.83	0.40;1.61	0.55
	High	101	Ref.			Ref.		
Siblings	None	134	2.62	1.42;4.84	0.00	2.40	1.40;4.81	0.00
	One	189	2.15	1.21;3.81	0.01	2.18	1.23;3.87	0.01
	2 or more	66	Ref.			Ref.		
Father education	Low	161	0.22	0.11;0.44	<0.001	0.22	0.11;0.43	<0.001
	Middle	133	0.56	0.27;1.15	0.11	0.55	0.27;1.15	0.11
	High	75	Ref.			Ref.		
Mother education	Low	105	0.09	0.05;0.17	<0.001	0.09	0.05;0.18	<0.001
	Middle	130	0.32	0.17;0.58	<0.001	0.32	0.17;0.58	<0.001
	High	145	Ref.			Ref.		

Note. Reference category: child do not participate in a sport; adjusted for children's sex, age, parents' education, and family income; OR=odds ratio; AOR=adjusted odds ratio; CI=confidence interval; $p<0.05$ was considered significant.

Non-urban children whose parents reported lower incomes had lower odds of being engaged in an extracurricular sport (OR=0.17 and AOR=0.17, p<0.001), compared with children with parents with higher income (Table 5.3.1). Non-urban children participating in extracurricular sport were less likely to live in houses where fathers had low education (OR=0.22, p<0.001) and mothers had low or middle education levels (OR=0.09, p<0.001 and OR=0.32, p<0.001, respectively). Single children or children with just one sibling had more than two times the odds of participating in an extracurricular sport (OR=2.40, p=0.00 and AOR=2.18, p=0.01) than children from bigger families (Table 5.3.1).

In crude analyses, urban children had approximately half the odds of being in a sport if they had an inactive father (OR=0.60, p<0.05) but the association was not significant in the adjusted analysis. Mother PA or the type of PA practiced by both the mother and the father was not a predictor of child sport participation in the urban setting. Still in urban children, sport participation was not predicted by fathers' participation in an organised sport when younger (OR=1.15, p=0.51; AOR=0.97, p=0.91). Urban children had lower odds of being in a sport (OR=0.64, p=0.04) if they had a mother who was never engaged in an organised sport but the association was not significant after adjusting for children's sex, age and SES indicators (Table 5.3.2).

Sport participation by non-urban children was less likely if the children had an inactive father (OR=0.47, p=0.00) but the association was weak after adjustment (AOR=0.55, p=0.06). Children living in the non-urban setting, with an inactive mother had half the odds of practicing an extracurricular sport than children with mothers practicing unorganised PA (OR=0.52, p=0.02; AOR=0.43, p=0.02). Before adjustment, the type of PA practiced by the mother was a predictor of sport participation in non-urban children (OR=2.59, p<0.05), meaning that children whose mothers reported to engage in organised PA in a regular way had 2.59 more times the odds of being in a sport when compared with children with mothers practicing only unorganised PA. No association was found between children's sport participation and PA behaviours of mother and father when younger (Table 5.3.2).

Table 5.3.2. Parents' physical activity predictor of participation in extracurricular sport in the urban and in the non-urban setting (crude and adjusted).

		Urban						
			Crude			Adjusted		
		n	OR	95%CI	P	AOR	95%CI	p
Father's PA	Inactive	210	0.60	0.36;0.99	<0.05	0.75	0.41;1.37	0.35
	Organised	108	1.69	0.89;3.22	0.11	1.46	0.70;3.04	0.31
	Unorganised	108	Ref.			Ref.		
Mother's PA	Inactive	259	0.72	0.43;1.22	0.22	0.73	0.39;1.36	0.32
	Organised	87	2.07	0.99;4.32	0.05	1.77	0.75;4.15	0.19
	Unorganised	88	Ref.			Ref.		
Father did sport	No	263	1.15	0.76;1.73	0.51	0.97	0.59;1.60	0.91
	Yes	178	Ref.			Ref.		
Mother did sport	No	266	0.64	0.42;0.97	0.04	0.72	0.43;1.20	0.21
	Yes	175	Ref.			Ref.		
		Non-urban						
		n	OR	95% CI	p	AOR	95% CI	p
Father's PA	Inactive	225	0.47	0.28;0.79	0.00	0.55	0.30;1.03	0.06
	Organised	40	1.79	0.68;4.77	0.24	1.04	0.35;3.06	0.94
	Unorganised	104	Ref.			Ref.		
Mother's PA	Inactive	238	0.52	0.30;0.90	0.02	0.43	0.22;0.87	0.02
	Organised	58	2.59	1.02;6.54	<0.05	1.50	0.52;4.34	0.46
	Unorganised	84	Ref.			Ref.		
Father did sport	No	263	0.86	0.56;1.32	0.49	0.94	0.56;1.58	0.81
	Yes	178	Ref.			Ref.		
Mother did sport	No	266	1.12	0.73;1.72	0.62	1.61	0.93;2.76	0.09
	Yes	175	Ref.			Ref.		

Note. Reference category: child do not participate in a sport; adjusted for children's sex, age, parents' education, and family income; OR=odds ratio; AOR=adjusted odds ratio; CI=confidence interval; p<0.05 was considered significant.

Table 5.3.3 shows family characteristics has predictors of sport participation by boys and girls. Girls had lower odds of practicing a sport if their family reported low (OR=0.16, p<0.001) or medium income (OR=0.46, p=0.01), if the father had low education (OR=0.24,

p<0.001), and if the mother had low or middle education (OR=0.12, p<0.001 and OR=0.36, p<0.001, respectively). On the other side, girls with one or no siblings had almost two times the probability of being in an extracurricular sport compared with girls that had two or more siblings (OR=1.81, p=0.04 and OR=1.99, p=0.03, respectively). After adjustment, results were similar and family income, the number of siblings and mother's education were associated with girls' participation in extracurricular sport (Table 5.3.3).

Among boys, coming from a low income family was associated with significantly lower odds of practicing a sport (OR=0.16, p<0.001), even after adjusting for confounder variables (AOR=0.28, p=0.00). Boys that were a single child (OR=2.02, p=0.03) or had only one sibling (OR=2.03, p=0.02) had more than 2 times the odds of practicing an extracurricular sport, compared with boys with two or more siblings. The association remained significant after adjustment (AOR=3.44, p=0.00 for single boys and AOR=2.12, p=0.04 for boys with one sibling). Having a mother with low education (OR=0.15, p<0.001; AOR=0.27, p=0.00) or a mother with middle education (OR=0.36, p<0.001; AOR=0.37, p=0.01) was associated with lower odds of boys practicing a sport. Father education was significantly associated with boys' sport activity but only in the crude analysis, in which, boys whose fathers had low education had lower odds of being in a sport (OR=0.25, p<0.001) than boys with fathers holding a higher degree (Table 5.3.3).

Results of parents' PA behaviours used to predict sport participation in boys and girls are presented in Table 5.3.4. Girls with a father (OR=2.09, p=0.04) and a mother (OR=4.05, p=0.00) who regularly practice organised PA had increased odds of being in an extracurricular sport. After adjustment, mother's organised PA was still positively associated with girls' sport participation (AOR=2.94, p=0.03). Having parents that practiced organised sport during childhood was not a predictor of girls' sport participation. For boys, the type of PA practiced by the parents was not a predictor of participation in a sport, but the simple involvement in PA was. Boys with an inactive father had significantly lower odds of practicing a sport compared with boys with a father physically active (OR=0.34, p<0.001 and AOR=0.43, p=0.01). Similar results were found for mothers, in which boys had half the odds of being in a sport if they had an inactive mother (OR=0.46, p=0.00), compared with boys with a mother who reported to be physically active. Parents involvement in sports when younger was not a predictor of sport participation in boys (Table 5.3.4).

Table 5.3.3. Family characteristics predictors of participation in extracurricular sport in boys and girls (crude and adjusted).

		Girls						
			Crude			Adjusted		
		n	OR	95%CI	p	AOR	95%CI	p
Family income	Low	120	0.16	0.09;0.27	<0.001	0.20	0.09;0.45	<0.001
	Medium	102	0.46	0.26;0.82	0.01	0.37	0.19;0.75	0.01
	High	180	Ref.			Ref.		
Siblings	None	133	1.99	1.06;3.71	0.03	2.49	1.14;5.43	0.02
	One	227	1.81	1.02;3.21	0.04	1.74	0.86;3.51	0.12
	2 or more	62	Ref.			Ref.		
Father education	Low	113	0.24	0.15;0.41	<0.001	1.24	0.52;2.96	0.63
	Middle	121	0.66	0.38;1.12	0.12	1.33	0.64;2.77	0.44
	High	171	Ref.			Ref.		
Mother education	Low	75	0.12	0.07;0.21	<0.001	0.16	0.07;0.37	<0.001
	Middle	103	0.36	0.21;0.60	<0.001	0.45	0.23;0.90	0.02
	High	233	Ref.			Ref.		
		Boys						
		n	OR	95%CI	p	AOR	95%CI	p
Family income	Low	114	0.16	0.10;0.28	<0.001	0.28	0.13;0.61	0.00
	Medium	104	0.59	0.33;1.06	0.08	1.03	0.49;2.17	0.94
	High	168	Ref.			Ref.		
Siblings	None	130	2.02	1.09;3.73	0.03	3.44	1.56;7.57	0.00
	One	213	2.03	1.15;3.58	0.02	2.12	1.04;4.33	0.04
	2 or more	66	Ref.			Ref.		
Father education	Low	127	0.25	0.15;0.42	<0.001	0.56	0.26;1.23	0.15
	Middle	104	0.77	0.43;1.38	0.38	1.27	0.59;2.76	0.54
	High	162	Ref.			Ref.		
Mother education	Low	74	0.15	0.08;0.26	<0.001	0.27	0.12;0.64	0.00
	Middle	118	0.36	0.21;0.60	<0.001	0.37	0.19;0.74	0.01
	High	211	Ref.			Ref.		

Note. Reference category: child did not participate in a sport; adjusted for children's age, urbanization, parents' education, and family income; OR=odds ratio; AOR=adjusted odds ratio; CI=confidence interval; $p<0.05$ was considered significant.

Table 5.3.4. Parents' physical activity predictor of participation in extracurricular sport in boys and girls (crude and adjusted).

		Girls						
			Crude			Adjusted		
		n	OR	95%CI	p	AOR	95%CI	p
Father's PA	Inactive	223	0.80	0.49;1.30	0.36	0.92	0.51;1.66	0.79
	Organised	76	2.09	1.03;4.25	0.04	1.33	0.59;2.99	0.50
	Unorganised	106	Ref.			Ref.		
Mother's PA	Inactive	252	0.80	0.48;1.34	0.40	0.66	0.35;1.25	0.20
	Organised	74	4.05	1.71;9.60	0.00	2.94	1.08;7.99	0.03
	Unorganised	85	Ref.			Ref.		
Father did sport	No	253	1.01	0.66;1.53	0.98	0.91	0.57;1.46	0.70
	Yes	169	Ref.			Ref.		
Mother did sport	No	259	0.88	0.57;1.33	0.53	1.00	0.63;1.61	0.99
	Yes	163	Ref.			Ref.		
		Boys						
		n	OR	95%CI	p	AOR	95%CI	p
Father's PA	Inactive	212	0.34	0.19;0.58	<0.001	0.43	0.23;0.81	0.01
	Organised	72	1.24	0.57;2.70	0.60	1.16	0.48;2.83	0.74
	Unorganised	106	Ref.			Ref.		
Mother's PA	Inactive	245	0.46	0.26;0.81	0.00	0.54	0.28;1.08	0.08
	Organised	71	1.25	0.57;2.74	0.58	0.96	0.39;2.39	0.94
	Unorganised	87	Ref.			Ref.		
Father did sport	No	243	0.99	0.65;1.52	0.97	1.20	0.74;1.94	0.45
	Yes	165	Ref.			Ref.		
Mother did sport	No	246	0.79	0.52;1.22	0.29	0.81	0.50;1.30	0.37
	Yes	162	Ref.			Ref.		

Note. Reference category: child did not participate in a sport; adjusted for children's age, urbanization, parents' education, and family income; OR=odds ratio; AOR=adjusted odds ratio; CI=confidence interval; $p<0.05$ was considered significant.

5.4. Discussion

In this sample of 6-10-year-old Portuguese children, it was found that family characteristics and parents' PA were predictors of sport participation, but more importantly, it was found that the predictors may differ according to the level of urbanization and children's sex. In general, children, independently of the sex and place of residence, were less likely to practice an extracurricular sport if they were from low income families, if they had bigger families (more siblings), and if their parents had lower education. This is consistent with previous research which shows that differences in children and adolescents' sport participation is best accounted by socioeconomic indicators, such as family income and parents' education level (Timperio et al. 2013; Vella et al. 2013, 2014). A longitudinal study starting with 5-6-year-old Australian children, found that at a family level, sports participants were more likely to exist in houses with fewer people, with a greater standardised household income, and with highly educated parents (Vella et al. 2014). Another study examining sport participation in 6-years-old in the Netherlands, observed that children of low educated mothers, low educated fathers, and middle income household had approximately two times the odds of not participating in a sport, compared with children of high educated parents and high income households (Wijtzes et al. 2014). Indeed, financial barriers are often mentioned as a major factor restricting organised sport participation among children from low-income families (Cottrell et al. 2015; Holt et al. 2011; Smith et al. 2010). Furthermore, a high income may be associated to a more favourable residential neighbourhood with (quality) sport facilities nearby and more available sports (Humbert et al. 2006; Veitch et al. 2013).

In Portugal, as in other countries, participation in organised sports may involve multiple expenses, including memberships fees, costs of sport gear, and costs associated with transportation to the sport facilities and competitions. Previous studies observed that children and adolescents (aged 10-18) with high SES (OR=1.7) and medium SES (OR=1.4) were significantly more involved in sports than children from low SES (Seabra et al. 2008). Similarly, 3-10-year-old children living in the central region of Portugal, were significantly less likely to participate in sport activities if they were from low (OR=1.76) or medium SES (OR=1.57), compared with children from higher SES (Nogueira et al. 2013), which are consistent with the results found in the present work.

Fewer siblings, in the same way as higher family income, is likely to represent the necessary resources for participation in organised sport. A study carried among 5-6-year-old children found that, informal and impromptu child's PA may be positively influenced by siblings (e.g. cycling, playing in the garden, riding a scooter), as opposed to structured and/or fee paying activities (Edwards et al. 2015). Less parental education may be linked to lower income but there are other hypothesizes that may help to explain why low parental education levels are associated with lower odds of child's sport participation. For instance, knowledge (e.g., with respect to the health benefits of children's sport participation), attitudes, and skills (e.g., favourable parenting practices) may represent some of the contributing mechanisms (Nielsen et al. 2012). Parents with lower levels of education may also lack the awareness of existent funding opportunities, even in the presence of such funding (Spence et al. 2010).

The present findings show a link between parents' PA and their children's sport participation, an intergenerational link that was observed in previous studies. For example, Moore and colleagues (Moore et al. 1991) observed that children (aged 4-7) were 3.5 to almost 6 times more likely to be active when one or both parents were active than when both parents were inactive. More recently, data shows that there are quantifiable relationships between parents' and 5-19 or 7-8-year-old children's steps/day (Craig, Cameron, and Tudor-Locke 2013; Stearns et al. 2016) and that the more active the parents or the greater their enjoyment of PA, the more likely the children (aged 3-5 years) were to engage in the recommended amount of 60 min of daily activity (Zecevic et al. 2010). Looking specifically for sport participation, a study carried out with children (aged 10-12) from seven European countries found that parental modelling was positively associated (OR=1.07) with participation in 30 min/week or more of sport (Timperio et al. 2013). In Portugal, parents self-reported PA was positively associated with their children's PA, either formal or spontaneous (Mota 1998), and children (12-18 years) of active parents were more likely to practiced PA in several contexts (Marques et al. 2014).

It seems that children take cues from their parents in regards to physical behaviours but, previous works have been inconclusive about which parent is the biggest role-model. Some studies observed that mothers were the biggest influence on children's PA (Fogelholm et al. 1999; Marques et al. 2014) while others verified that fathers had more influence than mothers (Moore et al. 1991). In this dataset, a strong father-son and mother-daughter relation in PA behaviours was found, in which active mother and fathers were positively associated with sport participation in girls and boys, respectively. These findings are somewhat consistent with

other studies showing a positive association between mother-daughter and father-son PA behaviours (Gustafson and Rhodes 2006). More recently, a meta-analysis of parental and children's PA concluded that father-son PA was significantly higher than mother-son PA but parental modelling and girls' PA were not associated (Yao and Rhodes 2015). Fuemmeler et al. (Fuemmeler et al. 2011) identified positive associations between objectively measured PA in mothers and girls and between fathers and sons, whilst associations were non-significant in pairs of opposite sex. Present findings parallel the results of other studies that have accelerometers to objectively measure PA in children and adults (Kalakanis et al. 2001; Moore et al. 1991).

Looking specifically for extracurricular sport participation in children, a study from 2005, concluded that parental exercise was positively associated with the number of sports practiced by 9-15-year-old Australian children, but when only one parent was active, the sex of that parent was not an independent predictor of the child's extracurricular sport participation (Cleland et al. 2005). Other studies have identified the father as the biggest influence for boys' sport participation, while mothers were more likely to serve the same function for girls; however, girls who were highly involved in sports were more likely to be influenced by both members of the family (McElroy 1983; Spreitzer and Snyder 1976). A Portuguese study observed that daughters (aged 10-18 years) showed a greater propensity for practising sports when their mothers did (Seabra et al. 2008). In 2014, a study carried among 2661 Portuguese nuclear families suggested that fathers and mothers had a similar influence on their offspring's PA levels and sport participation, irrespective of their sex (Maia et al. 2014).

While a majority of studies have focused on general parental PA this work shows that the type of PA practiced by parents may have a crucial role in children's sport behaviours. It was found that for boys having an active father, independent of the type of PA, was a predictor of sport participation while for girls the type of PA practiced by the parents, particularly mothers, have a positive effect on girls' sport participation. This is consistent with a recent study carried out in 10-12-year-old European children and their parents, which concluded that self-reported maternal participation in sport, but not paternal, was associated with higher participation in sport by children (Schoeppe et al. 2017).

The relations between mother-daughter and father-son may be explained by differences in the type of physical activities. One could intuitively assume that mothers would spend more time sharing physical activities with daughters than sons simply because in

general, males tend to engage in 'masculine' activities (e.g., football, basketball, rugby) while females often favour the neutral or 'feminine' ones (e.g., dancing, gymnastics, swimming) (Riemer and Visio 2003). Also, because 'feminine' sports are often played indoors, mothers who accompany their daughters may have the need to register themselves in similar activities, which could in part explain present results of the positively correlation between mother-daughter organised PA. Moreover, parents may influence their children's PA in different ways. For instance, a study carried in 12-18-year-old Portuguese children and adolescents observed that the ones with an active father and an inactive mother were characterized by the practice of unorganised PA while having an active mother and an inactive father was associated with higher participation in organised PA (Marques et al. 2014).

Parents' modelling, especially mothers' involvement in PA, was particularly important (and positive) for sport participation in non-urban children. It is known that non-urban children often do not participate in after school sports due, in part, to limited opportunities and transportation barriers (Liu et al. 2007). It may be the case that, in the present study, non-urban physically active mothers, were more aware of sport offers and recreational facilities nearby, engaged in PA while their children also practice sport, or attribute more importance to PA and sport participation, facilitating their children's sport participation. Those are some of the mechanisms through which parental PA may influence children's sport participation (Gustafson and Rhodes 2006; Moore et al. 1991; Sallis et al. 1992; Trost et al. 2003; Vella et al. 2014). Also, when seeing parents engage in unorganised or organised PA, children may form positive cognitions toward PA and sport and be inspired to adopt similar behaviours (Timperio et al. 2013). Knowing that women are usually less physically active than men (Azevedo et al. 2007; Baptista et al. 2012; Hagströmer, Oja, and Sjöström 2007), girls may have fewer role models to look upon which may negatively influence their involvement in PA behaviours, including extracurricular sport.

5.5. Conclusion

Future studies and interventions should pay attention to the interplay of child sex, socioeconomic factors, parental support and level of urbanization, through the lens of the Socio-Ecological Model. Interventions to promote sports participation are urgently required

and must be targeted to populations at highest risk, such as children from lower SES families and children who receive low parental PA modelling. Present findings suggest the importance of family-based coactivity interventions during child development, and reinforces that both mothers' and fathers' PA are influential for children's sport participation, particularly in father-son and mother-daughter relations. Mothers' own involvement in organised PA was a strong and independent predictor of girls' participation in extracurricular sport. Targeting Portuguese parents in order to increase their own PA levels, particularly through the participation in organised PA, may provide health benefits for the whole family.

Chapter 6. Parental opinions about sport and perception of barriers and facilities nearby as predictors of children's sport participation

6.1. Introduction

Participation in organised sporting activities provides direct favourable health effects for children as well as additional psycho-social benefits (Macphail, Gorely, and Kirk 2003). Furthermore, children sports have been invoked as a potentially important means to combat the worldwide epidemic of childhood obesity through the provision of regular physical activity (PA) (Malina, 2009). Nevertheless, in 2016, the percentage of Portuguese children (aged 10-18) meeting PA guidelines of at least 60 minutes of moderate-to-vigorous PA (MVPA) per day was low (16.8%; 28.3% for boys and 7.7% for girls) and significantly more boys (51.3%) than girls (28.3%) reported to be involved in organised sports participation (Marques, Ekelund, and Luís B. Sardinha 2016).

Promoting PA is therefore a key focus of public health policy and to aid intervention development, it is important to understand the factors that influence children's PA, including organised sport participation. A socio-ecological approach suggests that factors influencing PA occur within a multi-layered context. For instance, children's PA may be influenced by intrapersonal/individual factors, (e.g., sex, personal preferences), interpersonal or social factors (e.g., parental support), and environmental factors (e.g., distance to recreational facilities, lack of athletic programs) (Davison and Birch 2001; G. M. Dwyer et al. 2008; J. Dwyer et al. 2008). Among younger children, PA is primarily influenced by their parents, since children spend most of their time within the family context and need family members to take them to recreational facilities or sports (Fredricks and Eccles 2004).

Parents may determine children's exposure to a number of factors that are enablers or barriers to PA and sport, such as lack of money and transportation (Gustafson and Rhodes 2006). Other factors such as the distance to recreational facilities, cost, crime/danger, or lack of time were seen to have an inverse association with habitual PA among children (Ling et al. 2016; Moore et al. 2010). A Portuguese study among 11-12-year-old children, found that parental perception of their neighbourhood as dangerous accounted for 13% less of children's outdoor play and autonomous active transport (Santos et al. 2013). Parental decisions regarding their child's participation in organised sports are also determined by factors such as attitudes and awareness of health benefits and safety concerns (Sallis et al. 2000). A study from France found that parents' beliefs about child's sport competence can influence 9-11-year-old children's level of PA involvement (Bois, Sarrazin, Brustad, Trouilloud, et al. 2005). Another

study that followed 2nd-5th grade children, revealed that parental perception of their children's ability and the value they attribute to sport, was related with children's beliefs and participation both concurrently and over time (Fredricks and Eccles 2005). Mothers' beliefs about their children are often moderated by their gender stereotypic beliefs about the abilities of female and male people in general or what is appropriate for males and females, as seen in a study among American children (aged 11 and 12) (Jacobs and Eccles 1992). Parents who adhere to strict gender-typed notions of PA and sport tend to have children with lower levels of PA (Fredricks and Eccles 2005).

Previous studies have reported differences in PA levels between urban and non-urban children and adolescents (Bathrellou et al. 2007; Golle et al. 2014; Hoekman, Breedveld, and Kraaykamp 2016; Aristides M. Machado-Rodrigues et al. 2014; Orhan 2015). It seems that significantly lower levels of PA have been observed in rural children compared with their urban counterparts both in a sample of middle school students from the United States of America and among Portuguese children aged 13-16 years (Aristides M. Machado-Rodrigues et al. 2014; Moore et al. 2010). In the Portuguese sample previously mentioned, different results were found according to children's sex, with urban boys engaging in significantly more MVPA in all seven days of the week compared with rural boys (85.9min/day vs. 76.3min/day) while the opposite was found for girls (rural: 62.7min/day, urban: 57.9min/day) (Machado-Rodrigues et al., 2014a). However, studies looking specifically for participation in organised sports have been inconclusive, with some works reporting higher rates of participation in rural children compared with their urban peers (Dollman and Lewis 2010), while others shown that children living in urban areas tended to have higher possibility to attend sport clubs (and accumulate more MVPA) (Žaltauskė and Petrauskienė 2016). An important study examining 1140 children (aged 10-12 years) living in Cyprus, found that rural children reported being slightly more active after school and occupy weekly with outdoor chores compared to urban children, who on the other hand reported engaging in sports on a weekly basis more than their rural peers (Bathrellou et al. 2007).

These disparities suggest that urban and non-urban parents may perceived different barriers and motivators for their children sport participation. The study has two aims: the first is to examine parents' opinions of sport and PA, their perceived barriers and proximity of recreational facilities, according to the level of urbanization and children's sex; and the second

is to explore which perceived barriers and opinions influence urban and non-urban children's participation in extracurricular sports.

6.2. Methods

A sample of parents of children aged 6 to 10 years (n=834), residing in an urban (Coimbra) and a non-urban setting (Lousã), were surveyed. Parents reported if their children were engaged in an extracurricular sport (Yes/No), which was used as a dependent variable. Survey questions also included asking parents (i) whether the time their children spent in sedentary behaviours was little, normal, or excessive; (ii) whether the time their children spent in PA in and out of school was little, normal, or excessive; and (iii) whether recreational facilities, like swimming pool, football field, parks, and playgrounds, existed close to their home. In a list of possible barriers (e.g., money, child's health and interest, available time) parents reported which one(s) influenced their child's physical behaviours, including participation in extracurricular sport (response categories later divided by the number of reported barriers: none, 1-2 barriers, 3 or more).

Parents' opinions of sport were collected using a five-point Likert-Scale range from 1 (completely disagree) to 5 (completely agree), with higher rates meaning that parents have lower opinions of sport participation, value sport less, have more stereotyped beliefs, and more perceived barriers. A first scale was fulfilled by all parents and generated three factors that explained 51.56% of the variance in scores (gender stereotypes in sport, available sports and facilities, children's and parents' time to be physically active). A second scale was exclusive for parents with children engaged in an extracurricular sport, in which 59.71% of the variance was explained by two factors (benefits in practicing sport, and parental motivation for sport participation). A third and last scale was limited for parents with children not engaged in a sport and generated three factors that explained 62.93% of the variance (lack of will, health problems, and lack of facilities/sports). Complete statistical analysis of the Likert-Scales may be seen in chapter 2 – Methodology.

Data were stratified by child's sex and level of urbanization, and group differences were tested using the Chi-square test and the T-test for independent samples. Logistic regression analysis was undertaken to assess the association between three groups of risk factors –

number and type of perceived barriers by parents, perceived proximity of facilities, and opinions about sport - with children's sport participation (dependent variable). Crude odds ratios, adjusted odds ratio (for children's sex, age, urbanization, family income, and parents' education), and 95% confidence intervals were computed. Data were analysed using SPSS version 23.0 (SPSS, Chicago, IL, USA) and $p<0.05$ was considered significant.

6.3. Results

Majority of parents reported one or two barriers for their child to engage in PA, including extracurricular sport (65.6%), followed by no barriers (21.5%), and three or more (12.9%) (data not shown in the tables), but no statistically significant differences were found between parents of boys and parents of girls nor according to the level of urbanization in the number of perceived barriers. Parents of girls reported significantly more times that money was a barrier to PA and sport participation than parents of boys (46.8% and 40.0%, respectively; X^2=3.98, $p<0.05$), but no significant differences were found for the other barriers. When comparing places, parents of girls living in the non-urban setting reported significantly more lack of child interest (16.7%) than parents of girls living in the urban setting (9.5%; X^2=4.80, p=0.03). Still among girls, a slightly tendency was observed for non-urban parents reporting more lack of child's health compared with urban parents (7.8% and 3.5%, respectively) and for urban parents reporting more lack of time than parents living in the non-urban setting (60.6% and 51.6%, respectively). Among boys, lack of money was more frequently reported by urban parents (44.8%) than non-urban parents (34.1%; X^2=4.18, p=0.04), and the same was observed for lack of places (urban: 22.9%, non-urban: 15.2%; X^2=3.91, $p<0.05$). On the other side, non-urban parents of boys reported lack of child' health more frequently as a barrier (9.6%) than urban parents (3.3%) (X^2=6.70, p=0.01) (Table 6.3.1).

The recreational facility most reported by parents as existing close to their house was playgrounds (63.9%) and swimming pool (57.3%), followed close by football field (56.2%) and parks (55.8%) (data not shown in Table 6.3.1). Parents of girls reported significantly higher frequency of gymnasiums (52.0% vs. 41.7%; X^2=8.87, p=0.00), sports hall (53.9% vs. 42.2%; X^2=4.36, p=0.04), parks (59.3% vs. 52.2%; X^2=4.31, p=0.04), and playgrounds (69.0% vs. 58.5%; X^2=9.94, p=0.00) than parents with boys (Table 6.3.1).

Table 6.3.1. Frequency (%) of parents' reported barriers, existence of recreational facilities nearby, and perceived time their children spend engaging in PA in and out of school.

	Total sample (%)			Parents of girls (%)			Parents of boys (%)		
	Girls	Boys	p	Urban	Non-urban	p	Urban	Non-urban	p
Number of barriers									
None	20.8	22.3	0.74	20.8	20.8	0.87	19.0	25.8	0.18
1-2	65.5	65.7	0.70	66.7	64.1	0.74	67.1	64.1	0.20
≥3	13.7	12.0	0.71	12.6	15.1	0.70	13.8	10.1	0.31
Type of barriers									
Time	56.5	56.9	0.92	60.6	51.6	0.06	60.5	53.0	0.13
Child's health	5.4	6.4	0.57	3.5	7.8	0.05	3.3	9.6	0.01
Money	46.8	40.0	<0.05	47.6	45.8	0.71	44.8	34.8	0.04
Lack of places	21.7	19.1	0.35	21.6	21.9	0.95	22.9	15.2	<0.05
Child interest	12.8	15.4	0.27	9.5	16.7	0.03	17.1	13.6	0.33
Facilities nearby									
Large open spaces	24.3	25.9	0.62	20.3	29.2	0.04	20.3	31.8	0.01
Gymnasium	52.0	41.7	0.00	43.3	62.5	0.00	32.1	52.0	0.00
Swimming pool	60.3	54.1	0.07	55.8	65.6	0.04	50.5	58.1	0.12
Sports hall	49.4	42.2	0.04	42.9	57.3	0.00	32.5	52.5	0.00
Football field	53.9	58.5	0.18	42.0	68.2	0.00	43.4	74.7	0.00
Parks	59.3	52.2	0.04	58.9	59.9	0.83	51.4	53.0	0.74
Playgrounds	69.0	58.5	0.00	70.1	67.7	0.59	58.0	59.1	0.83
Other	3.8	3.7	0.92	3.0	4.7	0.37	4.7	2.5	0.24
Time in PA at school									
Little	21.6	21.7	0.99	23.2	19.7	0.38	23.8	19.4	0.30
Normal	78.4	78.3	0.98	76.8	80.3	0.48	76.2	80.6	0.28
Excessive	0.0	0.0	-	0.0	0.0	-	0.0	0.0	-
Time in PA out of school									
Little	32.8	30.7	0.70	32.6	33.1	0.23	33.3	27.8	0.40
Normal	61.2	64.1	0.69	58.5	64.6	0.30	60.9	67.5	0.38
Excessive	5.9	5.2	0.72	8.9	2.2	0.02	5.8	4.6	0.60

Non urban parents reported significantly more available facilities close to their home than urban parents, namely: large open spaces (girls: 29.2% in urban and 20.3%; boys: 31.8% vs. 20.3%), gymnasiums (girls: 62.5% vs. 43.3%; boys: 52.0% vs. 32.1%), pools (girls: 65.6% vs. 55.8%; no significant differences among boys), sports hall (girls: 57.3% vs. 42.9%; boys: 52.5% vs. 32.5%) and football field (girls: 68.2% vs. 42.0%; boys: 74.7% vs. 43.4%) (Table 6.3.1).

Parents of boys and girls reported similar opinions about the time their children spent in PA during school, with the majority referring to it as "a normal" amount of time (girls: 78.4% and boys: 78.3%); and no parents believe their children are spending excessive time in PA during school hours. The majority of urban and non-urban parents of both boys and girls classified the time their children spent in PA during school as "normal", and no statistically significant differences were found according to the level of urbanization. Concerning the time spent in PA out of school, 62.7% of the parents said that their child was spending a "normal" amount of time, and 31.8% said that their offspring were little active, but no significant differences were found between parents of boys and parents of girls. More urban parents of girls seem to believe their daughters are spending an excessive amount of time in PA out of school, compare with non-urban parents of girls (8.9% in urban, and 2.2% in non-urban, p=0.02), but the differences were not statistical significant (Table 6.3.1).

Table 6.3.2. shows the mean values of the factors generated by the EFA and the comparison of means by children's sex and level of urbanization. Opinions about stereotypes on sport and PA were similar between parents of boys and parents of girls, independently of urbanization. Likewise, no statistical differences between parent of boys and girls were found in the reported availability of places/sports (p=0.08) and time to engage in PA (p=0.99).

Regarding children already practicing an extracurricular sport, no significant differences were found between sexes nor between urban and non-urban girls in parental opinions about sport benefits (p=0.68) and levels of parental motivation (p=0.30). Similarly, no significant differences were found between urban and non-urban boys in parental opinions about sport benefits but non-urban parents of boys reported higher levels of parental motivation (e.g. "I am proud of my child's sport exhibitions", "I often tell my child that I am proud of hid/her sport performances", "My child has potential and can develop a sport-related career") compared with their urban counterparts (t=0.03, p=0.00). Considering children not practicing an extracurricular sport, no significant differences were found in parental opinions about lack of children's health according to children's sex or the level of urbanization. On the other side,

parents of girls reported mean values of lack of sports/lack of facilities, compared with parents of boys (t=10.76, p=0.04) and non-urban parents of girls reported higher values of lack of child will to be physically active, compared with parents of girls living in the urban setting (t=10.34, p=0.02) (Table 6.3.2).

Table 6.3.2. Mean values and standard deviation (SD) of the factors, reflecting parents' opinions about sport and PA.

		Total sample			Girls (mean; SD)			Boys (mean; SD)		
		Girls	Boys	p	Urban	Non-urban	p	Urban	Non-urban	p
Do/not do sport	Stereotypes	0.03 (1.01)	-0.03 (0.99)	0.40	0.04 (0.94)	0.01 (1.10)	0.78	-0.02 (0.97)	-0.04 (1.01)	0.89
	Availability	0.06 (1.06)	-0.07 (0.93)	0.08	0.09 (1.12)	0.02 (0.97)	0.51	-0.04 (0.95)	-0.09 (0.91)	0.58
	Time	-0.00 (1.00)	0.00 (0.99)	0.99	-0.05 (0.97)	0.06 (1.04)	0.27	0.07 (1.01)	-0.08 (0.98)	0.15
Do sport	Benefits	-0.02 (0.98)	0.02 (1.02)	0.68	-0.06 (0.99)	0.03 (0.96)	0.50	0.00 (0.95)	0.04 (1.11)	0.76
	Parental motivation	-0.05 (1.04)	0.05 (0.96)	0.30	-0.07 (1.01)	-0.02 (1.09)	0.69	-0.13 (0.98)	0.25 (0.90)	0.00
Not do sport	Lack of will	0.11 (1.04)	-0.13 (0.94)	0.05	-0.09 (0.79)	0.32 (1.21)	0.02	-0.15 (1.01)	-0.10 (0.88)	0.79
	Lack of health	0.02 (0.94)	-0.02 (1.06)	0.73	-0.01 (0.88)	0.05 (1.02)	0.73	-0.13 (1.13)	0.09 (0.98)	0.24
	Lack of sport/facilities	0.12 (1.15)	-0.14 (0.78)	0.04	0.14 (1.05)	0.10 (1.25)	0.82	-0.16 (0.90)	-0.11 (0.62)	0.75

Table 6.3.3. shows how parents' perceived barriers were associated with children's participation in extracurricular sport, both in the urban and in the non-urban setting. In the urban setting, parents who did not reported any barrier to PA (including sport) had more than three times the odds of their children being in a sport, compared with parents who reported three or more barriers, both before (OR=3.33, p<0.001) and after adjustment (AOR=3.73, p=0.01). The same tendency was observed in the non-urban setting, in which parents who did

not reported any barrier had eight times the probability of their children to participate in a sport, compared with parents who reported ≥3 barriers (crude: OR=8.00, p<0.001; adjusted: AOR=8.71, p<0.001). In the urban setting, parents that reported lack of places had lower odds of their children practicing an extracurricular sport (OR=0.48, p=0.00; AOR=0.38, p=0.00). In the non-urban setting, children had lower odds of practicing a sport if parents reported lack of time (AOR=0.58, p=0.04), lack of money (OR=0.39, p<0.001; AOR=0.45, p=0.01) and lack of places (OR=0.34, p<0.001; AOR=0.38, p=0.00).

Table 6.3.3. Parents' perceived barriers as predictors of participation in extracurricular sport in children living in urban and non-urban settings (crude and adjusted).

Barriers		Urban				Non-urban			
		OR	95%CI	AOR	95%CI	OR	95%CI	AOR	95%CI
None barrier		3.33***	1.48;7.53	3.73**	1.40;9.90	8.00***	3.54;18	8.71***	3.23;9.50
1-2 barriers		0.97	0.54;1.75	1.01	0.51;2.01	2.41**	1.30;4.49	2.28*	1.08;4.79
≥3 barriers		Ref.		Ref.		Ref.		Ref.	
Time	Yes	0.78	0.51;1.18	0.84	0.51;1.39	0.69	0.45;1.05	0.58*	0.34;0.98
	No	Ref.		Ref.		Ref.		Ref.	
Health	Yes	0.89	0.30;2.65	0.57	0.17;1.89	0.91	0.44;1.90	0.79	0.30;2.04
	No	Ref.		Ref.		Ref.		Ref.	
Money	Yes	0.71	0.47;1.06	0.84	0.51;1.37	0.39***	0.25;0.60	0.45**	0.26;0.79
	No	Ref.		Ref.		Ref.		Ref.	
Places	Yes	0.48**	0.30;0.76	0.38**	0.22;0.67	0.34***	0.20;0.57	0.38**	0.20;0.73
	No	Ref.		Ref.		Ref.		Ref.	
Interest	Yes	1.07	0.60;1.50	1.42	0.67;3.01	0.75	0.42;1.32	0.52	0.25;1.07
	No	Ref.		Ref.		Ref.		Ref.	

Note. Reference category: child do not participate in an extracurricular sport; NE=not existent; OR=odds ratio, AOR=adjusted odds ratio (children's sex, age, parental education, family income), CI=confidence interval; *p<0.05, **p<0.01, ***p<0.001.

Table 6.3.4. shows that the proximity to sport facilities may be a predictor of children's sport participation, both in the urban and non-urban settings.

Table 6.3.4. Parents' perceived proximity of sport facilities as predictor of participation in extracurricular sport in children living in urban and non-urban settings (crude and adjusted).

	Urban				Non-urban			
	OR	95%CI	AOR	95%CI	OR	95%CI	AOR	95%CI
Large open spaces								
NE	0.34***	0.19;0.63	0.35**	0.17;0.72	0.58*	0.36;0.93	0.84	0.48;1.49
Exist	Ref.		Ref.		Ref.		Ref.	
Gymnasium								
NE	0.46***	0.30;0.72	0.57*	0.33;0.97	0.56*	0.37;0.86	0.91	0.54;1.54
Exist	Ref.		Ref.		Ref.		Ref.	
Swimming pool								
NE	0.43***	0.29;0.66	0.57*	0.35;0.94	0.64*	0.42;0.98	1.14	0.67;1.96
Exist	Ref.		Ref.		Ref.		Ref.	
Sports hall								
NE	0.40***	0.25;0.62	0.47*	0.27;0.81	0.37**	0.24;0.57	0.73	0.43;1.23
Exist	Ref.		Ref.		Ref.		Ref.	
Football field								
NE	0.57**	0.37;0.86	0.50*	0.30;0.84	0.68	0.43;1.07	1.11	0.62;1.99
Exist	Ref.		Ref.		Ref.		Ref.	
Parks								
NE	0.77	0.51;1.15	0.69	0.42;1.13	0.71	0.47;1.08	0.87	0.52;1.46
Exist	Ref.		Ref.		Ref.		Ref.	
Playgrounds								
NE	0.56*	0.37;0.85	0.70	0.42;1.16	0.63*	0.41;0.98	0.76	0.45;1.30
Exist	Ref.		Ref.		Ref.		Ref.	
Others								
NE	0.67	0.22;2.10	0.89	0.24;3.30	1.11	0.37;3.39	1.87	0.45;7.89
Exist	Ref.		Ref.		Ref.		Ref.	

Note. Reference category: child do not participate in an extracurricular sport; NE=not existent; OR=odds ratio, AOR=adjusted odds ratio (children's sex, age, parental education, family income), CI=confidence interval; *p<0.05, **p<0.01, ***p<0.001.

In the urban setting, significantly lower odds of children participating in a sport were observed if parents reported some recreational places as inexistent nearby their home, namely: large open spaces (OR=0.34, p<0.001), gymnasium (OR=0.46, p<0.001), swimming pool (OR=0.43, p<0.001), sports hall (OR=0.40, p<0.001), football field (OR=0.57, p=0.01), and playgrounds (OR=0.56, p=0.01). After adjustment, urban children had approximately half the odds of participating in a sport if their parents perceived large open spaces (AOR=0.35, p=0.00), gymnasiums (AOR=0.57, p=0.04), pool (AOR=0.57, p=0.03), sports hall (AOR=0.47, p=0.01), and football field (AOR=0.50, p=0.01) as non-existent in the neighbourhood. In the non-urban setting, parents who reported that the neighbourhood did not have large open spaces (OR=58, p=0.03), gymnasium (OR=0.56, p=0.01), swimming pool (OR=0.64, p=0.04), sports hall (OR=0.37, p=0.00), and playgrounds (OR=0.63, p=0.04) had lower odds of having children engaged in an extracurricular sport, but the factors did not remain significantly associated after adjusting for children's sex, age, parental education degree, and family income. In both setting, the existence of parks and other places were not associated with children's participation in extracurricular sport (Table 6.3.4).

The association between parental opinions about sport and children's sport participation, according to the urbanization degree are shown in Table 6.3.5. In the urban setting, parents who reported less available sports and facilities had lower odds of their children to be engaged in an extracurricular sport, but only in the crude analysis (OR=0.75, p=0.01). In the non-urban setting, stereotypes and availability were statistical significant predictors of children's sport participation in the crude model (OR=0.75, p=0.01 and OR=0.61, p<0.001, respectively), but in the adjusted model, only the lack of available sports/facilities remained negatively associated with children's sport participation (AOR=0.73, p=0.04). Also, parents who reported that their children were sending little time being physical active out of school had significantly lower odds of their child practicing a sport, both in the urban setting (OR=0.02, p<0.001; AOR=0.04, p<0.001) and in the non-urban (OR=0.12, p=0.02) (Table 6.3.5).

Table 6.3.5. Parents' opinions related with sport and PA as predictors of participation in extracurricular sport in children living in urban and non-urban settings (crude and adjusted).

	Urban				Non-urban			
	OR	95%CI	AOR	95%CI	OR	95%CI	AOR	95%CI
Time in PA in school								
Little	0.99	0.62;1.61	1.06	0.60;1.86	1.13	0.66;1.95	0.98	0.52;1.85
Normal	Ref.		Ref.		Ref.		Ref.	
Time in PA out of school								
Little	0.02**	0.00;0.15	0.04**	0.01;0.29	0.12*	0.03;0.56	0.26	0.04;1.57
Normal	0.19	0.03;1.40	0.38	0.05;2.99	0.82	0.18;3.83	2.17	0.36;9.02
Excessive	Ref.		Ref.		Ref.		Ref.	
Opinions about sport								
Stereotypes	0.97	0.78;1.21	0.99	0.76;1.30	0.75*	0.61;0.93	0.85	0.65;1.11
Availability	0.75*	0.62;0.91	0.93	0.73;1.19	0.61**	0.48;0.79	0.73*	0.55;0.98
Time	0.98	0.79;1.22	0.98	0.76;1.25	0.87	0.70;1.09	1.06	0.80;1.41

Note. Reference category: child do not participate in an extracurricular sport; OR=odds ratio, AOR=adjusted odds ratio (children's sex, age, parental education, family income), CI=confidence interval; *p<0.05, **p<0.01, ***p<0.001.

Table 6.3.6 shows the results of the logistic regression using parents' perceived barriers as predictors of children's sport participation. Parents who did not perceived any barriers to PA had more than 5 times the odds of their daughters (OR=5.03, p<0.001) and more than 4 times the odds of their sons (OR=4.94, p<0.001) to be engaged in an extracurricular sport, compared with parents who reported three or more barriers. The association remained statistically significant after adjusting for possible confounders, both in girls (AOR=6.99, p<0.001) and in boys (AOR=4.10, p=0.01). Boys had lower odds of practicing a sport if parents reported money as a barrier (OR=0.43, p<0.001; AOR=0.53, p=0.02), but reported lack of time, places, health and child interest were not associated with boys' sport participation. Among girls, parents who reported lack of places as a barrier to PA (including sport) had significant lower odds of their daughters being engaged in an extracurricular sport (OR=0.30, p<0.001; AOR=0.22, p<0.001).

Table 6.3.6. Parents' perceived barriers as predictors of participation in extracurricular sport by boys and girls (crude and adjusted).

Barriers		Girls				Boys			
		OR	95%CI	AOR	95%CI	OR	95%CI	AOR	95%CI
None barrier		5.03**	2.30;10.99	6.99**	2.63;18.60	4.94**	2.15;11.32	4.10*	1.54;10.87
1-2 barriers		1.59	0.90;2.82	1.92	0.98;3.76	1.37	0.74;2.54	1.01	0.49;2.11
≥3 barriers		Ref.		Ref.		Ref.		Ref.	
Time	Yes	0.73	0.48;1.10	0.69	0.42;1.16	0.75	0.49;1.15	0.69	0.41;1.15
	No	Ref.		Ref.		Ref.		Ref.	
Health	Yes	0.90	0.37;2.18	0.70	0.25;1.98	0.86	0.37;1.97	0.75	0.25;2.25
	No	Ref.		Ref.		Ref.		Ref.	
Money	Yes	0.67	0.44;1.00	0.77	0.47;1.28	0.43***	0.28;0.66	0.53*	0.31;0.89
	No	Ref.		Ref.		Ref.		Ref.	
Places	Yes	0.30***	0.19;0.49	0.22***	0.12;0.39	0.59*	0.35;0.98	0.88	0.47;1.66
	No	Ref.		Ref.		Ref.		Ref.	
Interest	Yes	1.06	0.58;1.96	0.75	0.36;1.57	1.28	0.70;2.34	0.99	0.50;2.00
	No	Ref.		Ref.		Ref.		Ref.	

Note. Reference category: child do not participate in an extracurricular sport; OR=odds ratio, AOR=adjusted odds ratio (children's sex, age, parental education, family income), CI=confidence interval; *p<0.05, **p<0.01, ***p<0.001.

In the crude analyses, girls had significantly lower odds of participating in an extracurricular sport if parents reported less availability in the neighbourhood of large open spaces (OR=0.41, p=0.00), gymnasium (OR=0.63, p=0.03), swimming pool (OR=0.51, p=0.00), sports hall (OR=0.36, p<0.001), and playgrounds (OR=0.60, p=0.02); but after adjusting only the existence of large open spaces was associated with girls' sport participation, with parents who reported those spaces as inexistent having half the odds of their daughters being in an extracurricular sport (AOR=0.50, p=0.03). Among boys, significantly lower odds of being in a sport was related with parents' perceived non-existence of large open spaces (OR=0.55, p=0.02), gymnasium (OR=0.43, p<0.001), swimming pool (OR=0.54, p=0.01), sports hall (OR=0.44, p<0.001), football field (OR=0.57, p=0.01), and playgrounds (OR=0.57, p<0.01). After adjusting, boys still had approximately half the odds of being in a sport if parents reported that there were no gymnasiums (AOR=0.57, p=0.04), sports hall (AOR=0.58, p<0.05), and football field (AOR=0.48, p=0.01) in the neighbourhood. Parks and other facilities were not predictors of sport participation both in boys and girls (Table 6.3.7).

Table 6.3.7. Parents' perceived proximity of sport facilities as predictor of participation in extracurricular sport by boys and girls (crude and adjusted).

	Girls				Boys			
	OR	95%CI	AOR	95%CI	OR	95%CI	AOR	95%CI
Large open spaces								
NE	0.41**	0.24;0.71	0.50*	0.27;0.95	0.55*	0.33;0.91	0.64	0.35;1.16
Exist	Ref.		Ref.		Ref.		Ref.	
Gymnasium								
NE	0.63**	0.42;0.95	0.92	0.55;1.56	0.43***	0.28;0.68	0.57*	0.34;0.98
Exist	Ref.		Ref.		Ref.		Ref.	
Swimming pool								
NE	0.51**	0.34;0.77	0.81	0.49;1.35	0.54**	0.36;0.83	0.75	0.45;1.26
Exist	Ref.		Ref.		Ref.		Ref.	
Sports hall								
NE	0.36***	0.23;0.55	0.61	0.36;1.02	0.44***	0.28;0.69	0.58*	0.34;0.99
Exist	Ref.		Ref.		Ref.		Ref.	
Football field								
NE	0.76	0.51;1.14	1.01	0.60;1.70	0.57**	0.38;0.87	0.48*	0.27;0.83
Exist	Ref.		Ref.		Ref.		Ref.	
Parks								
NE	0.74	0.49;1.11	0.82	0.49;1.36	0.73	0.48;1.11	0.75	0.45;1.23
Exist	Ref.		Ref.		Ref.		Ref.	
Playgrounds								
NE	0.60*	0.39;0.93	0.88	0.51;1.51	0.57**	0.38;0.87	0.67	0.40;1.12
Exist	Ref.		Ref.		Ref.		Ref.	
Others								
NE	0.68	0.44;3.50	1.79	0.50;6.38	0.53	0.15;1.90	0.76	0.17;3.44
Exist	Ref.		Ref.		Ref.		Ref.	

Note. Reference category: child do not participate in an extracurricular sport; NE=not existent; OR=odds ratio, AOR=adjusted odds ratio (children's age, urbanization, parental education, family income), CI=confidence interval; *p<0.05, **p<0.01, ***p<0.001.

Parents of girls who reported more gender stereotypes about sport, had significantly lower odds of their daughters being engaged in a sport (OR=0.80, p=0.03), but the association was not statistical significant after adjustment. Also, in the crude model, parents who reported less accessibility and availability of sports/places had lower odds of their children participate in a sport (girls: OR=0.70, p<0.001; boys: OR=0.69, p=0.00). Parents that characterized the time spent by their children in PA out of school as "little" had significantly lower odds of their sons (OR=0.07, p<0.001; AOR= 0.16, p=0.01) and their daughters (OR=0.03, p<0.001; AOR=0.04, p<0.01) practicing an extracurricular sport (Table 6.3.8).

Table 6.3.8. Parents' opinions related with sport and PA as predictors of participation in extracurricular sport by boys and girls (crude and adjusted).

	Girls				Boys			
	OR	95%CI	AOR	95%CI	OR	95%CI	AOR	95%CI
Time in PA in school								
Little	1.04	0.63;1.72	0.76	0.43;1.36	1.08	0.65;1.80	1.43	0.76;2.67
Normal	Ref.		Ref.		Ref.		Ref.	
Time in PA out of school								
Little	0.07***	0.02;0.32	0.16*	0.03;0.75	0.03***	0.00;0.19	0.04**	0.00;0.31
Normal	0.43	0.10;1.91	1.14	0.24;5.50	0.27	0.04;2.08	0.45	0.05;3.89
Excessive	Ref.		Ref.		Ref.		Ref.	
Opinions about sport								
Stereotypes	0.80*	0.65;0.98	0.81	0.63;1.05	0.92	0.74;1.15	1.08	0.82;1.42
Availability	0.70***	0.57;0.85	0.98	0.80;1.22	0.69**	0.55;0.88	0.93	0.75;1.16
Time	0.97	0.78;1.20	1.03	0.80;1.32	0.89	0.71;1.11	1.02	0.78;1.33

Note. Reference category: child do not participate in an extracurricular sport; OR=odds ratio, AOR=adjusted odds ratio (children's age, urbanization, parental education, family income), CI=confidence interval; *p<0.05, **p<0.01, ***p<0.001.

6.4. Discussion

The present study found that parents' perceived barriers and proximity of facilities, as well as opinions about sport, PA, and the time children spend in those activities differ between parents of boys and girls, and according to the degree of urbanization, while at the same time,

predicting children's extracurricular sport participation. Parents of girls, compared with parents of boys, reported similar number of barriers but more facilities nearby. Also, among children not practicing a sport, parents of girls reported higher rates of lack of sports/facilities. While it may seem something of a contradiction, more facilities nearby and less available sports/facilities this may be explained, since there may be facilities but no sports for a specific age or sex, or the existent sports may depend of substantial financial resources. Sports are often classified as feminine, neutral, or masculine and traditionally more boys participate in masculine sports, whereas girls to a greater extent participate in sports classified as feminine or neutral (Klomsten, Marsh, and Skaalvik 2005). In this study, parents of girls particularly reported more gymnasiums, sports hall, parks and playgrounds nearby home, than parents of boys which may be associated with the activities that both girls and boys perform. For example, dancing classes and gymnastics, activities favoured by girls, often take place in gymnasiums or sports hall which may explain why parents of daughters are more aware of these places in the neighbourhood.

In both boys and girls, parents who reported facilities as non-existent close to their home had significantly lower odds of their children practicing a sport. These findings are consistent with previous literature conducted among children and adolescents in the United States (Gordon-Larsen et al. 2006), Hong Kong (Wong et al. 2010), and Germany (Steinmayr, Felfe, and Lechner 2011), suggesting that availability of sports facility is associated with PA. More recently, a study carried in 11-17-year-old German children found that proximity to facilities may influence not only sport participation but also the type of sport (Reimers et al. 2014). For example, the proximity to indoor pools is supposed to influence water sports activities taking place in indoor pools such as swimming or water polo, either as a leisure time activities or as a part of a sports club.

Most important predictor of participation in sport by both boys and girls was the number of barriers reported by parents. Girls whose parents reported no barriers had almost seven times the odds of practicing a sport compared with parents of girls who reported three or more barriers. Among boys, parents who reported no barriers had four times the odds of their son being engaged in a sport compared with parents who perceived three or more barriers. Research has point out that the perceived barriers have an inverse association with leisure-time PA in children and adolescents (Dias et al. 2015; Kahn et al. 2008; Lubans et al. 2009), therefore the greater the number of barriers perceived by young people, the less likely

they are to engage in adequate levels of PA. A study from 2010, carried out in young Australian children (5-11 years) found that the proportion of children not meeting PA guidelines was significantly higher when a greater number of barriers to PA were reported by parents (8.4% when 0-1 barriers were reported and 31.6% when four or more barriers were reported) (Smith et al. 2010). The authors also found that the greater the number of barriers reported by parents the less children participated in organised sports, which is similar to the findings reported by Heitzler et al (Heitzler et al. 2006) in their study of 9-13-year-old in the United States, and is consistent with present results.

Present findings show that parents of girls reported significantly more lack of money than parents of boys, which may be due to different reasons, namely: 'female' sports may depend of more financial resources (e.g., equipment) or parents may perceive less value in their daughters' sport participation. In fact, although gender stereotypes about sport did not differed according to children's sex, girls had lower odds of participating in a sport if parents reported more stereotyped opinions of sport (e.g., "there are more sports for boys than girls", "I believe playing a sport is more important for boys than girls"). It is known that Eccles et al.'s Expectancy-Value Model posits that the stereotypes endorsed by parents may influence their children's participation in leisure-time activities (Fredricks and Eccles 2004). In a study from 2014, parents with the most traditional beliefs about masculinity and femininity were likelier to value sport for 12-17-year-old sons, than for daughters (Heinze et al. 2014). This influence is presumed to occur through perceived competence and value as well as providing experiences and opportunities to engage in sport context that differs between their daughters and sons.

Within the barriers reported by parents, lack of money was associated with boys' and non-urban children participation in extracurricular sport while lack of places influenced participation in sport in children living in both settings. Differences in parental perceived barriers according to children's sex and urbanization level were reported before by Hardy et al. (Hardy et al. 2010), where the financial costs associated with 5-17-year-old children's participation in organised sports influenced families with lower incomes and with girls, while for rural families the option of a wider variety of local sporting activities influenced decisions about their child's participation in organised sport. Our results are also in line with the study of Basterfield et al. (Basterfield et al. 2016) that found that barriers before 12-years-old, even when self-reported by children, were predominantly of a physical environmental nature, and

required high parental involvement (for transport, money) or were associated with a lack of suitable clubs or facilities.

In this study, the number of barriers reported by parents was the strongest predictor of sport participation in urban and non-urban children, with parents who reported zero barriers increasing the odds of their children practicing a sport in 4 to 8 times, respectively. Urban parents reported more lack of money and places than non-urban parents, and non-urban parents described more facilities close to home than urban parents. Because present results were self-reported by parents they only indicate a parental perspective, for which we can speculate about some explanations: (1) non-urban parents may be more aware of the existence of those facilities because they accompany their children to those places, while urban children transportation to extracurricular sport may depend of school/sport club bus or other adults, such as grandparents; (2) densely populated areas may have a lack of facilities and outdoor areas for exercise and recreation or sometimes they are built in suburban areas making them less perceivable and accessible for parents living in the city centre; (3) both urban and non-urban families may have similar recreational facilities in the neighbourhood but, urban parents may perceived their neighbourhood as less safe (e.g., criminal rates, traffic density and speed) than non-urban parents (Loucaides et al. 2004), influencing their perception of accessibility; and (4) the specific non-urban setting observed in this study may have a great number and variety of recreational facilities. In fact, the city hall of Lousã have many sport clubs and recreational facilities, both public and private, available for its citizens (CM-Lousã 2016). Also, smaller communities may have more community programs or financial help to facilitate citizens participation in sports. In previous works, either in urban and non-urban settings, lack of places was associated with lower odds of participation in a sport (Dollman and Lewis 2010).

Present findings indicate that parents who reported lack of places and less facilities nearby home had lower odds of having children practicing a sport, independently of the degree of urbanization. The absence of nearby sports facilities in the neighbourhood increases the effort of residents to participate in sports that require these facilities or makes it impossible to participate in such activities when it is not possible to reach a more distant facility. Also, proximity to sports facilities may increase children's familiarity with that sport which could generate demand for individual visits, as well as, for partaking in organised sports taking place in those facilities. Low proximity to sports facilities could be a barrier of participation in sports

activities, especially in young urban children, because they tend to depend on others for their daily mobility (Cordovil et al. 2015; Santos et al. 2013) and therefore experience more difficulty in reaching sports facilities further away from their home.

6.5. Conclusion

The current study should feed into the knowledge base for those seeking to increase sports participation in children, specifically by understanding the variety of barriers reported by Portuguese parents. Present findings indicate that boys and girls as well as urban and non-urban children may encounter unique barriers to sport participation that must be considered in the development of interventions. Multidimensional interventions targeted to specific populations subgroups and to the all family might be most promising and most effective for children's health promotion. The views of parents should be sought prior to, and during, intervention design and implementation since children at this age are quite dependent of their parents' decisions.

Chapter 7. Children's opinions about sport and PA as predictors of extracurricular sport participation

7.1. Introduction

A gender-based disparity, whereby girls are less physically active than boys, is a persistent finding in the literature (Ekelund et al. 2012; Pearce et al. 2012; Telford, Telford, Cunningham, Cochrane, Davey, and Waddington 2013), including in previous Portuguese studies, in which, on average, boys have two times the odds of following the moderate-to-vigorous physical activity (MVPA) recommendations (60 min/day) compared to girls (Baptista et al. 2012; Borges et al. 2015). Also, 10-18-year-old Portuguese boys participate in organised sports during more hours per week and in more high intensity sports than girls of the same age (Seabra et al. 2007).

Previous research points to several possible explanations as to why girls are less physically active than boys, such as girls receiving less social support to engage in physical activity (PA) (Edwardson et al. 2013). Psychological, social, and physical environmental factors were identified related with children's PA, following the idea of the socio-ecological model that emphasizes the multidimensionality of behaviours, like PA (including organised sport), which are influenced by individual, organizational, interpersonal, community, and physical-environmental factors (Owen et al. 2004).

An understanding of barriers preventing sport participation from the child or adolescent's perspective is important and has been gaining much attention in the last years (Basterfield et al. 2016; Dias et al. 2015). A longitudinal study observing children at ages 9 and 12, concluded that younger children often report physical environmental characteristics (lack of facilities or sports) and parental involvement (e.g. transport, money, permission) as barriers to sport participation, while at 12 years, perceived barriers were predominantly classed as intrapersonal (lack of interest) or social environmental (inactive friends) (Basterfield et al. 2016). Another study found that parental support, plus access to a variety of clubs, are motivators for young children's participation in sports (Allender et al. 2006). Lack of time is another barrier often cited by 9-year-old children, either due to homework or other activities they enjoyed (Basterfield et al. 2016; C.F.L.R.I. 2013). Children in Ireland who had never participated in sports clubs provided similar reasons; they struggled to find suitable clubs, with transport, and with feelings of incompetence (Woods et al. 2010).

Literature suggests that the number of perceived barriers by children and adolescents have an inverse association with PA levels and that reported barriers may differ according to sex (Brockman, Jago, and Fox 2011; Gomes et al. 2011; Lubans et al. 2009). For example, girls

often perceived less enjoyment than boys when engaging in PA (Cairney et al. 2012), and feel that they are not allowed to join the boys' sports/plays (Pawlowski et al. 2014). Urbanization is periodically highlighted as a factor that influences PA (Aristides M. Machado-Rodrigues et al. 2014). Because distance and quality of the recreational facilities, safety and car traffic may varied across settings (Moore et al. 2010), it can be intuitively assumed that urban children perceive and use the PA environment differently than their non-urban counterparts.

Considering the aforementioned, understanding children's perceived barriers, while taking in consideration children's sex and place of residence, is fundamental and necessary to the development of policy strategies aimed to promote participation in extracurricular sports. There were two aims in this study: first, to investigate if perceived barriers to sport differ between boys and girls and according to the level of urbanization and second, explore which barriers were associated with children's sport participation.

7.2. Methods

A sample of 793 children (6-10-year-old) reported their perception of barriers and motivators to participate in sport, in a semi-structured interview. Full description of the interview is shown in chapter 2- Methodology. The interview focused on four themes that were previous found as barriers to PA in children and adolescents, as presented by Dias and colleagues (Dias et al. 2015): (1) psychological, cognitive, and emotional, (2) personal organization, (3) cultural and social factors, and (4) physical environment. The instrument evaluated 16 barriers that are presented below in Tables 7.2.1, 7.2.2, 7.2.3, and 7.2.4. The children's answers were classified as "disagree" and "agree"; the cases where the children said that they had no opinion were not take in consideration for the statistical analyses. In the end of the interview, children were asked what was their favourite sports, which were later divided into masculine, feminine, and neutral sports according to the categories of Riemer and Visio (Riemer and Visio 2003). Masculine sports included football, rugby, martial arts; feminine sports were gymnastics, dance; volleyball, swimming, bicycling, basketball, and running were classified as neutral.

Table 7.2.1. Psychological, cognitive, and emotional barriers reported by children and evaluated in this study.

Psychological, cognitive, and emotional barriers	
PCE_1	Sport is more important for boys than girls
PCE_2	Boys are better at sport than girls
PCE_3	There are sports exclusive for boys
PCE_4	There are sports exclusive for girls
PCE_5	You are good at sports
PCE_6	You like sports
PCE_7	You are interest in making a career in sport
PCE_8	Family tells you to be active

Table 7.2.2. Personal organization barriers reported by children and evaluated in this study.

Personal organization barriers	
PO_1	You have time to run, jump, ride bicycle, etc. in most days after school
PO_2	You have time to go to the parks or playgrounds

Table 7.2.3. Cultural and social barriers reported by children and evaluated in this study.

Cultural and social barriers	
CS_1	You watch women's sport on TV
CS_2	Family is active with you on weekdays
CS_3	Family is active with you on weekends
CS_4	Friends engage in PA with you during recess

Table 7.2.4. Physical environment barriers reported by children and evaluated in this study.

Physical environment barriers	
PE_1	You have places where you can be active during winter and rainy days
PE_2	You have spaces at home or nearby where you can be physically active

Parents fulfilled a questionnaire and reported children's participation in an extracurricular sport (Yes/No). In addition, they self-reported their education level (low, middle, or high) and family income (low, medium, and high). Frequency of the perceived

barriers was observed according to children's sex and place of residence and chi-square tests were performed to observe possible statistical differences between groups. The sample was divided first by sex and second by level of urbanization. Logistic regression models were constructed to assess the odds ratio of children participating in an extracurricular sport and reported barriers (independent variables). The results are presented crude and adjusted for children's sex, age, urbanization, parental education, and family income. Two chi-square tests were performed to observe the distribution of boys and girls/urban and non-urban children in the feminine, neutral, and masculine sports that they favoured. Significance was set at $p<0.05$. All statistical analyses were performed using the Statistical Package for the Social Sciences (SPSS v.23; SPSS an IBM Company, Chicago, IL).

7.3. Results

Table 7.3.1. presents the frequency of the perceived psychological, cognitive, and emotional barriers to the practice of sport and PA, according to children's sex and the level of urbanization. There were statistically significant differences between boys and girls regarding gender stereotypes in sport (PCE_1,2,3), enjoyment of sport (PCE_6), and in the interest of following a sport-related career (PCE_7). More boys than girls believe that sport is more important for boys (30.4% vs. 9.7%) and that boys are better at sport than girls (51.1% vs. 24.2%) (X^2=45.43, $p<0.001$; X^2=54.01, $p<0.001$, respectively). Boys also reported more enjoyment than girls (93.8% vs. 88.7%) and were more interested than girls in following a career in sport in adulthood (61.6% vs. 32.2%) (X^2=6.36, $p=0.01$ and X^2=68.62, $p<0.001$, respectively). There was a slightly tendency for boys to report more perceived competence than girls ($p=0.06$), with 94.0% of boys reporting that they are good at sport, PE, and general PA, compared with 90.4% of girls. No significant difference was found between boys and girls' opinions to "there are sports exclusively for girls" and "family tells you to be active".

Urban and non-urban girls statistically differ in two points: more non-urban girls, compared with their urban peers, believe that are sports exclusively for girls (33.1% vs. 23.9%; X^2=4.01, $p<0.05$) and more urban girls, than non-urban ones, reported that their family often tells them to be physically active (85.3% vs. 76.0%; X^2=5.36, $p=0.02$). No other significant difference was found between urban and non-urban girls and their perception of

psychological, cognitive, and emotive barriers. Urban boys said, significantly more times than non-urban boys, that sport is more important for boys than girls (37.7% vs. 22.7%; X^2=9.46, p=0.00) and that there are sports exclusively for girls (33.1% vs. 22.1%; X^2=5.38, p=0.02). No other significant difference regarding gender stereotypes on sport, perceived competence, motivation, and desire to pursue a career in sport was observed between urban and non-urban boys (Table 7.3.1).

Table 7.3.1. Frequency (%) of children's perceived psychological, cognitive and emotional barriers to sport and PA, according to sex and urbanization degree.

		Total sample (%)			Girls (%)			Boys (%)		
Barriers		Girls	Boys	p	Urban	Non-urban	p	Urban	Non-urban	p
PCE_1	Disagree	90.3	69.6	<0.001	88.6	92.3	0.27	62.3	77.3	0.00
	Agree	9.7	30.4		11.4	7.7		37.7	22.7	
PCE_2	Disagree	75.8	48.9	<0.001	73.5	79.0	0.24	45.3	52.5	0.17
	Agree	24.2	51.1		26.5	21.0		54.7	47.5	
PCE_3	Disagree	78.9	63.5	0.00	78.0	80.0	0.63	62.2	65.0	0.58
	Agree	21.1	36.5		22.0	20.0		37.8	35.0	
PCE_4	Disagree	71.7	72.2	0.87	76.1	66.9	<0.05	66.9	77.9	0.02
	Agree	28.3	27.8		23.9	33.1		33.1	22.1	
PCE_5	Disagree	9.6	6.0	0.06	11.8	7.0	0.10	7.9	3.8	0.09
	Agree	90.4	94.0		88.2	93.0		92.1	96.2	
PCE_6	Disagree	11.3	6.2	0.01	11.4	11.2	0.97	5.9	6.5	0.81
	Agree	88.7	93.8		88.6	88.8		94.1	93.5	
PCE_7	Disagree	67.8	38.4	<0.001	69.1	66.3	0.55	35.6	41.5	0.24
	Agree	32.2	61.6		30.9	33.7		64.4	58.5	
PCE_8	Disagree	19.1	16.4	0.34	14.7	24.0	0.02	14.4	18.4	0.30
	Agree	80.9	83.6		85.3	76.0		85.6	81.6	

Note. PCE_1= Sport is more important for boys than girls, PCE_2= Boys are better at sport than girls, PCE_3= There are sports exclusive for boys, PCE_4= There are sports exclusive for girls, PCE_5= You are good at sports, PCE_6=You like sports, PCE_7=You are interest in making a career in sport, PCE_8=Family tells you to be active; p-value obtained by X^2 test; p<0.05 was considered significant.

No statistically significant difference was found between boys and girls and their perceived personal organization barriers (Table 7.3.2). Urban children, independently of the sex, reported more lack of time to be physically active in most days after school (girls: 41.7%% and boys: 47.0%) than non-urban children (girls: 27.8% and boys: 18.1%) (girls: X^2=7.18, p=0.01 and boys: X^2=31.40, p<0.001). In the same way, non-urban girls and boys (75.3% and 72.1%, respectively) reported more time to go the parks and playgrounds compared with urban girls and boys (43.0% and 44.5%, respectively) (girls: X^2=34.74, p<0.001; boys: X^2=23.57, p<0.001).

Table 7.3.2. Frequency (%) of children's perceived personal organization barriers to sport and PA, according to sex and urbanization degree.

Barriers		Total sample (%)			Girls (%)			Boys (%)		
		Girls	Boys	p	Urban	Non-urban	p	Urban	Non-urban	p
PO_1	Disagree	35.0	32.4	0.48	41.7	27.8	0.01	47.0	18.1	<0.001
	Agree	65.0	67.6		58.3	72.2		53.0	81.9	
PO_2	Disagree	41.2	42.1	0.82	57.0	24.7	<0.00	55.5	27.9	<0.001
	Agree	58.8	57.9		43.0	75.3		44.5	72.1	

Note. PO_1= You have time to run, jump, ride bicycle, etc. in most days after school, PO_2= You have time to go to the parks or playgrounds; p-value obtained by X^2 test; p<0.05 was considered significant.

Table 7.3.3 shows the frequency of cultural and social barriers perceived by boys and girls and according to the level of urbanization. Boys and girls reported similar barriers and no significant differences were found between children's sex regarding the time family spends practicing PA on weekdays and weekends and the amount of PA performed with friends during recess. A slightly tendency (p=0.07) was observed for girls watching women's sport on TV more times than boys (82.3% and 77.1%, respectively). Non-urban children, either girls (87.2%) or boys (86.3%), reported watching significantly more TV programs with women playing sports compared with urban girls (78.2%) and boys (68.8%) (girls: X^2=5.60, p=0.02; boys: X^2=16.73, p<0.001). Urban children also reported more parental role modelling compared with non-urban children. Among urban girls, 55.5% said that their parents engaged in PA with them during weekdays, while only 25.7% of the non-urban girls reported the same behaviour (X^2=36.87, p<0.001). During weekend days, that value increased in both settings, but still significantly more urban girls reported being active with their family, compared with their non-

urban counterparts (90.0% and 79.1%, respectively; X^2=11.29, p=0.00). The same pattern was observed among boys, both on weekdays (urban: 55.9%, non-urban: 27.7%; X^2=31.39, p<0.001) and during the weekend (urban: 90.6%, non-urban: 82.6%; X^2=5.36, p=0.02). No statistical significant difference was found between urban and non-urban children and how children spent their time in recess engaged in PA with their friends (Table 7.3.3).

Table 7.3.3. Frequency (%) of children's perceived cultural and social barriers to sport and PA, according to sex and urbanization degree.

Barriers		Total sample (%)			Girls (%)			Boys (%)		
		Girls	Boys	p	Urban	Non-urban	p	Urban	Non-urban	p
CS_1	Disagree	17.7	22.9	0.07	21.8	12.8	0.02	31.2	13.7	<0.001
	Agree	82.3	77.1		78.2	87.2		68.8	86.3	
CS_2	Disagree	58.2	57.5	0.84	44.5	74.3	<0.001	44.1	72.3	<0.001
	Agree	41.8	42.5		55.5	25.7		55.9	27.7	
CS_3	Disagree	14.5	13.2	0.60	9.1	20.9	0.00	9.4	17.4	0.02
	Agree	85.5	86.8		90.0	79.1		90.6	82.6	
CS_4	Disagree	1.5	2.1	0.53	0.5	2.7	0.07	2.0	2.2	0.89
	Agree	98.5	97.9		99.5	97.3		98.0	97.8	

Note. CS_1= You watch women's sport on TV, CS_2= Family is active with you on weekdays, CS_3= Family is active with you on weekends, CS_4= Friends engage in PA with you during recess; p-value obtained by X^2 test; p<0.05 was considered significant.

Table 7.3.4 presents the frequency of physical environment barriers reported by boys and girls, and according to their place of residence. Boys and girls reported similar physical environment barriers (lack of places to be active during winter/rainy days and lack of places nearby where they can be physically active). Non-urban children reported slightly more places to be active nearby home than urban children, but the difference was not statistical significant. The barrier "lack of places to be active during winter and rainy days" was more reported by urban girls (416%) and boys (50.0%) than by their non-urban peers (27.3% for girls and 18.5% for boys) (girls: X^2=9.04, p=0.00; boys: X^2=42.07, p<0.001).

Table 7.3.4. Frequency (%) of children's perceived physical environment barriers to sport and PA, according to sex and urbanization degree.

Barriers		Total sample (%)			Girls (%)			Boys (%)		
		Girls	Boys	p	Urban	Non-urban	p	Urban	Non-urban	p
PE_1	Disagree	35.0	35.0	1.00	41.6	27.3	0.00	50.0	18.5	<0.001
	Agree	65.0	65.0		58.4	72.7		50.0	81.5	
PE_2	Disagree	15.3	15.4	0.95	16.8	13.4	0.35	16.4	14.4	0.58
	Agree	84.8	84.6		83.2	86.6		83.6	85.6	

Note. PE_1= You have places where you can be active during winter and rainy days, PE_2= You have spaces at home or nearby where you can be physically active; p-value obtained by X^2 test; p<0.05 was considered significant.

Table 7.3.5 presents the odds ratios, crude and adjusted, of girls' participation in extracurricular sport, according to the perceived barriers. In the crude analysis, only child's interest in pursuing a sport-related career was a significant predictor of sport participation, with girls who reported no interest having half the odds of being in a sport, compared with girls who shown some interest (OR=0.40, p<0.001). After adjustment, girls who were not interest in having a sport career had less than half the odds of practicing an extracurricular sport compared with girls who considerer to pursuing a sport-related career (AOR=0.37, p=0.00). No significant association was found between girls' sport participation and perceived personal organization, cultural and social, or physical environment barriers.

Table 7.3.6 presents the odds ratios, crude and adjusted, of extracurricular sport participation according to the perceived barriers by boys. In the crude analysis boys who reported not being good at sports (OR=0.39, p=0.03), that were not interest in pursuing a career in sport (OR=0.45, p<0.001), and that the family was not physically active with them during weekdays (OR=0.64, p<0.05), had lower odds of practicing a sport compared with boys who reported being good at sport, interest in pursuing a sport-related career and that they practice PA with family during weekdays. In the adjusted model, interest in pursuing a sport-career remain a significant predictor of boys' sport participation (AOR=0.41, p=0.00). Also, boys who reported more lack of time to go the parks and playgrounds had half the odds of practicing an extracurricular sport compared with boys who did not reported this barrier (AOR=0.45,

p=0.02). Physical environment barriers were not associated with boys' participation in extracurricular sport, both in the crude and in the adjust models.

Table 7.3.5. Girls perceived psychological, personal organization, cultural, social, and physical environment barriers as predictors of extracurricular sport participation (crude and adjusted).

		Girls			
		OR	95%CI	AOR	95%CI
Sport is more important for boys than girls	Yes	1.03	0.47;2.26	1.10	0.40;2.99
	No	Ref.		Ref.	
Boys are better at sport than girls	Yes	0.89	0.53;1.51	1.00	0.50;1.99
	No	Ref.		Ref.	
There are sports exclusive for boys	Yes	1.00	0.59;1.69	0.84	0.41;1.69
	No	Ref.		Ref.	
There are sports exclusive for girls	Yes	0.71	0.45;1.14	0.62	0.33;1.17
	No	Ref.		Ref.	
You are good at sports	No	0.59	0.30;1.15	0.71	0.31;1.62
	Yes	Ref.		Ref.	
You like sports	No	0.80	0.42;1.52	0.59	0.27;1.28
	Yes	Ref.		Ref.	
You are interested in making a career in sport	No	0.40***	0.25;0.66	0.37**	0.20;0.67
	Yes	Ref.		Ref.	
Family tells me to be active	No	0.75	0.44;1.27	0.79	0.40;1.54
	Yes	Ref.		Ref.	
You have time to be active	No	0.75	0.47;1.20	0.66	0.36;1.19
	Yes	Ref.		Ref.	
You have time to go to the parks or playgrounds	No	0.74	0.46;1.18	0.57	0.31;1.06
	Yes	Ref.		Ref.	
You watch women's sport on TV	No	0.96	0.56;1.64	0.98	0.51;1.90
	Yes	Ref.		Ref.	
Family is active with you on weekdays	No	0.86	0.56;1.31	1.14	0.67;1.95
	Yes	Ref.		Ref.	
Family is active with you on weekends	No	0.93	0.52;1.67	1.87	0.86;4.04
	Yes	Ref.		Ref.	
Friends engage in PA with me during recess	No	2.49	0.29;9.54	1.02	0.11;9.69
	Yes	Ref.		Ref.	

Table 7.3.5 (continuation)		Girls			
		OR	95%CI	AOR	95%CI
You have places to be active during winter	No	0.88	0.57;1.35	0.76	0.43;1.34
	Yes	Ref.		Ref.	
You have spaces at or nearby home where you can be physically active	No	1.18	0.65;2.15	1.91	0.84;4.32
	Yes	Ref.		Ref.	

Note. Reference category: child do not participate in an extracurricular sport; barriers divided in four groups: 1) physical, cognitive, and emotional barriers, 2) personal organization barriers, 3) cultural and social barriers, 4) physical environment barriers; OR=odds ratio, AOR=adjusted odds ratio (children's age, urbanization, parental education, household income), CI=confidence interval; *p<0.05, **p<0.01, ***p<0.001.

Table 7.3.6. Boys perceived psychological, personal organization, cultural, social, and physical environment barriers as predictors of extracurricular sport participation (crude and adjusted).

		Boys			
		OR	95%CI	AOR	95%CI
Sport is more important for boys than girls	Yes	0.84	0.52;1.35	0.88	0.47;1.62
	No	Ref.		Ref.	
Boys are better at sport than girls	Yes	1.10	0.70;1.71	1.16	0.67;2.02
	No	Ref.		Ref.	
There are sports exclusive for boys	Yes	1.07	0.68;1.70	1.42	0.79;2.54
	No	Ref.		Ref.	
There are sports exclusive for girls	Yes	1.02	0.62;1.69	1.47	0.79;2.74
	No	Ref.		Ref.	
You are good at sports	No	0.39*	0.17;0.91	0.46	0.16;1.33
	Yes	Ref.		Ref.	
You like sports	No	0.74	0.31;1.74	0.66	0.24;1.82
	Yes	Ref.		Ref.	
You are interest in making a career in sport	No	0.45***	0.29;0.70	0.41**	0.24;0.70
	Yes	Ref.		Ref.	
Family tells you to be active	No	0.82	0.45;1.48	1.21	0.59;2.47
	Yes	Ref.		Ref.	
You have time to be active in most days after school	No	0.90	0.55;1.47	0.86	0.47;1.59
	Yes	Ref.		Ref.	
You have time to go to the parks or playgrounds	No	0.70	0.43;1.15	0.45*	0.23;0.87
	Yes	Ref.		Ref.	

Table 7.3.6. (continuation)		Boys			
		OR	95%CI	AOR	95%CI
You watch women's sport on TV	No	0.74	0.45;1.22	0.60	0.28;0.94
	Yes	Ref.		Ref.	
Family is active with you on weekdays	No	0.64*	0.41;0.99	0.77	0.45;1.34
	Yes	Ref.		Ref.	
Family is active with you on weekends	No	0.89	0.47;1.66	0.88	0.42;1.86
	Yes	Ref.		Ref.	
Friends engage in PA with me during recess	No	3.12	0.38;9.63	2.96	0.31;9.98
	Yes	Ref.		Ref.	
You have places to be active during winter	No	0.85	0.54;1.34	0.60	0.33;1.09
	Yes	Ref.		Ref.	
You have spaces at or nearby home where you can be physically active	No	1.02	0.56;1.87	1.17	0.57;2.41
	Yes	Ref.		Ref.	

Note. Reference category: child do not participate in an extracurricular sport; barriers divided in four groups: 1) physical, cognitive, and emotional barriers, 2) personal organization barriers, 3) cultural and social barriers, 4) physical environment barriers; OR=odds ratio, AOR=adjusted odds ratio (children's age, urbanization, parental education, family income), CI=confidence interval; *p<0.05, **p<0.01, ***p<0.001.

Table 7.3.7 shows the association between perceived barriers and participation in extracurricular sport in the urban setting. The only significant association was in psychological, cognitive and emotional barriers, in which, children living in the urban setting who reported no interest in pursuing a sport-related career had significant lower odds of practicing a sport (OR=0.41, p<0.001, AOR=0.37, p<0.001). Urban children also had lower odds of practicing a sport if they reported having no time to go to the parks and playgrounds (OR=0.60, p=0.04) but the association was not significant in the adjusted model. No significant association was found between participation in extracurricular sport in urban children and perceived cultural/social and physical environment barriers.

In the non-urban setting (Table 7.3.8), children had lower odds of practicing a sport if they reported less competence (OR=0.39, p=0.04) and less interest in not pursuing a sport career in adulthood (OR=0.50, p=0.00; AOR=0.37, p=0.00). No statistical significant association was found in the non-urban setting, between participation in extracurricular sport and personal organization, cultural/social, and physical environment barriers.

Table 7.3.7. Urban children perceived psychological, personal organization, cultural, social, and physical environment barriers as predictors of extracurricular sport participation (crude and adjusted).

		Urban			
		OR	95%CI	AOR	95%CI
Sport is more important for boys than girls	Yes	0.76	0.46;1.27	1.10	0.40;2.99
	No	Ref.		Ref.	
Boys are better at sport than girls	Yes	1.00	0.64;1.56	1.00	0.50;1.99
	No	Ref.		Ref.	
There are sports exclusive for boys	Yes	0.94	0.58;1.48	0.84	0.41;1.69
	No	Ref.		Ref.	
There are sports exclusive for girls	Yes	1.03	0.63;1.66	0.62	0.33;1.17
	No	Ref.		Ref.	
You are good at sports	No	0.54	0.28;1.04	0.71	0.31;1.62
	Yes	Ref.		Ref.	
You like sports	No	0.69	0.34;1.39	0.59	0.27;1.28
	Yes	Ref.		Ref.	
You are interest in making a career in sport	No	0.41***	0.27;0.64	0.37***	0.20;0.67
	Yes	Ref.		Ref.	
Family tells you to be active	No	1.06	0.57;1.99	0.79	0.40;1.54
	Yes	Ref.		Ref.	
You have time to be active in most days after school	No	0.81	0.51;1.28	0.66	0.36;1.19
	Yes	Ref.		Ref.	
You have time to go to the parks or playgrounds	No	0.60*	0.37;0.99	0.57	0.31;1.06
	Yes	Ref.		Ref.	
You watch women's sport on TV	No	0.83	0.52;1.32	0.98	0.51;1.90
	Yes	Ref.		Ref.	
Family is active with you on weekdays	No	0.69	0.45;1.04	1.14	0.67;1.95
	Yes	Ref.		Ref.	
Family is active with you on weekends	No	1.12	0.54;2.33	1.87	0.86;4.04
	Yes	Ref.		Ref.	
Friends engage in PA with me during recess	No	1.74	0.19;9.75	1.02	0.11;9.69
	Yes	Ref.		Ref.	

Table 7.3.7. (continuation)		Urban			
		OR	95%CI	AOR	95%CI
You have places to be active during winter	No	0.97	0.64;1.48	0.76	0.43;1.34
	Yes	Ref.		Ref.	
You have spaces at or nearby home where you can be physically active	No	0.84	0.48;1.45	1.91	0.84;4.32
	Yes	Ref.		Ref.	

Note. Reference category: child do not participate in an extracurricular sport; barriers divided in four groups: 1) physical, cognitive, and emotional barriers, 2) personal organization barriers, 3) cultural and social barriers, 4) physical environment barriers; OR=odds ratio, AOR=adjusted odds ratio (children's sex, age, parental education, family income), CI=confidence interval; *p<0.05, **p<0.01, ***p<0.001.

Table 7.3.8. Non-urban children perceived psychological, personal organization, cultural, social, and physical environment barriers as predictors of extracurricular sport participation (crude and adjusted).

		Non-urban			
		OR	95%CI	AOR	95%CI
Sport is more important for boys than girls	Yes	1.15	0.60;2.21	1.10	0.40;2.99
	No	Ref.		Ref.	
Boys are better at sport than girls	Yes	1.03	0.64;1.67	1.00	0.50;1.99
	No	Ref.		Ref.	
There are sports exclusive for boys	Yes	1.18	0.72;1.94	0.84	0.41;1.69
	No	Ref.		Ref.	
There are sports exclusive for girls	Yes	0.70	0.43;1.13	0.62	0.33;1.17
	No	Ref.		Ref.	
You are good at sports	No	0.39*	0.16;0.97	0.71	0.31;1.62
	Yes	Ref.		Ref.	
You like sports	No	0.87	0.41;1.83	0.59	0.27;1.28
	Yes	Ref.		Ref.	
You are interest in making a career in sport	No	0.50**	0.32;0.78	0.37**	0.20;0.67
	Yes	Ref.		Ref.	
Family tells you to be active	No	0.63	0.37;1.06	0.79	0.40;1.54
	Yes	Ref.		Ref.	
You have time to be active in most days after school	No	0.80	0.47;1.36	0.66	0.36;1.19
	Yes	Ref.		Ref.	
You have time to go to the parks or playgrounds	No	0.75	0.44;1.27	0.57	0.31;1.06
	Yes	Ref.		Ref.	

Table 7.3.8. (continuation)		Non-urban			
		OR	95%CI	AOR	95%CI
You watch women's sport on TV	No	0.77	0.42;1.43	0.98	0.51;1.90
	Yes	Ref.		Ref.	
Family is active with you on weekdays	No	0.87	0.53;1.43	1.14	0.67;1.95
	Yes	Ref.		Ref.	
Family is active with you on weekends	No	0.84	0.49;1.45	1.87	0.86;4.04
	Yes	Ref.		Ref.	
Friends engage in PA with me during recess	No	4.12	0.51;9.32	1.02	0.11;9.69
	Yes	Ref.		Ref.	
You have places to be active during winter	No	0.65	0.39;1.07	0.76	0.43;1.34
	Yes	Ref.		Ref.	
You have spaces at or nearby home where you can be physically active	No	1.57	0.80;3.07	1.91	0.84;4.32
	Yes	Ref.		Ref.	

Note. Reference category: child do not participate in an extracurricular sport; barriers divided in four groups: 1) physical, cognitive, and emotional barriers, 2) personal organization barriers, 3) cultural and social barriers, 4) physical environment barriers; OR=odds ratio, AOR=adjusted odds ratio (children's sex, age, parental education, family income), CI=confidence interval; *p<0.05, **p<0.01, ***p<0.001.

Majority of boys (58.7%) reported football as their favourite sport, while girls favoured gymnastic (22.3%), swimming, (18.0%), and dancing (16.9%). Significantly more boys than girls favoured football and rugby, while significantly more girls than boys favoured swimming, gymnastic, dancing, and volleyball (Figure 7.3.1). Table 7.3.9 shows that both boys and girls tend to significantly favoured the sports deemed appropriate for their sex, 'feminine' for girls (41.7% vs. 2.6% for boys) and 'masculine' for boys (65.3% vs. 9.8% for girls). 'Neutral' sports were also more favoured by girls (48.5%) than boys (32.1%) (p<0.001). No statistical significant differences were found in favoured sport between urban and non-urban children, with both urban and non-urban girls favouring 'feminine' and 'neutral' sports while majority of boys, independently of their place of residence, favoured sports culturally classified as 'masculine'.

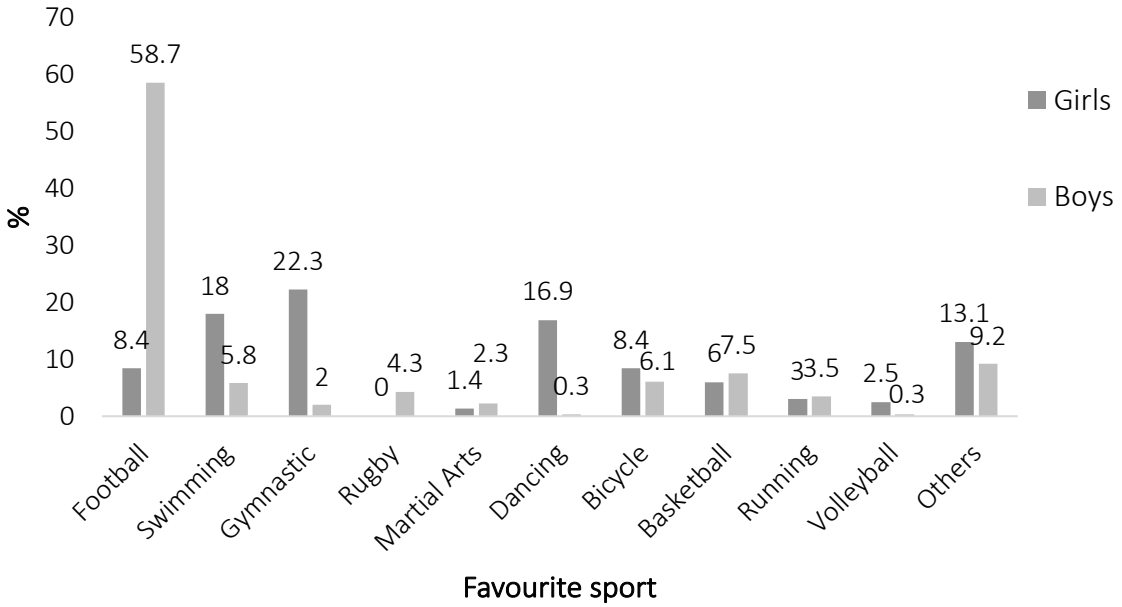

Figure 7.3.1. Prevalence of sports favoured by boys and girls (*p<0.05 in X^2 test).

Table 7.3.9. Frequency (%) of children's favoured sport divided in feminine, neutral, and masculine categories.

	Total sample			Girls			Boys		
	Girls	Boys	p	Urban	Non-urban	p	Urban	Non-urban	p
Feminine	41.7	2.6	<0.001	45.6	37.8	0.28	3.7	1.6	0.34
Neutral	48.5	32.1	<0.001	44.5	52.4	0.39	34.0	30.4	0.30
Masculine	9.8	65.3	<0.001	9.9	9.7	0.31	62.3	67.9	0.38

7.4. Discussion

This study identified a high frequency of reported barriers to PA and sport participation in a sample of 6-10-year-old Portuguese children. In addition, significant differences were found in the reported barriers, according to children's sex and level of urbanization. Differences between boys and girls were only visible at the psychological, emotional, and cognitive barriers in which girls were at a greater disadvantage than boys, since: (1) gender stereotypes about sport tend to position sport as male domain (sport is more important for boys than girls, and boys are better at sport than girls), (2) a greater number of girls (21.1%) and boys (36.5%) believe that there are sports that only boys can perform which may exclude girls from some physical activities, (3) more boys (93.8%) than girls (88.7%) reported to like sport and PA, and

(4) boys, more than girls, shown an interest in pursuing a sport-related career (61.6% vs. 32.2%). The findings of this study are in accordance with the literature in which, in general, perceived barriers to PA are more prevalent among girls than boys (Dias et al. 2015; Gomes et al. 2011; Slater and Tiggemann 2011).

Dias and colleagues (Dias et al. 2015) also observed that 15-16-year-old Brazilian girls reported significantly more psychological, cognitive and emotional barriers to PA than boys, often saying that they prefer to do other things, that they feel lazy, and have lack of motivation. Boys usually consider themselves faster, stronger, and sportier than their opposite sex, and significantly rate sport as more important, useful, and enjoyable than girls (Barnett et al. 2008; Eccles and Harold 1991; Fredricks and Eccles 2002, 2005; Jacobs et al. 2002; Schmalz and Kerstetter 2006). Also, according to the expectancy-value theories, an individual values an activity if he/she attributes it more importance or if he/she has more enjoyment while performing it (Eccles and Harold 1991). Present results seems to indicate that boys may be having more fun while performing sport and PA since they attributed greater importance to sport and more boys than girls reported that they enjoy PA and sport which, in consequence may influence their present and future involvement in sport (Jacobs et al. 2005).

In Portugal, a cross-sectional study considered the barriers reported by 8-10-year-old children and observed that boys scored higher than girls on all subscales related to attraction to PA and had higher perceived physical competence (A. C. Seabra et al. 2013), which is consistent with the present study. According to Seabra et al (A. C. Seabra et al. 2013), boys enjoyed games and sports more than girls and perceived themselves as excelling in PA more frequently than girls, which is similar to present findings in which 30.4% of boys perceived sport as more important for them than for girls, more boys than girls reported enjoyment in PA and sport, and boys were more interest in pursuing a sport-related career in adulthood. These observations were consistent with previous studies carried in 7-12-year-old children living in different cultural settings (Brustad 1996; Eccles et al. 1993).

Personal organization, cultural and social, and physical environmental barriers to sport and PA were reported in similar rates by boys and girls and no significant difference was found. Seabra et al. (A. C. Seabra et al. 2013), also did not found sex differences outside perceived physical competence and attraction to PA, when observing reported barriers by 8-10-year-old Portuguese children. This difference in the perception of barriers between boys and girls has practical relevance as it indicates that interventions to promote PA during childhood should

take in consideration that girls perceive more obstacles. Thus, it is necessary to develop different strategies, according to children's sex, to ensure that greater number of children, especially girls, engage in sports and overall PA. Moreover, this difference in perceived barriers by boys and girls may also reflect symbolic and preconceived notions that naturalize sports as a male domain (Fredricks and Eccles 2005).

Gender –specific regression analyses revealed that participation in extracurricular sport among Portuguese primary school girls was positively associated with the interest in pursuing a sport-related career in adulthood. Children may attribute greater importance and higher value in tasks that they believe will use in the future, meaning that girls who want to have a sport-related job when older may show more interest to engage in an extracurricular sport, compared with girls who reported no interest. The same association was found in boys, with the ones who reported no interest in a career in sports having lower odds of practicing a sport, compared with boys who reported an interest.

Among boys, lack of perceived physical competence, lack of time, and lack of parental role modelling were also associated with lower odds of being in an extracurricular sport. Perceived physical competence was positively related with involvement in PA among 8-10-year-old Portuguese boys (A. C. Seabra et al. 2013), consistent with observations that boys with higher perceived competence were more likely to approach achievement tasks with a high expectancy of success, leading to greater persistence and effort in PA than boys with low perceived physical competence (Paxton, Estabrooks, and Dzewaltowski 2004; Welk, Wood, and Morss 2003). Also, boys may feel more pressure to perform better and win, since they often practice team and competitive sports which will affect they will to practice a sport. Participation in PA was more enjoyable when children (aged 9-15) were not forced to compete and win, but were encouraged to experiment with different activities (Macphail et al. 2003).

Boys and girls favoured different sports that were seen to be related with social and cultural perceptions of what is an appropriate sport for males and females. Most boys reported football as their favourite sport while girls favoured sports by girls included gymnastic, swimming, and dance. This strong division of male and female sports may negatively influence children's sport participation, since boys and girls may feel more family, peer, and social pressure to not engage in a sport that they want if that sport is more acceptably attributed to the opposite sex. This may be particular danger in settings with less sport offers. Nevertheless, the present study did not find any significant difference in favoured sport between urban and

non-urban children which may indicate that this choice is more associated with children's perception of gender-roles and stereotypes and less related with sports/clubs presence in the place of residence.

In the same way, similar results found in the answers to "sport is more important for boys than girls" and "boys are better at sport than girls" between urban and non-urban children, reinforces the idea that the context have little to do with the way stereotypes and gender-roles spread between generations and that family socialization is a very important process, particularly in this age range where is common to learn by example. Non-urban children (independently of the sex), compared with urban ones, reported that they have more time to be physically active after school, more time to go to the parks and playgrounds, that they have more places to be physically active during winter and rainy days, and that they watch more women's sport on TV. On the other side, urban children reported more parental encouragement to be physically active, either by family saying them to be active and by engaging in PA with them on weekdays and weekends, compared with non-urban counterparts. Previous studies have also found that non-urban school Greek-Cypriot children have significantly more space available in both the garden and the neighbourhood, compared with urban children (Loucaides et al. 2004). A study from Hong Kong, observed that lack of space adjacent to the home environment restricted children's playtime outdoors and thus their activity levels (Johns and Ha 1999). It may be assumed that more space available and safer neighbourhood characteristics are factors that help children spent more time outside playing and using the parks and playgrounds. More recently, a study observed that urban parents mentioned that resources such as local recreation club and newer parks were built outside the city, in the suburbs, a long drive from their residences, which may increase their sense of lack of places and time (Moore et al. 2010).

Previous studies have pointed that non-urban children may spend less time in sedentary behaviours than urban children, either by complying with the screen time recommendations (<2 hours/day) (Andrade Neto et al. 2014), by reporting more weekly participation in outdoors chores (Bathrellou et al. 2007), and by having more space and spending more time outside playing (Loucaides et al. 2004), which may in part explain why more urban boys and girls reported that family tells them to be physically active, compared with their non-urban peers. Also, because parents often reported non-urban settings as safer than urban ones, they may grant their children to move more independently and to engage in

PA without supervision (Cordovil et al. 2015; Santos et al. 2013). In the present study, both boys and girls living in the urban setting reported that parents provided more support by taking part in PA with them, than non-urban boys and girls, both on weekdays on weekends. Apart from more independent mobility, other factors may be acting over non-urban parents less involvement in their child's PA. For instance, parents with lower education levels (that in this study were more frequent in the non-urban setting), may not perceive PA and sport participation as high education parents. Cottrell et al. (Cottrell et al. 2015) reported inverse results, in which direct parent involvement in children's PA was higher among the lower income families in the rural setting but added that although disadvantage parents seem more encouraging of PA and more directly involved, some of these physical activities may be limited in quality in contrast with more affluent parents which have the possibilities to offer more enriched PA experiences.

In the present study, urban and non-urban children who reported less interest in pursuing a sport-related career had lower probability of practicing an extracurricular sport, compared with children who had shown some interest. Also, urban children who reported lack of time had lower odds of engaged in a sport while in the non-urban setting, participation in a sport had lower rates if children reported more lack of physical competence. Because non-urban settings often have small communities with strong connections, children may feel more pressure to win and be successful in a sport, which may lead to less participation (Macphail et al. 2003). Urban children may be involved in other extracurricular activities living less time to sport, may be more dependent of adults' transportation and supervision in their sport activities, and may have less recreational facilities nearby, compared with non-urban children which may help to explain why lack of time was associated with sport participation in the urban setting but not in the non-urban.

Overall, sport was considered an enjoyable activity and majority of children did not report any barriers. As seen in chapter four, many children already participated in a sports club, perhaps explaining why many children did not perceive any barriers. In addition, only a small number of barriers reported by the children were significant associated with participation in extracurricular sport maybe because at this age children's behaviours, including participation in sport, are dependent of their parents (e.g., support, role modelling, transportation, fees) (D'Haese et al. 2015; Fernandez-Alvira et al. 2015; Gustafson and Rhodes 2006; Hardy et al. 2010; Reverter Masià, Montero Plaza, and Gonzalez 2013). However, several responses could

be intervention targets, including providing more recreational facilities and transportation in urban neighbourhoods, reinforce the need to involve parents in children's healthy lifestyles, and changing role-models and stereotypes regarding the role of females and males in sport.

7.5. Conclusion

Findings from this study suggest that children perceive different barriers according to their sex and place of residence. This is important in developing future strategies to promote an active lifestyle during childhood. Boys and girls differed in the reported psychological, emotional and cognitive barriers, while the level of urbanization influenced the personal organization, cultural and social, as well as, physical environmental barriers reported by children. Girls may be at a disadvantage compared to boys, since the later reported more perceived physical competence and more enjoyment, attribute more importance to sport participation, and shown more interest in pursuing a sport-related career when older. Regarding urbanization, children living in an urban setting, compared with their non-urban peers, reported more parental involvement in PA but also more lack of time and places to be physically active. In the end, children's perception of sport in their adult lives was the factor more associated with participation in sport. The results provide potentially important observations on several correlates of PA that should be incorporated into future interventions in order to increase their effectiveness.

Chapter 8. Prevalence and trends of childhood general and abdominal obesity

8.1. Introduction

In the last decades, the prevalence of obesity among children raised rapidly worldwide (Ahrens et al. 2014; Lobstein and Frelut 2003; Ng et al. 2014; Ogden et al. 2014, 2016). The prevalence of obesity among Portuguese children also increased during the last decades (Padez et al. 2004) but recent studies show that they may have become more stable (Gomes et al. 2014) following the same pattern of other developed countries (Olds et al. 2011; Wabitsch et al. 2014). Nevertheless, Portugal is on the top list of European countries with the highest rates of overweight and obesity (27.65%) only surpass by Italy (35.95%) (Wijnhoven et al. 2013). Obesity is linked to serious complications in childhood (Bridger 2009; Choudhary et al. 2007; Must and Strauss 1999; Paulis et al. 2014) and an obese child is at risk of becoming an obese adult with an associated raised likelihood of ill health and premature death (Biro and Wien 2010; Dietz 1998).

The methods used to classify obesity during childhood and adolescence are controversial due to sex differences, and the variability of growth rate. Body Mass Index (BMI) is use as a standard measure of adult obesity and a BMI age and sex-specific is used among children and adolescents (Cole et al. 2000). The use of BMI has significant practical advantages, being based on common anthropometric measures of weight and height and being familiar to many practitioners. Currently, there are three cut-off points to infer body composition: the ones from the International Obesity Task Force (IOTF) (Cole et al. 2000; Cole and Lobstein 2012), those from the United States Center for Disease Control (CDC) (Kuczmarski et al. 2002), and the cut-off points from the World Health Organization (WHO) (de Onis et al. 2007). Previous studies reported that the WHO is the most accurate method and sensitive for classifying the Portuguese children but most studies, both internationally and in Portugal, use the IOTF cut-off points (Cole and Lobstein 2012; Kêkê et al. 2015; Lopes 2012; de Onis et al. 2009). However, BMI may be an insufficient obesity indicator because it is limited to give an approximation of the total adiposity in the body which is why other complementary measures can and should be used to observe the prevalence of overweight and obesity in children. Waist circumference (WC), and particularly waist-to-height ratio (WHtR), has been considered the best index of fat distribution and was found related with a number of comorbidities in children (Schwandt 2011). In addition, WHtR may be advantageous because it avoids the need for age, sex, and ethnic-specific boundary values (Browning, Hsieh, and Ashwell 2010). Data on secular

trends in WHtR is scarce in Portuguese children, but recent studies indicate that more than 20% of children are above recommended levels (Albuquerque et al. 2012).

In order to combat the obesity epidemic, trends need to be monitored through population surveys, using standardized definitions of terms such as obese, overweight and normal weight for specific sex and ages. The aim of this study, is to estimate the prevalence of overweight, obesity, and abdominal obesity among 6-10-year-old Portuguese children, according to sex and the level of urbanization, providing new data based on different obesity measures.

8.2. Methods

A cross-sectional study was done in Coimbra and Lousã in 6-10-year-old children (n=793), during Spring of 2013 and 2014. The sample comprised 422 children living in Coimbra (urban setting) and 371 children from Lousã (non-urban setting). Height (cm), weight (kg), and waist circumference (cm) were measured with participants dressed in lightweight clothing and without shoes. Waist circumference was measured midway between the lowest rib and the iliac crest to the nearest 0.1 cm after inhalation and exhalation. BMI was calculated as the weight (kg) divided by the square of height in meters (kg/m^2). Using a specific software, BMI z-score (BMI for specific sex and age), and z-scores for height and weight were calculated. The definition of overweight and obesity were defined using the IOTF cut-offs (Cole and Lobstein 2012) and the references of the WHO (de Onis et al. 2007). Abdominal obesity was defined as the WHtR using the cut-off value of ≥0.5 (Savva et al. 2000).

Descriptive analyses of the measures were made for the total sample according to sex and the level of urbanization. Student's t-tests were used to compare the mean values of the anthropometric measures of the studied population. Prevalence of thinness, normal weight, overweight, and obesity were calculated according to references form the IOTF and the WHO, and distribution was observed according to children's sex, and urbanization. Chi-square test was applied to observe possible differences in the prevalence of overweight and obesity, as well as, abdominal obesity, between boys and girls and urban/non-urban children. The rate of agreement of the IOTF and the WHO cut-offs was determined for overweight and obesity by calculating kappa, which measures the inter-rater agreement for categorical items. Kappa

coefficient range form 0 (no agreement) and 1 (when there is a perfect agreement between the observed and the expected). A kappa ≥0.4 indicates a moderate agreement, while values equal or above 0.8 suggest a good agreement (Landis and Koch 1977). The distributions of overweight and obesity using the IOTF and the WHO cut-offs were compared using the chi-square test with different outputs for boys and girls. Comparison of proportions of abdominal obesity and children's nutritional status defined by the WHO and the IOTF cut-offs were performed by chi-square tests. All statistical analyses were performed using the SPSS v.23. P-value below 0.05 was considered significant.

8.3. Results

In the present sample, children had mean values of BMI equal to 17.03 kg/m^2 (SD=2.25) with mean weight of 28.35kg (SD=6.57) and 128.2cm of height (8.73). The mean value for waist-circumference was 60.79cm (SD=6.79) and the WHtR=0.47. Although girls, compared to boys, had slightly higher values of weight (28.54kg vs. 28.15kg), waist-circumference (60.92cm vs. 60.65cm), and BMI (17.10 vs. 16.90) the differences were not statistically significant (Table 8.3.1).

Table 8.3.2. shows the mean values (and standard deviation) of the anthropometric measures of children living in different settings. Urban girls, compared with non-urban girls had significantly higher mean values of height (129.4cm vs. 126.99cm; t=2.52, p=0.01) and weight (29.16kg vs. 27.81kg; t=2.00, p<0.05). Urban girls also had slightly higher values of BMI (17.22 vs. 17.03) and waist circumference (60.94cm vs. 60.90cm) than girls living in the non-urban setting. Among girls, a tendency was found for higher mean value of height-for-age in girls living in the urban setting (p=0.06) and for girls living in the non-urban setting having slightly higher values of weight-for-age (p=0.06).

Although no statistical significant difference was found between boys living in the urban and in the non-urban setting, urban boys, compared with their non-urban counterparts, had slightly higher mean values of height (128.94cm vs. 127.57cm), weight (28.55kg vs. 27.72kg), BMI (16.99 vs. 16.85) and BMI z-score (0.56 vs. 0.47). Boys living in the non-urban setting had higher mean values of waist circumference than urban boys (61.05 vs. 60.38) but the difference was not statistical significant (Table 8.3.2).

Table 8.3.1. Mean values, standard deviation and p-values of the anthropometric measures of the total population and according to children's sex.

Anthropometric measures	Total sample		By sex			
	Mean	SD	Sex	Mean	SD	p
Height (cm)	128.2	8.73	Girls	128.21	9.02	0.90
			Boys	128.29	8.44	
Height z-score	0.37	1.01	Girls	0.38	1.02	0.75
			Boys	0.36	0.99	
Weight (kg)	28.35	6.57	Girls	28.54	6.86	0.41
			Boys	28.15	6.25	
Weight z-score	0.42	1.09	Girls	0.39	1.16	0.10
			Boys	0.43	1.02	
Waist-circumference (cm)	60.79	6.79	Girls	60.92	6.86	0.59
			Boys	60.65	6.71	
WHtR	0.47	0.04	Girls	0.47	0.04	0.59
			Boys	0.47	0.04	
BMI (kg/m^2)	17.03	2.25	Girls	17.10	2.32	0.19
			Boys	16.90	2.09	
BMI z-score	0.50	0.99	Girls	0.49	0.99	0.65
			Boys	0.52	0.99	

Note. BMI=body mass index, WHtR=waist-to-height ratio; mean values and standard deviation (SD) of the anthropometric measures of the studied population; p-values presented are the result from the Student's t-test analyses of sex comparison.

Table 8.3.2. Mean values, standard deviation and p-values of the anthropometric measures, according to the level of urbanization.

Anthropometric Measures	Urbanization	Girls			Boys		
		Mean	SD	p	Mean	SD	p
Height (cm)	Urban	129.24	8.99	0.01	128.94	8.38	0.11
	Non-urban	126.99	8.92		127.57	8.47	
Height z-score	Urban	0.33	0.94	0.06	0.40	0.99	0.84
	Non-urban	0.26	1.10		0.30	0.98	
Weight (kg)	Urban	29.16	6.98	<0.05	28.55	6.26	0.19
	Non-urban	27.81	6.65		27.72	6.23	
Weight z-score	Urban	0.39	1.04	0.06	0.52	1.00	0.52
	Non-urban	0.41	1.29		0.33	1.03	
Waist-circumference (cm)	Urban	60.94	6.73	0.96	60.38	6.59	0.37
	Non-urban	60.90	7.10		61.05	6.89	
WHtR	Urban	0.47	0.04	0.85	0.47	0.04	0.24
	Non-urban	0.48	0.05		0.47	0.04	
BMI (kg/m^2)	Urban	17.22	2.32	0.40	16.99	2.01	0.51
	Non-urban	17.03	2.40		16.85	2.25	
BMI z-score	Urban	0.49	0.96	0.81	0.56	0.98	0.34
	Non-urban	0.47	1.02		0.47	1.02	

Note. BMI=body mass index, WHtR=waist-to-height ratio; mean values and standard deviation (SD) of the anthropometric measures of the studied population; p-values presented are the result from the Student's t-test analyses of sex comparison.

8.3.1. Prevalence of nutritional status using the WHO and the IOTF cut-off points

As presented in Figure 8.3.1.1, majority of the population studied had normal weight, independently of the cut-off point used to classify the nutritional status (WHO=71.6% and IOTF=74.8%). The prevalence of overweight was 20.7% (WHO) and 15.9% (IOTF) and the prevalence of obesity was 7.7% and 6.1%, when using the WHO and IOTF cut-offs, respectively. This indicates that 25 children that were considered as having a normal weight using the IOTF were classified as overweight by the WHO reference, and 13 children that were classified as overweight by the IOTF cut-offs were considered obese by the WHO cut-offs. Also, 3.3% of the

children were considered underweight when using the IOTF cut-offs and no children followed into that category when applying the WHO references. Due to the small percentage of children considered underweight by the IOTF cut-offs, and because only the prevalence of overweight and obesity were further used in the analyses, they were integrated into the 'normal weight' group.

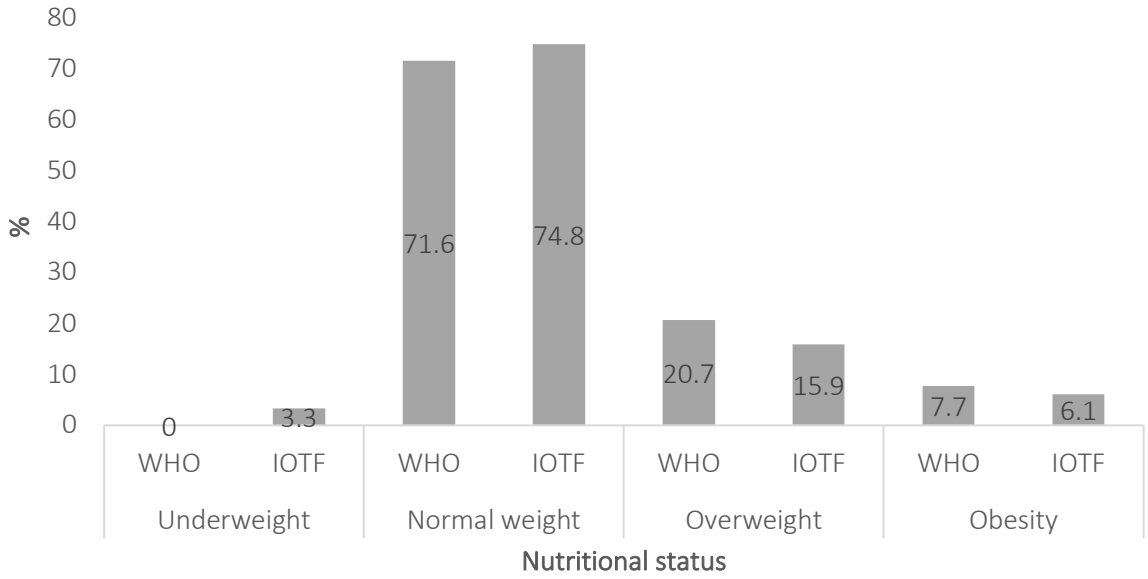

Figure 8.3.1.1. Prevalence of nutritional status among children, using the WHO and the IOTF cut-offs.

Using the WHO reference, the nutritional status of boys and girls was not statistically different; even if slightly more boys (22.1%) than girls (19.4%) were considered overweight and slightly more girls than boys were classified as obese (8.3% and 7.0%, respectively). According to the IOTF cut-offs, significantly more girls than boys were considered overweight (17.4% vs. 14.3%) and obese (7.6% vs. 4.4%) (X^2=8.30, p=0.04). More girls than boys were classified as obese independently of the methodology used (Figure 8.3.1.2).

Prevalence of overweight and obesity differed significantly between references being highest according to the WHO cut-offs, both among boys and girls. Overall agreement coefficient of kappa was 0.87 for girls and 0.67 for boys, indicating that the IOTF and the WHO criteria have an excellent agreement in girls and a moderate one in boys (Table 8.3.1.1).

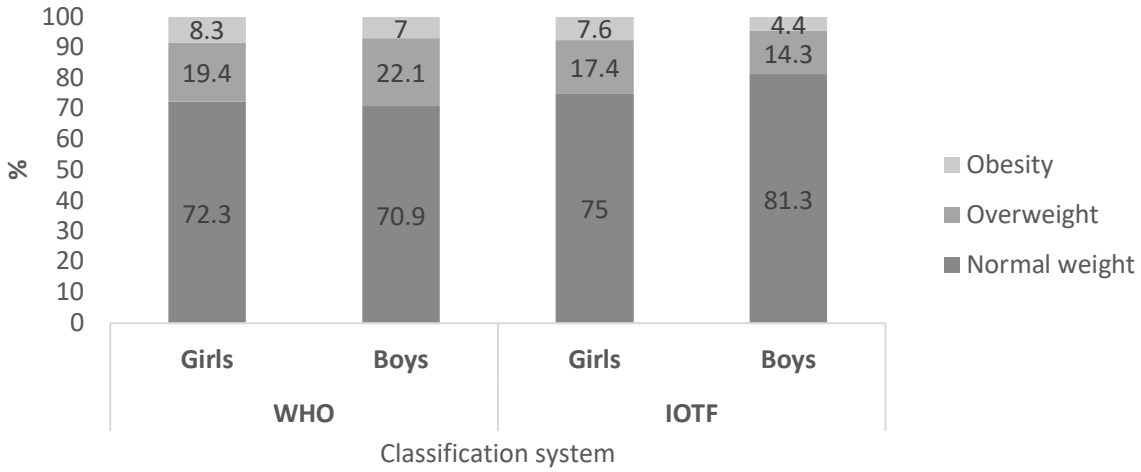

Figure 8.3.1.2. Prevalence of overweight and obesity and the comparison between girls and boys, using the WHO and the IOTF cut-offs (p-values are the result of chi-square test).

Table 8.3.1.1. Prevalence of overweight and obesity using the IOTF and the WHO cut-offs, according to children's sex, and respective kappa coefficient (and standard error) and p-values comparing the two references.

Sex	Overweight		Obesity		Kappa coefficient (SE)	p
	IOTF	WHO	IOTF	WHO		
Girls (%)	17.4	19.4	7.6	8.3	0.87 (0.03)	<0.001
Boys (%)	14.3	22.1	4.4	7.0	0.67 (0.04)	<0.001

Figure 8.3.1.3. presents the prevalence of overweight and obesity in boys and girls, according to the level of urbanization. Using the WHO cut-offs, prevalence of overweight was higher among girls living in the urban setting (20.5%) compared with their non-urban counterparts (18.1%), but the inverse was seen in the prevalence of obesity (urban girls: 7.7%; non-urban girls: 9.0%). Among boys, the ones living in the urban setting had higher prevalence of overweight than the boys living in the non-urban setting (25.7% and 18.0%, respectively), while more non-urban boys than urban ones were considered obese (6.9% vs. 7.1%). However, there were no significant differences between urban and non-urban children using the WHO cut-offs. Using the IOTF cut-offs, no significant differences were found between urban and non-

urban children, even if slightly more urban girls (18.6%) and boys (7.3%) were considered overweight compared with non-urban girls (16%) and boys (10.9%) (Figure 8.3.1.3).

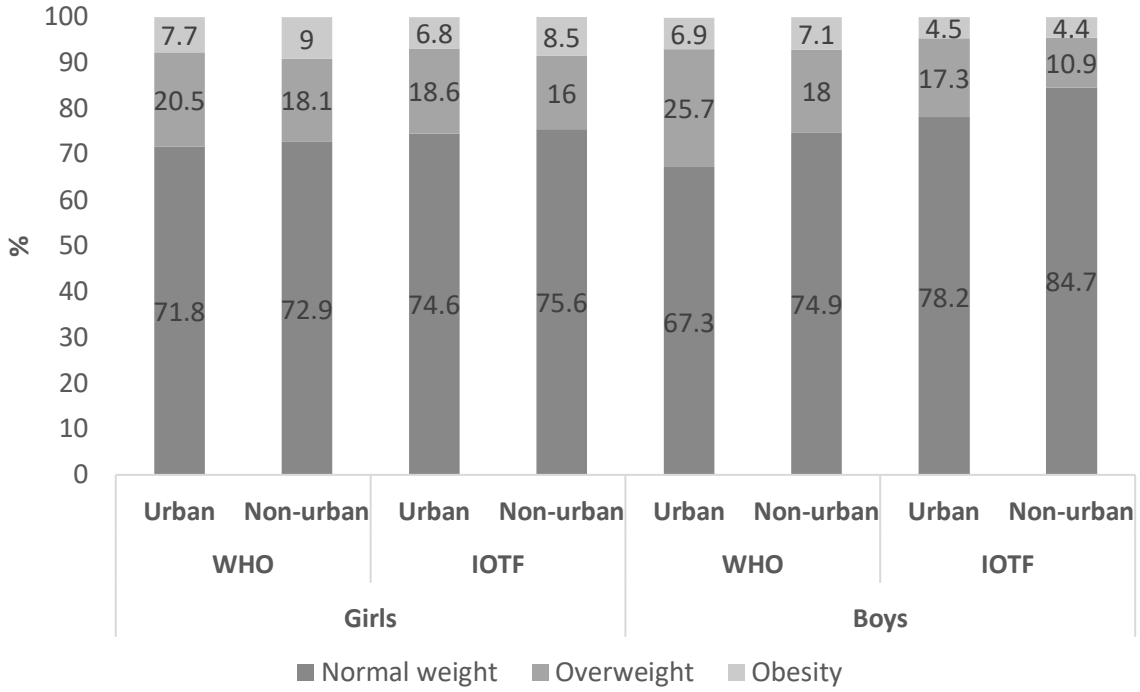

Figure 8.3.1.3. Prevalence of overweight and obesity in girls and boys, according to the level of urbanization, using the WHO and the IOTF cut-offs (p-values are the result of chi-square tests).

8.3.2. Trends in the prevalence of overweight and obesity in children

Figure 8.3.2.1. shows the prevalence of overweight (including obesity) described in the literature within the last decade in Coimbra and Lousã, using the IOTF cut-off points. Generally, present results are among the lowest reported within the last decade. They are higher than those reported by Sardinha et al. (Sardinha et al. 2011) from 2008 for central Portugal (20.8%) but lower than those reported by Rito et al. (Rito et al. 2011) (27.8%) and Albuquerque et al. (Albuquerque et al. 2012) (33.0%) for the same area. Looking for the same specific settings, presents results for the urban setting, are lower than the ones observed by Santana (Santana 2013) (29.8%) and Muc (Muc 2014) (24.4%), and similar to the ones reported by Rito et al. (Rito 2006) (23.7%) for preschool children. Present results also show the lowest prevalence of

overweight (including obesity) in the non-urban setting, compared with the results found by Jorge (Jorge 2006) (29.2%) and Pronto (Pronto 2013) (29.0%).

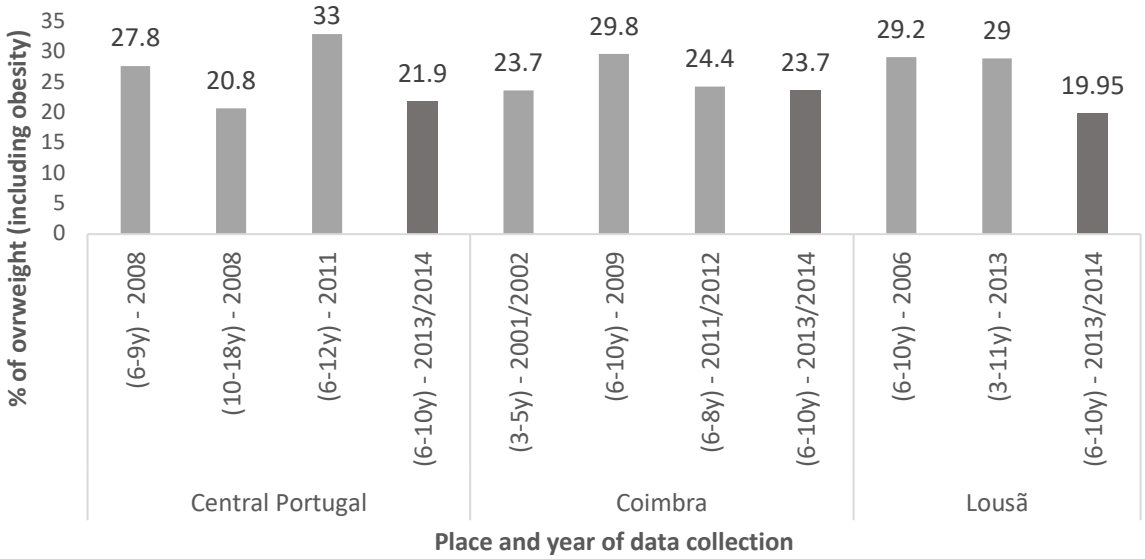

Figure 8.3.2.1. Prevalence of overweight (including obesity) using the IOTF cut-off points, reported in the last decades for central Portugal, Coimbra, and Lousã (present data are shown in a darker colour).

8.3.3. Prevalence of abdominal obesity

The majority of children (78.1%) had a WHtR lower than 0.5 indicating no or low risk of abdominal obesity. Girls had higher prevalence of abdominal obesity than boys (24.7% and 19.0%, respectively) but the difference was not statistically significant (p=0.07). Non-urban children, independently of the sex, had higher prevalence of abdominal obesity than their urban peers but the difference was not significantly, for boys nor girls (Table 8.3.3.1).

Table 8.3.3.1. Percentage of abdominal obesity (WHtR≥0.5), according to children's sex and the level of urbanization.

Abdominal	Total sample (%)			Girls (%)			Boys (%)		
obesity	Girls	Boys	p	Urban	Non-urban	p	Urban	Non-urban	p
WHtR≥0.5	24.7	19.0	0.07	23.6	26.5	0.55	17.8	20.7	0.50

Note. P-values are the result of chi-square tests.

The prevalence of abdominal obesity among normal weight, overweight, and obese children is shown on Table 8.3.3.2. The proportion of abdominal obesity (WHtR≥0.5) is higher according to children's nutritional status, independently of the reference category used. A number of children that were considered as having normal weight by the WHO and the IOTF cut-off points, had abdominal obesity; this was particularly visible among girls (WHO: 8.6%, IOTF:9.2%) and children living in the non-urban setting (WHO:8.2% of girls and 8.4% of boys, IOTF: 9.6% of girls and 10.3% of boys).

Table 8.3.3.2. Prevalence of abdominal obesity according to children's nutritional status, defined by the WHO and the IOTF cut-offs.

WHtR≥0.5		WHO (%)			IOTF (%)		
		Normal	Overweight	Obesity	Normal	Overweight	Obesity
Total	Girls	8.6	54.9	93.1	9.2	60.9	96.3
	Boys	4.3	37.0	96.0	7.3	57.7	93.8
Girls	Urban	8.9	51.1	88.2	9.0	58.5	93.3
	Non-urban	8.2	61.5	100.0	9.6	65.2	100.0
Boys	Urban	1.5	40.4	92.2	5.2	57.1	88.9
	Non-urban	8.4	31.0	100.0	10.3	58.8	100.0

8.4. Discussion

This study presents an estimation of the prevalence of overweight, obesity, and abdominal obesity among Portuguese 6-10-year-old children, and confirms that Portugal has one of the highest childhood obesity rates in Europe (Wijnhoven et al. 2013), with the rates of overweight (including obesity) varying between 22% (IOTF) and 30% (WHO). According to the WHO cut-off points, 7.7% of the children were classified as obese, while 6.1% of the children were considered obese when applying the IOTF references.

Present results of overweight (including obesity) (21.9%) and obesity alone (6.1%) using the IOTF reference, were used to compare with previous results described for childhood obesity in central Portugal in the last decade. Rito et al. (Rito et al. 2011) reported that 27.8% of children (aged 6-9) were overweight (including obese) and 9.0% were obese, and the rates were even higher in the study of Albuquerque et al. (Albuquerque et al. 2012), in which 33%

of children (6-12-year-old) were overweight (including obese) and 10.7% were obese. This may contradict the trend that was observed in Portugal, as in many other countries, in the beginning of the century, in which there was an increase in the prevalence of obesity and the BMI values among children (Cardoso and Padez 2008; Padez 2006; Padez et al. 2004). A possible stabilization or decline in the prevalence rates of overweight and obesity in children has been observed in several developed countries, such as Switzerland, England, France, and Germany (Olds et al. 2011; Wabitsch et al. 2014). This possible stabilization/decline in the obesity rates have also been reported for children living in Southern European countries, like Italy (Spinelli et al. 2015), and had previously been suggested for Portuguese children (9-11-year-old) (Gomes et al. 2014) and adolescents (Marques and de Matos 2016), who noted that there had not been significant changes in prevalence of overweight and obesity in the last decades. Marques and de Matos (Marques and de Matos 2016), actually observed that within 11-13-year-old children, the prevalence of overweight/obesity decreased from 23.5% in 2002 to 20.7% in 2010 (IOTF cut-off points). A possible stabilization in the prevalence of overweight (including obesity) was also visible in the specific urban and non-urban settings observed in this study. In the urban setting, the prevalence decreased from 29.8% in 2009 (Santana 2013), to 24.4% in 2011-2012 (Muc 2014), to 23.7% in the present study. Among children living in the non-urban setting, the prevalence of overweight (including obesity) varied between 29.2% in 2006 (Jorge 2006), 29% in 2013 (Pronto 2013), and 19.95% in the present sample.

The reason of the possible stabilization in the prevalence of childhood obesity observed in some countries is not clearly understood, and the same occurs in the present study. Some authors hypothesized that the obesity prevalence may have reached a country specific ceiling, implying that children with predisposition toward obesity are now obese and obesity prevalence will not increase systematically (Tambalis et al. 2010). Other explanations may be that (1) obesity has been recognised as a major public health problem, which has led to increased focus and awareness on healthy eating and PA among health providers and the general population, (2) a greater stigmatisation of obesity has led to a greater reluctance to participate in surveys, or that (3) the levelling off may hide opposite trends between socioeconomic groups.

Nevertheless, the values of overweight and obesity in Portuguese children are still high, particularly among girls. Present findings indicate that girls had significantly more prevalence of overweight (27.4%) and obesity (7.6%), compared to boys (14.3% and 4.4%, respectively),

when using the IOTF cut-off points. Previous Portuguese studies have shown some inconsistencies, with some reporting increased rates among girls (Padez et al. 2004, 2005; Rito 2006), while others found higher prevalence rates among boys (Albuquerque et al. 2012; Jorge 2006; Mota, Flores, et al. 2006; Rito et al. 2012; Sardinha et al. 2011). Those disparities have also been found in international studies (Austin, Haines, and Veugelers 2009; Ng et al. 2014; Wijnhoven et al. 2013, 2014). Furthermore, the prevalence of overweight was higher among girls when using the IOTF cut-offs and higher for boys when applying the WHO cut-offs, which is in line with data observed before in various countries (Wijnhoven et al. 2013) and can help to explain the discrepancies between sexes that were previously addressed. Apart from the type of references used, differences in the prevalence of overweight/obesity in boys and girls may also be due to changes in PA and sedentary activities in both sexes through time or sampling.

Almost a quarter of the children had a WHtR equal or above 0.5, which was the cut-off point considered for abdominal obesity, but data on secular trends in WHtR are scarce in Portuguese children, thus it is impossible to compare with previous results. Present results also show a tendency for girls to have higher prevalence of abdominal obesity compared to boys (24.7% and 19.0%, respectively) which goes against the study of Albuquerque et al. (Albuquerque et al. 2012) in which higher values of WHtR were more prevalent in 6-12-year-old boys (28.1%) than in girls (19.4%). Moreover, it was found that a proportion of children who were at high risk for obesity-related comorbidities (WHtR≥0.5) were not classified as such by the WHO and the IOTF criteria, which is consistent with previous findings from Spanish children (aged 6-17) (Schröder et al. 2014). The proportion of abdominal obesity in normal weight children was more prominent in girls than boys, and while using the IOTF cut-offs, compared with the ones from WHO. Part of the results are similar to the ones found by Schröder and colleagues (Schröder et al. 2014) in their sample of 6-11-year-old Spanish children, with a higher proportion of normal weight girls having abdominal obesity compared to boys (IOTF:8.5% vs. 6.4%, WHO:11% vs. 5.3%, respectively). Discrepancies in the results may be because the authors used BMI categories specific for Spanish children.

Recent literature suggests that the prevalence of abdominal obesity has increased to a higher degree than general obesity in children and adolescents, rising from 8.6% in 1985 to 18.3% in 2007 (Garnett et al. 2011), and that children classified as normal and overweight with abdominal obesity were at a higher risk of cardio-metabolic problems than overweight children

without normal excessive abdominal fat (Mokha et al. 2010). This is particularly worrying since present results point to the fact that a concerning proportion of children at high risk for obesity-related comorbidities were not classified as such by the BMI criteria, which is also the general measure of childhood obesity in the routine clinical practice. No significant differences were found between children, according to the level of urbanization, even if children in the urban setting had higher prevalence of overweight (including obesity), compared with their non-urban peers (23.7% and 19.95%, respectively). On the other side, non-urban children had higher prevalence of abdominal obesity (23.6%) than their urban counterparts (20.9%), but no significant differences were found.

8.5. Conclusion

Overweight, obesity, and abdominal obesity is highly prevalent in 6-10 year-old children living in the central area of Portugal, particularly among girls. Although prevalence of overweight/obesity was slightly higher in children living in the urban setting than in the non-urban, the inverse was true for the prevalence of abdominal obesity. Nevertheless, present findings seem to point to a stabilization, or even decrease, in the prevalence of overweight (including obesity) in Portugal, which is in line with studies from other developed countries. Based on present results, using WHtR allows to identify a proportion of normal and overweight children that are abdominally obese and can be considered at cardio-metabolic risk, but would not be identified as such using the traditional screening methods. The present study indicates the need to incorporate abdominal obesity into routine clinical practice and hopes to contribute to a better recognition of obesity patterns across children's sex and place of residence, which is of extreme importance to design specific strategies and interventions to improve children's nutritional status and overall health.

Chapter 9. Family, economic, and behavioural factors as predictors of childhood general and abdominal obesity

9.1. Introduction

Given the systematic high rates in the prevalence of obesity in children during the last decades, including in Portugal (Albuquerque et al. 2012; de Onis et al. 2010; Padez et al. 2004; WHO 2016a), determining associated factors is necessary in order to design efficient strategies targeting obesity reduction. The same is true for abdominal obesity, since previous works suggest that the prevalence of abdominal fat has increased to a higher degree than general obesity (Garnett et al. 2011).

Recent data suggest that the prevalence of overweight and obesity among Portuguese children may have stabilized during the last years (Gomes et al. 2014). A study published in 2014 comparing nine European countries, indicated that 22.7% of Portuguese boys and 30.5% of girls (aged 7 years and using the IOTF cut-offs) were overweight (including obese), rates that were only surpassed by other Southern European countries, like Spain (Wijnhoven et al. 2014). Data on secular trends in abdominal obesity are scarce in Portuguese children but one recent study observed that 23.6% of children (aged 6-12 years) had a WHtR≥0.5 (Albuquerque et al. 2012), which is the recommended cut-off to define abdominal obesity (McCarthy and Ashwell 2006). Nevertheless, even if Portuguese data on childhood obesity seems to follow the trend observed in other developed countries (Wabitsch et al. 2014), the rates are still high and of concerning, and healthy lifestyles should be adopted to improve children's weight and overall health.

Previous studies carried in Portuguese children found a number of factors associated with higher rates of obesity, namely: children's sex, the size of the family, socioeconomic status (SES), parental education and nutritional status, and sedentary behaviours (including screen time) (Bingham et al. 2013; Carvalhal et al. 2007; Gomes et al. 2014; Muc 2014; Nogueira et al. 2013; Padez et al. 2005; Stamatakis et al. 2013). Similarly, children's sex, SES, and screen time were also found to influence Portuguese children's abdominal obesity (Muc, 2014). Children's physical activity (PA) has been considered one of the most important behavioural factors associated with children's nutritional status. In general, studies have concluded that PA is important in the prevention of obesity (De Bourdeaudhuij et al. 2013; Katzmarzyk et al. 2015; Mendoza et al. 2011; Saelens et al. 2007). Similar results were seen before among Portuguese children, in which 3-10-year-old children were less likely to be obese if they engaged in at least 1 hour of PA daily (Bingham et al. 2013; Ekelund et al. 2004). Moreover, various kinds of PA,

such as walking, active playing, and particularly participation in organised sports, were described to be a protective factor against childhood obesity (Bingham et al. 2013). However, this association is not always observed, with some studies founding no significantly association between PA and obesity (Pronto 2013; Wang, Chen, and Zhuang 2013), probably due to methodological differences. The environment where the family lives is also very important and may influence children's weight by encouraging or discouraging PA. For instance, the intensity of traffic could indirectly influence children's weight by limiting their opportunities to play safely in the neighbourhood (Davison et al. 2006), while not living in close proximity to roads with heavy trucks passing was shown to promote walking or biking to school, rather than using passive forms of transportation (Timperio et al. 2005).

A better understanding of family, economic, and behavioural differences between normal –weight and obese children is needed to reduce the negative behavioural and health effects of excessive weight in childhood. This study has two aims: first, detect significant differences in biological, behavioural, family, and economic characteristics among normal-weight and overweight/abdominally obese children and second, investigate the importance of those factors in predicting children's nutritional status and abdominal obesity, according to their place of residence.

9.2. Methods

Anthropometric measures were taken in a sample of 793 children (aged 6-10 years) living in different geographic settings (urban and non-urban) in central Portugal. Obesity (including overweight) definition was applied using the IOTF criteria (Cole and Lobstein 2012) as described in chapter 2. Categorized WHtR (≥0.5) was used to assess the risk related to abdominal obesity.

Parents fulfilled a questionnaire regarding their children's PA behaviours: way of commute (active or passive), participation in an extracurricular sport (yes/no), time in an extracurricular sport (minutes per week), minutes in physical education classes (minutes per week), and active play (minutes per week). Parents also reported the time their children spent in a normal week watching TV (<2h/day and ≥2h/day), using the PC, and playing with electronic games (<1h/day and ≥1h/day). Family and economic factors included: family income (low,

middle, and high), family size (no siblings, one sibling, two or more siblings), parents' education level (low, medium, high), and parents' nutritional status (normal weight, overweight, or obese). Full description of the categories of these factors are presented in chapter 3.

Sample was divided according to the level of urbanization (urban and non-urban). Differences in the frequency of behavioural and socio-demographic traits between groups were computed using chi-square tests and Student-t test, for categorical and continuous variables, respectively. A multivariate logistic regression was used to estimate which factors were associated with obesity (including overweight) and abdominal obesity in total sample, unadjusted and adjusted to children's sex and age, parental education level and family income. The statistical analyses were made using SPSS v.23 and statistical significance was set at $p<0.05$.

9.3. Results

Descriptive data comparing differences between normal and obese children and children with and without abdominal obesity in behavioural, family, and socio-demographic traits are presented in Tables 9.3.1 and 9.3.2 for children living in the urban and non-urban setting, respectively. In the urban setting, the family and socio-demographic traits that differed according to children's nutritional status were: family income, parental education, mother' and fathers' BMI, and way of transportation. Prevalence of obesity was significantly higher (X^2=13.84, p=0.00) among children from lower income families (37.5%) than from medium (30.2%) and higher income families (17.9%). A higher prevalence of obesity (X^2=9.96, p=0.01) was found in children whose mother had low (34.1%) or middle education (33.7%) compared with children whose mother had a high degree (19.5%); the same patter was found according to father's education (low=30.6%, middle=29.5%, high=18.8%; X^2=6.90, p=0.03). A higher prevalence of obesity was found in children with obese mothers (40.5%) and fathers (40.5%) than in children with normal weight mothers (19.4%) and fathers (21.2%) (mothers: X^2=19.64, p<0.001; father: X^2=8.53, p=0.01). Also, children who commuted passively had higher prevalence of obesity (25.3%) than children who walked or bicycled to school (10.6%) (X^2=4.99, p=0.03). Still in the urban setting, no significant association was found between childhood obesity defined by the IOTF cut-off points and sex, number of siblings, participation in an extracurricular sport, the number of times per week playing an extracurricular sport, screen

time (TV, PC, and E. games), and the minutes per week engaged in PE, sport, or active play (Table 9.3.1).

Table 9.3.1. Biological, behavioural, family, and socio-demographic trait differences between normal weight and obesity (including overweight) children and children with and without abdominal obesity, living in the urban setting.

Characteristics		Normal weight†	Obesity†	p	WHtR<0.5†	WHtR≥0.5†	p
Sex	Girls	74.5 (164)	25.5 (56)	0.38	76.4 (168)	23.6 (52)	0.14
	Boys	78.2 (158)	21.8 (44)		82.2 (166)	17.8 (36)	
Income	Low	62.5 (45)	37.5 (27)		70.8 (51)	29.2 (21)	
	Medium	69.8 (60)	30.2 (26)	0.00	76.7 (66)	23.3 (20)	0.08
	High	82.1 (197)	17.9 (43)		82.5 (198)	17.5 (42)	
Family	No sibling	75.8 (94)	24.2 (30)		78.2 (97)	21.8 (27)	
size	One sibling	77.1 (185)	22.9 (55)	0.86	79.2 (190)	20.8 (50)	0.93
	≥2 siblings	73.7 (42)	26.3 (15)		80.7 (46)	19.3 (11)	
Mother	Low	65.9 (27)	34.1 (14)		63.4 (26)	36.6 (15)	
education	Middle	66.3 (57)	33.7 (29)	0.01	75.6 (65)	24.4 (21)	0.02
	High	80.5 (231)	19.5 (56)		82.2 (236)	17.8 (51)	
Father	Low	69.4 (50)	30.6 (22)		76.4 (55)	23.6 (17)	
education	Middle	70.5 (62)	29.5 (26)	0.03	68.2 (60)	31.8 (28)	0.01
	High	81.2 (203)	18.8 (47)		84.0 (210)	16.0 (40)	
Mother's	Normal	80.6 (235)	19.4 (59)		81.7 (241)	18.3 (53)	
BMI	Overweight	72.2 (52)	27.8 (20)	<0.001	81.9 (227)	18.1 (1)	<0.001
	Obese	44.8 (13)	55.2 (16)		48.3 (14)	51.7 (15)	
Father's	Normal	78.8 (130)	21.2 (35)		81.8 (135)	18.2 (30)	
BMI	Overweight	80.1 (137)	19.9 (34)	0.01	80.1 (137)	19.9 (34)	0.04
	Obese	59.5 (25)	40.5 (17)		64.3 (27)	35.7 (15)	
Commute	Active	89.4 (42)	10.6 (5)	0.03	93.6 (44)	6.4 (3)	0.01
	Passive	74.7 (280)	25.3 (95)		77.3 (290)	22.7 (85)	
Sport	Yes	78.6 (231)	21.4 (63)	0.09	83.0 (244)	17.0 (50)	0.00
	No	71.1 (91)	28.9 (37)		70.3 (90)	29.7 (38)	
Sport per	None	71.1 (91)	28.9 (37)		70.3 (90)	29.7 (38)	
week	1-2 times	79.5 (136)	20.5 (35)	0.23	81.3 (139)	18.7 (32)	0.01
	≥3 times	77.2 (95)	22.8 (28)		85.4 (105)	14.6 (18)	

Table 9.3.1 (continuation)

Characteristics		Normal weight†	Obesity†	p	WHtR<0.5†	WHtR≥0.5†	p
TV/ weekdays	<2h/day	75.5 (244)	24.5 (79)	0.91	79.3 (256)	20.7 (67)	0.69
	≥2h/day	76.1 (67)	23.9 (21)		77.3 (68)	22.7 (20)	
PC/ weekdays	<1h/day	76.7 (283)	23.3 (86)	0.18	78.6 (290)	21.4 (79)	0.91
	≥1h/day	66.7 (24)	33.3 (12)		77.8 (28)	22.2 (8)	
El. games/ weekdays	<1h/day	76.4 (288)	23.6 (89)	0.38	79.0 (298)	21.0 (79)	0.48
	≥1h/day	68.2 (15)	31.8 (7)		72.7 (16)	27.3 (6)	
Characteristics		Normal weight‡	Obesity‡	p	WHtR<0.5‡	WHtR≥0.5‡	p
PE (min/week)		84.5±34.1	84.9±29.2	0.92	86.3±34.1	77.9±27.3	0.03
Sport (min/week)		116.3±141.6	90.1±101.0	0.09	119.2±140.4	75.7±96.0	0.01
Active play (min/week)		700.9±488.9	622.0±426.7	0.15	683.1±479.5	676.2±461.6	0.91

Note. † frequencies (%) and number of individuals; ‡ mean values and standard deviation; BMI=body mass index, TV=television, PC=computer, El. Games=electronic games, PE=physical education, WHtR=waist-to-height ratio; p-values are the result of chi-square and Student-t tests, p<0.05 was considered significant.

A higher prevalence of abdominal obesity was found in children whose mothers had low education (36.6%) compared with a high degree (17.8%) (X^2=8.41, p=0.02), and the same pattern was found according to father's education (low=23.6% vs. high=16.0%; X^2=10.35, p=0.01). The prevalence of abdominal obesity was significantly higher in children with obese mothers (51.7%) and fathers (35.7%) than in children with normal weight parents (18.3% and 18.2% for mother and father, respectively) (mother: X^2=19.03, p<0.001; father: X^2=6.42, p=0.04). The prevalence of abdominal obesity in children living in the urban setting was higher in children that commuted passively instead of actively (22.7% vs. 6.4%; X^2=6.71, p=0.01), that were not practicing an extracurricular sport (29.7% vs. 17.0% in children that reportedly practiced at least one sport; X^2=8.69, p=0.00), or that were playing sport less times per week (1-2 times: 18.7%, ≥3 times: 14.6%; X^2=9.41, p=0.01). Generally, the prevalence of abdominal obesity significantly increased with a decrease in time in PE classes (86.3min/week and 77.9min/week for WHtR<0.5 and ≥0.5, respectively) and in sport participation (119.2min/week and 75.7min/week for WHtR<0.5 and ≥0.5, respectively). No statistical significant relationship was found between children's screen time (TV, PC, and E. games), sex, family size, and family income and childhood abdominal obesity (Table 9.3.1).

Table 9.3.2 shows the prevalence of obesity and abdominal obesity in children living in the non-urban setting in relation with biological, behavioural and socio-demographic traits.

Table 9.3.2. Biological, behavioural, family, and socio-demographic trait differences between normal weight and obesity (including overweight) children and children with and without abdominal obesity, living in the non-urban setting.

Characteristics		Normal weight†	Obesity†	p	WHtR<0.5†	WHtR≥0.5†	p
Sex	Girls	75.5 (142)	24.5 (46)	0.03	73.5 (100)	26.5 (36)	0.27
	Boys	84.7 (155)	15.3 (28)		79.3 (107)	20.7 (28)	
Income	Low	80.1 (121)	19.9 (30)		73.7 (84)	26.3 (30)	
	Medium	75.0 (81)	25.0 (27)	0.13	73.1 (57)	26.9 (21)	0.11
	High	86.3 (82)	13.7 (13)		86.2 (56)	13.8 (9)	
Family size	No sibling	81.7 (103)	18.3 (23)		78.2 (97)	21.8 (27)	
	One sibling	80.6 (145)	19.4 (35)	0.66	79.2 (190)	20.8 (50)	0.22
	≥2 siblings	76.2 (48)	23.8 (15)		80.7 (46)	19.3 (11)	
Mother	Low	77.2 (78)	22.8 (23)		72.2 (57)	27.8 (22)	
education	Middle	78.6 (99)	21.4 (27)	0.33	76.9 (70)	23.1 (21)	0.40
	High	84.3 (113)	15.7 (21)		80.9 (76)	19.1 (18)	
Father	Low	77.6 (118)	22.4 (34)		72.6 (85)	27.4 (32)	
education	Middle	78.9 (101)	21.1 (27)	0.26	77.2 (71)	22.8 (21)	0.36
	High	87.0 (60)	13.0 (9)		83.0 (39)	17.0 (8)	
Mother's BMI	Normal	85.2 (191)	14.8 (32)		81.9 (130)	18.1 (29)	
	Overweight	72.5 (66)	27.5 (25)	0.01	68.2 (45)	31.8 (21)	0.11
	Obese	64.0 (16)	36.0 (9)		68.2 (15)	31.8 (7)	
Father's BMI	Normal	80.9 (107)	19.1 (26)		74.7 (69)	25.3 (24)	
	Overweight	76.6 (111)	23.4 (34)	0.44	73.8 (76)	26.2 (27)	0.27
	Obese	85.0 (34)	15.0 (6)		88.2 (30)	11.8 (4)	
Commute	Active	81.8 (99)	18.2 (22)	0.60	80.5 (62)	19.5 (15)	0.34
	Passive	79.5 (198)	20.5 (51)		75.1 (145)	24.9 (48)	
Sport	Yes	78.6 (231)	21.4 (63)	0.71	81.5 (141)	18.5 (32)	0.01
	No	71.1 (91)	28.9 (37)		67.3 (66)	32.7 (32)	
Sport per	None	78.6 (99)	21.4 (27)		67.3 (66)	32.7 (32)	
week	1-2 times	80.1 (125)	19.9 (31)	0.82	80.4 (90)	19.6 (22)	0.03
	≥3 times	82.0 (73)	18.0 (16)		83.6 (51)	16.4 (10)	

Table 9.3.2 (continuation)

Characteristics		Normal weight†	Overweight†	p	WHtR<0.5†	WHtR≥0.5†	p
TV/ weekdays	<2h/day	75.5 (244)	24.5 (79)	0.45	76.8 (159)	23.2 (48)	0.67
	≥2h/day	76.1 (67)	23.9 (21)		74.1 (43)	25.9 (15)	
PC/ weekdays	<1h/day	79.6 (262)	20.4 (67)	0.50	75.5 (182)	24.5 (59)	0.33
	≥1h/day	85.7 (18)	14.3 (3)		86.7 (13)	13.3 (2)	
E. games/ weekdays	<1h/day	79.9 (271)	20.1 (68)	0.37	76.3 (190)	23.7 (59)	0.46
	≥1h/day	90.9 (10)	9.1 (1)		87.5 (7)	12.5 (1)	
Characteristics		Normal weight‡	Overweight‡	p	WHtR<0.5‡	WHtR≥0.5‡	p
PE (min/week)		10.3.6±35.3	98.2±38.0	0.25	10.5.2±34.7	100.6±35.6	0.36
Sport (min/week)		96.6±98.6	85.3±84.8	0.37	102.6±105.3	67.9±84.0	0.02
Active play (min/week)		719.3±529.3	620.0±381.0	0.14	715.5±496.8	586.2±413.3	0.07

Note. † frequencies (%) and number of individuals; ‡ mean values and standard deviation; BMI=body mass index, TV=television, PC=computer, E. Games=electronic games, PE=physical education, WHtR=waist-to-height ratio; p-values are the result of chi-square and Student-t tests, p<0.05 was considered significant.

In the non-urban setting, a higher prevalence of obesity was found in girls (24.5%) compared to boys (15.3%) (X^2=4.88, p=0.03) and in children whose mothers were obese (36.0%) instead of having normal weight (14.8%) or overweight (27.5%) (X^2=12.75, p=0.01). No relation was found between the prevalence of childhood obesity and family income, parental education, father's BMI, way of commute, participation in extracurricular sport, PE and active play, and screen time. A higher prevalence of abdominal obesity in non-urban children was found in children that reportedly were not engaged in any sport (32.7% vs. 18.5% for children practicing at least one sport; X^2=6.95, p=0.01) and children that practiced sports less times per week (0 times: 32.7%, 1-2 times: 19.6%, ≥3 times:16.4%; X^2=7.17, p=0.03). Also, children that had a WHtR above 0.5 practiced sport significantly less minutes per week than children with a WHtR<0.5. Still in the non-urban setting, no significant difference in childhood abdominal obesity was found according to sex, family income, parental education, parental nutritional status, commute, screen time, and the minutes per week spent in PE or active play (Table 9.3.2).

Table 9.3.3. shows the intrapersonal, social, and physical environment factors associated with childhood obesity. In the crude analysis, children had significantly higher odds of being obese if they were girls (OR=1.45, p=0.03), if they were from lower (OR=1.71, p=0.01) or medium income (OR=1.87, p=0.00) instead of higher income families, if their father had low or middle education (OR=1.57, p=0.04; OR=1.54, p=0.05, respectively), and if they had a mother with low (OR=1.57, p<0.05) or middle education (OR=1.60, p=0.02). Significantly lower odds of childhood obesity were associated with active commute (OR=0.62, p=0.04), more minutes per week in active play (OR=1.00, p=0.04), and having a mother with normal or overweight (OR=0.25, p=0.00; OR=0.44, p=0.01, respectively), instead of an obese mother.

Table 9.3.3. Association of childhood obesity (IOTF cut-off points) with intrapersonal, social and physical environment factors (results presented crude and adjusted).

Risk of obesity (including overweight)		Crude			Adjusted		
		OR	95%CI	p	AOR	95%CI	p
Sex	Girls	1.45	1.03;2.04	0.03	1.57	1.09;2.27	0.02
	Boys	Ref.			Ref.		
Age		1.06	0.92;1.22	0.42	1.08	0.93;1.25	0.32
Commute	Active	0.62	0.40;1.00	0.04	0.55	0.34;0.91	0.02
	Passive	Ref.			Ref.		
Sport	Yes	0.76	0.54;1.08	0.13	0.95	0.62;1.44	0.80
	No	Ref.			Ref.		
Sport per week	None	1.29	0.83;1.99	0.26	1.06	0.63;1.78	0.81
	1-2 times	0.97	0.63;1.48	0.87	1.01	0.64;1.60	0.97
	≥3 times	Ref.			Ref.		
Sport (min/week)		0.99	0.99;1.00	0.52	0.99	0.99;1.00	0.24
PE (min/week)		0.99	0.99;1.00	0.30	1.00	0.99;1.00	0.20
Active play (min/week)		1.00	0.99;1.00	0.04	0.99	0.99;1.00	0.01
TV week	<2h/day	0.92	0.61;1.38	0.68	0.97	0.62;1.53	0.90
	≥2h/day	Ref.			Ref.		
PC week	<1h/day	0.79	0.42;1.46	0.44	0.84	0.42;1.69	0.63
	≥1h/day	Ref.			Ref.		
E. G. week	<1h/day	0.88	0.39;1.98	0.75	1.02	0.40;2.61	0.97
	≥1h/day	Ref.			Ref.		

Table 9.3.3. (continuation)

		OR	95%CI	p	AOR	95%CI	p
Income	Low	1.71	1.13;2.59	0.01	1.41	0.80;2.48	0.23
	Medium	1.87	1.22;2.87	0.00	1.55	0.96;2.52	0.08
	High	Ref.			Ref.		
Sibling	None	0.81	0.48;1.35	0.41	0.92	0.52;1.64	0.78
	1	0.82	0.51;1.32	0.41	1.09	0.64;1.86	0.76
	≥2	Ref.			Ref.		
Father education	Low	1.57	1.03;2.38	0.04	1.05	0.58;1.88	0.87
	Middle	1.53	1.00;2.33	0.05	1.13	0.69;1.85	0.64
	High	Ref.			Ref.		
Mother education	Low	1.57	1.01;2.47	<0.05	1.21	0.64;2.26	0.56
	Middle	1.60	1.08;2.38	0.02	1.42	0.87;2.29	0.16
	High	Ref.			Ref.		
Father BMI	Normal	0.65	0.37;1.14	0.13	0.65	0.36;1.18	0.16
	Overweight	0.70	0.41;1.22	0.21	0.74	0.41;1.32	0.31
	Obese	Ref.			Ref.		
Mother BMI	Normal	0.25	0.25;0.44	<0.001	0.34	0.18;0.64	0.00
	Overweight	0.44	0.23;0.84	0.01	0.56	0.28;1.10	0.09
	Obese	Ref.			Ref.		
Setting	Urban	1.25	0.89;1.75	0.20	1.76	1.17;2.66	0.01
	Non-urban	Ref.			Ref.		

Note. Reference category: normal weight; OR=odds ratio, AOR=adjusted odds ratio (sex, age, parental education and family income); CI=confidence interval, Ref.=reference; PE=physical education, TV=television, PC=computer, E. G.=electronic games, BMI=body mass index; p-values below 0.05 were considered significant.

When adjusted for children's sex, age, parental education and family income, girls had almost the double of the risk of having obesity compared to boys (AOR=1.57, p=0.02) and children living in the urban setting had 1.76 more times the odds of having obesity than their non-urban counterparts (AOR=1.76, p=0.01). Children that reportedly spent more minutes per week in active play had lower odds of being obese (AOR=0.99, p=0.01). Significantly lower odds of having obesity were also associated with active commute (AOR=0.55, p=0.02) and having a mother with normal weight (AOR=0.34, p=0.00), instead of commute by car or public

transports, and having an obese mother. In both the crude and the adjusted analyses, no statistical significant association was found between risk of obesity and children's age, participation in an extracurricular sport and PE, screen time, number of siblings, and father's BMI (Table 9.3.3).

Table 9.3.4. presents the results of the logistic regression between abdominal obesity and intrapersonal, social, and physical environment factors. In the crude analysis, children who commute actively (OR=0.56, p=0.03), children who practiced at least one extracurricular sport per week (OR=0.48, p<0.001) and spent more minutes per week in a sport (OR=0.99, p<0.001), and children whose mother had normal weigh (OR=0.29, p<0.001) or overweight instead of obesity (OR=0.43, p=0.02), had significantly lower risk of being abdominally obese. A slightly tendency was found for girls to have higher odds of having a WHtR≥*5* compared to boys (OR=1.40, p=0.07). Still in the crude analysis, children who did not practice sport any time per week had 2.50 times more odds of having abdominal obesity compared with children practicing sport three or more times per week (OR=2.50, p<0.001), children from low or medium income families had higher odds of having abdominal obesity compared with high income children (OR=1.88, p=0.01; OR=1.66, p=0.03, respectively), children whit a low or middle educated father (OR=1.82, p=0.01; OR=1.94, p=0.00, respectively) or a mother with low education (OR=2.02, p=0.00) had significantly higher odds of having abdominal obesity compared with children of high educated parents.

In the adjusted model, girls had significantly more odds of having abdominal obesity than boys (AOR=1.59, p=0.02). Also, lower odds of being abdominally obese were associated with active commute (AOR=0.51, p=0.03), participation in an extracurricular sport (AOR=0.52, p=0.00), more minutes per week practicing sports (AOR=0.98, p=0.01) and PE (AOR=0.99, p=0.01), and having a mother with normal weight (AOR=0.35, p=0.00) or overweight (AOR=0.47, p=0.04) instead of having a mother with obesity levels. Children who practice no extracurricular sport had 2.42 more times the odds of being abdominally obese than children who practiced an extracurricular sport at least three times per week (AOR=2.42, p=0.00). Children's age, the time spent in active play and screen time, the number of siblings, father's BMI and the setting were not significantly associated with children's abdominal obesity, both in the crude and in the adjusted models (Table 9.3.4).

Table 9.3.4. Association abdominal obesity (WHtR≥0.5) with intrapersonal, social, and physical environment factors (results presented crude and adjusted).

Risk of abdominal obesity		Crude			Adjusted		
		OR	95%CI	p	AOR	95%CI	p
Sex	Girls	1.40	0.97;2.01	0.07	1.59	1.07;2.36	0.02
	Boys	Ref.			Ref.		
Age		0.98	0.85;1.14	0.81	0.98	0.84;1.16	0.88
Commute	Active	0.56	0.33;0.95	0.03	0.51	0.29;0.93	0.03
	Passive	Ref.			Ref.		
Sport	Yes	0.48	0.43;0.69	<0.001	0.52	0.33;0.80	0.00
	No	Ref.			Ref.		
Sport per week	None	2.50	1.53;4.09	<0.001	2.42	1.36;4.31	0.00
	1-2 times	1.31	0.80;2.17	0.28	1.40	0.82;2.40	0.22
	≥3 times	Ref.			Ref.		
Sport (min/week)		0.99	0.98;0.99	<0.001	0.98	0.98;0.99	0.01
PE (min/week)		0.99	0.98;1.00	0.06	0.99	0.98;0.99	0.01
Active play (min/week)		1.00	0.99;1.00	0.20	1.00	0.99;1.00	0.16
TV week	<2h/day	0.88	0.57;1.35	0.56	0.99	0.61;1.62	0.99
	≥2h/day	Ref.			Ref.		
PC week	<1h/day	1.20	0.59;2.46	0.62	0.95	0.45;2.02	0.90
	≥1h/day	Ref.			Ref.		
E. G. week	<1h/day	0.93	0.39;2.21	0.87	0.88	0.34;2.28	0.79
	≥1h/day	Ref.			Ref.		
Income	Low	1.88	1.21;2.92	0.01	1.42	0.78;2.61	0.25
	Medium	1.66	1.04;2.64	0.03	1.32	0.78;2.23	0.31
	High	Ref.			Ref.		
Sibling	None	0.87	0.49;1.54	0.63	0.92	0.48;1.77	0.81
	1	1.05	0.62;1.77	0.85	1.41	0.77;2.56	0.26
	≥2	Ref.			Ref.		
Father education	Low	1.82	1.16;2.84	0.01	1.21	0.64;2.29	0.56
	Middle	1.94	1.24;3.05	0.00	1.53	0.90;2.60	0.12
	High	Ref.			Ref.		

Table 9.3.4. (continuation)

		OR	95%CI	p	AOR	95%CI	p
Mother education	Low	2.02	1.26;3.22	0.00	1.42	0.73;2.76	0.31
	Middle	1.41	0.91;2.17	0.12	1.09	0.64;1.86	0.75
	High	Ref.			Ref.		
Father BMI	Normal	0.78	0.43;1.43	0.43	0.78	0.41;1.49	0.78
	Overweight	0.86	0.48;1.55	0.62	0.90	0.48;1.68	0.73
	Obese	Ref.			Ref.		
Mother BMI	Normal	0.29	0.16;0.54	<0.001	0.35	0.18;0.67	0.00
	Overweight	0.43	0.22;0.85	0.02	0.47	0.23;0.96	0.04
	Obese	Ref.			Ref.		
Setting	Urban	0.85	0.59;1.23	0.39	1.19	0.77;1.85	0.44
	Non-urban	Ref.			Ref.		

Note. Reference category: normal weight; OR=odds ratio, AOR=adjusted odds ratio (sex, age, parental education and family income); CI=confidence interval, Ref.=reference; PE=physical education, TV=television, PC=computer, E. G.=electronic games, BMI=body mass index; p-values below 0.05 were considered significant.

9.4. Discussion

Present results show that normal weight and children with general and abdominal obesity are significantly different in various family, socio-demographic, and behavioural characteristics, but may varied according to the degree of urbanization. Generally, in the urban setting, lower prevalence of childhood obesity was found in children who commuted passively, in children from lower income families, with low educated parents, and in parents within the obesity levels. Still in the urban setting, higher prevalence of abdominal obesity was found in children who commuted passively and the ones who were not engaged in any extracurricular sport or spent less minutes per week playing those sport, children whose parents had low or middle education and were obese. In the non-urban setting, girls and children with obese mothers had higher prevalence of obesity while children who were not practicing an extracurricular sport or practiced less times and less minutes per week had higher prevalence of abdominal obesity.

Previous research, also show strong evidence of familial aggregation in BMI, where children with parents with high BMI, tend to have high BMI values. This was seen among the Chinese Han population (Hu et al. 2013) and in Finland, where family's aggregation in BMI showed that when one or both parents were obese, 15-year-old children were more likely to be in the highest quartile of BMI (Fuentes et al. 2000). Also, this association was previously observed in Portuguese children (aged 9-11), in which obese mothers and fathers were associated with higher prevalence of overweight (47.4% and 67.8%) than normal weight children (33.7% and 58.7%) (Gomes et al. 2014). Familial aggregation may indicate known or unknown genetic and shared environmental impacts on BMI of family members. A longitudinal study of UK families, found not only a marked influence of maternal and paternal BMI on the children's weight gain, but also a relation between weight gain in mother-daughter and father-son (Perez-Pastor et al. 2009) which may indicate that shared environment is more important than shared genes because selective mother-daughter and father-son gene transmission is not a common Mendelian trait. In particular, stronger associations of BMI have been frequently reported between mother and offspring (Fuentes et al. 2000; Park, Yim, and Cho 2004), therefore the mother is widely believed to play an important role in parent-offspring correlations, which might be due to gestation (Hillier et al. 2007) and their greater impact on children's dietary behaviour (Park et al. 2004).

In the present study monthly family income and parents' education were found to be different between children of different weight status, with children from lower incomes and whose parents had lower education having higher prevalence of obesity. Available data do not consistently show a clear effect size and direction in the association of SES, either determined by income or education, and weight status. Previous research suggests that in develop countries, children of low and medium SES are more likely to be obese than those of high SES (Wang and Lim 2012), while others observed that SES was positively associated with overweight and obesity in Chinese children (Zhang and Wang 2012). Even among Portuguese studies there have been some inconsistencies, with some reporting no differences between 9-11-year-old children's nutritional status according to annual household income (Gomes et al. 2014), whereas others observed that children from low and medium SES had almost two times the risk of being obese than their high-SES peers (Nogueira et al. 2013) and that high parental levels of education was a protector against childhood obesity (Padez et al. 2005).

Low and high SES families may vary in their access to healthy food and behaviours. For instance, low SES families may have difficulty in implementing healthier diets, since the more healthy items such as meat, fish, fresh vegetables, and fruits generally costs more while refined grains and added sugars and fats are among the lowest-costs sources of dietary energy (Drewnowski and Darmon 2005). They may also experience problems while buying sport equipment, paying club fees, and transportation to sport facilities, finding them unaffordable. Families with lower income/education level may also not perceive childhood obesity as a health problem or they may lack the knowledge to adopt healthy lifestyles. Moreover, a Portuguese study found that 8-10-year-old children from lower SES perceive PA as less important and enjoyable than middle and higher SES families (A. Seabra et al. 2013). The higher prevalence of general and abdominal obesity found in children from lower income and with low educated parents was only found in the urban setting, maybe because the non-urban area may be more appealing for recreational PA, with natural open spaces being available. Also, smaller communities often provide financial help or free recreational activities for their inhabitants, which may indicate that lower SES families living in the urban setting are at a disadvantage compared with low SES families living in non-urban areas.

PA is usually correlated with weight status, regardless of the measurement device, with normal weight children being more active than their obese counterparts (Decelis, Jago, and Fox 2014; Hills, Andersen, and Byrne 2011), which is consistent with present findings in which children that were engaged in an extracurricular sport, and spent more times and minutes per week in a sport, had lower prevalence of abdominal obesity while children that commuted actively (e.g. walking, bicycling) had lower prevalence of obesity. Maffeis et al. (Maffeis et al. 1996) used heart rate monitoring to estimate PA in a small group of 8-10-year-old obese and non-obese children and found that non-obese children spent about 100 min a day more being physically active than the obese children. The results of several longitudinal studies pointed out the inverse relationship between PA and children's BMI (Lindstrom, Isacsson, and Merlo 2003; Obarzanek, Schreiber, and Crawford 1994). On the other side, some studies have found no difference at all, including previous studies carried among Portuguese children (Gomes et al. 2014). In addition, although total activity and PA are generally less in the obese children compared to the non-obese, total activity energy expenditure is not always reduced when adjusted for lean body mass (Ekelund et al. 2002) which may help to explain the different results observed in the literature.

The second purpose of this study was to investigate the importance of intrapersonal (biological and behavioural), social (family and economic), and physical environment factors (the degree of urbanization) on variation in children's BMI and abdominal obesity. Findings suggest that children's obesity and abdominal obesity are associated with similar social and behavioural factors. In the crude analysis, children from lower income, with lower educated parents and children with obese mothers had the highest odds of having higher prevalence of both general and abdominal obesity. Present findings are in accordance with findings previously reported that there is an association between parental and childhood obesity (Laitinen, Power, and Jarvelin 2001; Parikka et al. 2015; Xu et al. 2011) and that children of obese mothers had more than two times the odds of being abdominally obese (Melzer et al. 2015). No association was found between father's BMI and children's obesity indicators, even if paternal obesity was previously seen has an important predictor of obesity in Portuguese children (10-12 years) since obese parents often serve higher calorie meals to their children (Morais Macieira et al. 2017). Also, this association between parents-child's BMI may be due to genetic and sociocultural factors of family habits thus, the nutritional attention in maternal and child health status should begin during the prenatal period and encompass the whole family structure. In fact, it has been shown that parental involvement in nutritional education interventions and in promoting PA for children beneficially assist in reducing BMI and other nutritional status parameters (Niemeier, Hektner, and Enger 2012).

Family income and parental education were negatively associated with children's BMI, in which children of parents with lower income and/or education had significantly higher odds of being obese and having abdominal obesity than children whose parents reported higher income and education level. This is consistent with previous studies in which 3-10-year-old Portuguese children of low (OR=1.76) and medium SES (OR=1.57) were more likely to be obese than their high-SES peers (Nogueira et al. 2013), which is also in line with other international studies (Bonaccio et al. 2012; Danielzik et al. 2004; Fairclough et al. 2009). In the ENERGY cohort study, overweight and obesity were also more prevalent among 10-12-year-old children from parents with lower levels of education (Brug et al. 2012) and in Portugal, a study run in 2002-2003 demonstrated that parental education was a protector against 7-9.5-year-old children's obesity (Padez et al. 2005). Children from lower SES families (i.e., lower income or education) may lack the opportunities or the knowledge to engage in physical activities or to adopt healthier diets. As seen by Nogueira et al. (2013), 3-10-year-old children living in central

Portugal and in lower SES families were less likely to participate in PA. in addition, the discrepancies according to SES may begin early in life, as suggested by a study published in 2011, showing a graded association between weight gain in infancy and SES defined as maternal education and occupation (Wijlaars et al. 2011).

An increase in prevalence of obesity was shown to be correlated with the inequality among households and these disparities seem to be rising in Europe, increasing the gradient between lower and higher socioeconomic groups (Knai et al. 2012). In their study from 2010, Stamakis and colleagues reported a stabilization of obesity rates from 2002 to 2007 that did not benefit children from lower socioeconomic groups (Stamatakis, Wardle, and Cole 2010).

In the present study, girls had almost two times the odds of having obesity and abdominal obesity compared to boys. This is in line with the results observed by Melzer et al. in a sample of 3-10-year-old Brazilian children (Melzer et al. 2015) and by Muc in a sample of 6-8-year-old children living in the central area of Portugal (Muc 2014). Girls usually have a higher body fat percentage than boys, maybe because they typically engaged in less PA, including organised sport, than the opposite sex (Hallal et al. 2012; Pearce et al. 2012; Telford et al. 2016; Trost et al. 2002) and may spend more time in sedentary behaviours (Biddle et al. 2009; Steele et al. 2010).

Some studies have concluded that lower PA levels are predictive of higher BMI (Janssen et al. 2004), while a review of the available prospective study of objectively assessed PA and gains in adiposity has concluded that PA is a poor predictor of increases in excessive fatness (Wilks et al. 2011). Present findings show that participation in PA, either by participation in extracurricular sport, active play, active commute, or PE classes, was associated with lower odds of obesity and abdominal obesity, even when adjusting for sex, age and socio-economic factors. Janssen et al. (Janssen et al. 2005), in a review paper examining associations between obesity, dietary and PA behaviours in children, concluded that increasing PA participation was a relevant strategy to prevent and treat overweight and obesity. German children (aged 7 and 8-year-old) participating in organised sports more than once per week were significantly less likely to be overweight (OR=0.52) (Drenowatz et al. 2013). In a review, 55% of the studies that examined the relationship between active commute and weight status/body composition reported significant associations (Lubans et al. 2011). Furthermore, Bingham et al. (Bingham et al. 2013) found that performing at least 1 hour of moderate PA every day was a protective factor against obesity in Portuguese children (aged 3-10), which was reinforced later in a

sample of 9-11-year-old Portuguese children (Gomes et al. 2014). Nevertheless, this association is not always established. Suton et al. (Suton et al. 2013) found that the self-reported level of PA was not associated with body fat in 10 year old children. In their review, Nelson et al. found no clear pattern of association between body weight and sport participation (Nelson et al. 2011). Also, two studies focusing on children living in central Portugal, one with 3-11-year-olds (Pronto 2013) and the other with 6-8-years-old (Muc 2014), evaluated the children's levels of PA reported by parents, and did not show any significant association with the children's nutritional status, although an increased risk of obesity and abdominal obesity was found related with lower frequency of vigorous PA.

Although PA results in energy expenditure and facilitates weight loss and maintenance of healthy body mass it may be that most studies, because of their cross-sectional design, might not reflect this process. Overweight and obese children may already be participating in sport, with obesity being a motivator to introduce a weight-loss intervention, such as extracurricular sport, which would explain the present findings. In fact, Muc (Muc 2014) reported that during data collection, many overweight and obese children that were aware of their condition, admitted to having started practicing more sports in order to lose some weight.

Screen time (TV, PC, and electronic games) showed no statistically significant association with obesity and abdominal obesity even if the odds of having excess weight or abdominal fat was slightly lower in children that followed the recommended guidelines, of less than 2h/day of TV and less than 1h/day of PC. These findings are consistent with the results found in 3-10-year-old Brazilian children (Melzer et al. 2015), where activities considered as sedentary practices showed no association with abdominal obesity. In a Portuguese study from 2014, screen time recommendations (<2h/day and ≥2h/day) was not associated with obesity levels in 9-11-year-old children (Gomes et al. 2014). More recently it was found that the proportions of Portuguese obese children spending less than 2h/day watching TV or using video games (26.9%) was similar to that of children spending 2 or more hours in that behaviour (29.4%) and screen time did not predict BMI (OR=0.88) (Morais Macieira et al. 2017). However, those findings contradict the results reported by Muc (Muc 2014), that watching TV less than an hour per day as compared to watching over 3 hours a day very significantly decreased the risk of obesity, high fat percentage and abdominal obesity. Present results also contradict the ones observed by Padez et al. (Padez et al. 2005), in which compared to children watching TV less than 2 hours a day, those who watched TV between 2 and 3 hours a day had a 50%

increased risk of obesity and those who watched 3-4 hours had a 72% increased risk, and the results by Carvalhal et al. (2007) in which the odds ratio of being obese were 0.45 times more for boys and 0.57 times more for girls that played more than 1h/day of electronic games compared with those who played only 1 hour. Watching TV for more than 1h/day was found to significantly increase the odds of obesity in a national sample of 3-10-year-old Portuguese children (Bingham et al. 2013). However, it should be noted that the time spent watching TV, using the PC and playing electronic games was reported by parents and may have been underestimated.

Previous studies have reported that urban children had higher risk of being overweight, compared with children living in non-urban areas (Muc 2014; Rito et al. 2012). In a national study run in 2008, 6-8-year-old children living in an urban area had an over 20% higher risk of being overweight, compared with their rural counterparts (Rito et., 2012). In fact, Muc (2014) found that living in urban areas showed to increase the risk of all obesity indicators but the highest and significant risk was found for abdominal obesity and high body fat. Another study, based on a sample of Portuguese adolescents (18-year-old men) confirmed that the prevalence of obesity in Portugal tends to increase with the degree of urbanization, being highest in urban and lowest in rural areas (Padez 2006). In the present study, urban children had almost two times the odds of being obese compared with children living in the non-urban setting, which is in line with the studies previously mentioned. They also had higher risk of being abdominally obese compared with non-urban children but the association was not statistically significant. Urban areas usually have more traffic and less road safety which were seen to affect children' PA, particularly walking and cycling in the residential area (Timperio et al. 2004). In another study by Timperio et al. (Timperio et al. 2005), it was shown that negative perceptions about traffic and road safety were an indirect influence on overweight and obesity among 10-12-year-old children.

The association involving the child's abdominal obesity are still uncertain, particular in Portugal, where data on secular trends in WC and WHtR are scarce, making it impossible to compare present results with previous studies. In addition, it may be the case that other factors, like nutritional habits, may be acting over children's nutritional status and fatness. In fact, some studies have found that unhealthy behaviours coexist. A review from 2011, found that children and adolescents involved in sports were more likely to consume fruit and vegetables (Nelson et al. 2011). More recently, Rodrigues et al. (Rodrigues et al. 2016)

concluded that children who adopted unhealthy diets spent significantly more time watching TV and reported lower levels of PA.

9.5. Conclusion

In summary, present study showed that there are behavioural, family and socio-demographic differences between normal weight/obese children and children with or without abdominal obesity. Also, intrapersonal, socio-economic factors and the degree of urbanization are important predictors of children's nutritional status and abdominal obesity. In general, PA (extracurricular sport, PE classes, active commute, active play) had a protective effect against child's excess weight and fat; while being a girl and living in the urban setting increased the risk of general and abdominal obesity. Through a combination of children's unhealthy behaviours influenced by their parents and poorest home environment, present results suggest a model of environmental injustice among socially deprived groups, which is particularly worrying in the current national situation of economic crisis in Portugal. Taken together, this information should be carefully considered by families, school and teaching staff, paediatricians, and planners of intervention studies when designing more efficient strategies to combat the obesity epidemic.

Chapter 10. Main findings, recommendations and final conclusion

10.1. Main findings

The present study indicates that children living in the non-urban setting may engage in more physical activities but majority of children, independently of the sex and degree of urbanization, participate in at least one extracurricular sport, usually the ones that are socially associated with their own gender or that have a tradition in their community. Sport participation is considered to be a priority among those involved in the public health and the promotion of active lifestyles, which makes it so important to study the factors that may predict this behaviour in children. Independently of children's sex and place of residence, parents with lower education, bigger families, and lower family income decreased the odds of practicing a sport.

Family was found to be one of the most important determinant of extracurricular sport participation in children, either by role modelling or perceived barriers. A strong parental-child relationship was found, particularly within the same sex, in which fathers and mothers that reported to be physically active were associated with increased sport participation in boys and girls respectively. Also, mothers who reported to engage in organised PA increased the odds of their daughters to practice an extracurricular sport, showing the importance of role models in the adoption of healthy behaviours, particularly for girls. Parents who reported less barriers had higher odds of their children being in a sport, compared with parents who reported three or more. For instance, parents who reported proximity of recreational facilities and less availability of sports also had lower odds of having children in a sport. Also, parents of girls who hold more gender stereotypes and gender-role notions on sport, had lower odds of their child participating in a sport in the crude analysis.

Regarding intrapersonal or individual factors, present study shows that girls are in disadvantage compared to boys since both sexes often declare that boys are better at sport than girls and that sport is more important for boys than girls. In addition, perceived competence and interest in pursuing a career in sport is higher among boys than in girls. Non-urban children reported more time to be active and more places to be active during winter, compared with children living in the urban setting, but urban children reported more parental motivation (parents engage in PA with the child during weekdays and/or weekends) than non-

urban children. Not being interest in pursuing a sport-related career was the intrapersonal factor more negatively associated with sport participation, in both sexes and settings. Also, boys favoured more masculine sport, while girls favoured feminine and neutral sport. Present findings suggest that from a young age, children adopt socially and culturally construct gender-roles notions of what is appropriate for boys and girls.

Obesity was classified using two cut-off points and a large number of children were classified as being overweight (WHO: 20.7% and IOTF: 15.9%) or obese (WHO: 7.7% and IOTF: 6.1%). Using the IOTF cut-offs, girls were significantly more obese than boys (7.6% and 4.4%, respectively) but no statistical difference was found between settings. Moreover, girls had higher prevalence of abdominal obesity (WHtR) than boys (24.7% and 19.0%, respectively), and it was found that a large proportion of children that were classified as having normal weight or overweight were abdominally obese, which points to the need to include abdominal obesity in routine clinical practice. Comparing with previous findings, present results are within the lowest observed in the last decade for children of the same age living in central Portugal, which may indicate a possible plateau or stabilization in the prevalence of childhood obesity. Nevertheless, these inferences should be taken carefully, since the results may not reflect a tendency for all the population.

Present results show familial aggregation in BMI, where children with obese mothers, have high BMI values and prevalence of abdominal obesity, independent of the setting. Family income and parental education were also important predictors of childhood obesity together with less participation in physical activity behaviours, including PE, active play, active commute, and extracurricular sport. Being a girl and living in the urban setting were significantly associated with higher odds of having general and abdominal obesity, which reinforces the need to facilitate the access to various sports that allow children, independently of the sex and place of residence, to engage in a variety of activities crucial to their health.

10.2. Strengths, limitations, and future indications

This study has several strengths. First, it has a large and representative sample of children living in the central area of Portugal. Also, the sample has a similar representation of boys and girls and of children living in the urban and in the non-urban setting, from all types of socioeconomic

status. Other important strength of the study are the anthropometric measurements used, which have a methodological advantage over self-reported measures. The measurements of children's height, weight, and waist circumference were performed with high precision by the author of the thesis with the help of a small well-trained group of researchers. By including waist circumference, it was possible to assess children's fat accumulation in abdominal regions and not only children's BMI. Moreover, regarding the scarce data on WHtR in Portuguese children, this study hopes to contribute to a better understanding of this important indicator of metabolic risk. The interviews of the children were carried by the same investigator, avoiding inter-errors.

Part of the parents' questionnaire were previously used in other studies in the same population to study children's PA behaviours, however, in the present study, the Likert-scales were included to assess parents' opinions of sport. Because of that the questionnaire was distributed in a control group of 30 parents in order to test the validity and reliability of the survey. Results of the test shown the tool to be reliable and valid. Meticulously prepared and performed data collection, was followed by solid statistical analyses, using advanced methods as exploratory factor analysis (EFA) and multivariate testing, to obtain the most reliable results and minimize the effects of confounder and bias. Also, statistical tests were adjusted to a number of variables, such as income and parental education, to avoid the effect of those factors in the studied population. In fact, using parental education and income it is not a typical procedure in most studies but, since the variables may measure different things (knowledge and financial possibilities, both important in the adoption of healthy lifestyles) we believe that it is an important strength of this study.

The findings of the present study contribute to themes that have never, or very rarely, described in Portugal. Also, most studies regarding PA in Portugal were carried among adolescents and not children, few have focused on extracurricular sport participation, and even less have explore the urban/non-urban dichotomy. This study hopes to contribute to a better understanding of the factors associated with children's sport participation and why the literature commonly described that girls are less physically active than boys, by observing intrapersonal (sex, perceived psychological, cultural, and physical barriers, interest and enjoyment), social (parents' perceived barriers, opinions, stereotypes and gender-role notions, and PA behaviours), and environmental (urban and non-urban characteristics) factors.

Despite the strengths, this study has some limitations, that may be overcome in future studies. This study is a cross-sectional so that the cause-effect relationships cannot be assumed. Also, observations are limited to a sample of Portuguese children of 6-10 years of age living in central Portugal. Although, specific measures were taken to adapt the questions to this specific age range, young children may not be able to understand the full meaning of some questions and of their answers. Generalization of the results to other samples, including urban and non-urban children, should be made with caution, especially since the non-urban setting observed in this study has particular characteristics, like a wide variety of recreational facilities and sport programs. Also, it may be the case that many parents living in one place are working in the other.

Questionnaire-based data is always prone to bias related to self-reporting. People, consciously or unconsciously, may misreport the truth either by faulty memory or by trying to give the "right answer". This can be particular true in topics concerning themes often associated with social stigma such as PA, sedentary behaviours, and weight. Some social groups may be more likely than others to misreport the facts, which we hope was overcome by adjusting the tests for household income and parental education. In addition, we targeted last days or week, and not some years back, which we hope helped to overcome misreports related with forgetfulness. Children's PA was not objectively measured but self-reported by parents. Literature indicates that accelerometers appears to provide slightly more consistent results in relation to self-reported PA, and recent investigations combined the use of both methods to collect complementary and comprehensive data. To avoid overestimates or underestimates of PA, children's sport participation (Yes or No) was the outcome observed in the majority of statistical analyses. It should be interesting to recreate this study using accelerometers or pedometers in order to study the association of factors, like parents' or children's opinions of sport, with the intensity of PA.

Findings from the present study should be further explored in large samples, other populations and contexts. The questionnaire, although valid and reliable, may be improved. For instance, it may information about the children's diet which may help to explain why in some contexts, the factors observed in this study had little or no role in childhood obesity. Also, specific variables related to the build environment in the neighbourhood should be measure, by partnering with experts in geographic information systems geocoding and the Global Positioning System. At the current time, most studies are cross-sectional and unable to infer

which correlates are, in fact, determinants of children's PA behaviours. More longitudinal studies involving interventions, control groups and/or changes in the built environment are needed to investigate causality. Majority of children were practicing a sport but will they stay involved in that same sport, or at any sport, when older? Will girls, whose parents hold more stereotypical views about sport, remain involved in a sport, and if yes, which sport? The effects of weight loss and gain could add important layers to our knowledge.

10.3. Conclusion

The present study highlights different correlates of organized PA among 6-10-year-old Portuguese children living in two geographical environments. Following the notions of the socio-ecological model, this study shows that participation in sport is associated with both intrapersonal and social factors, and that the factors may varied according to the degree of urbanization. Overall, children who perceived more psychological, cultural, and physical environmental barriers, from lower SES, with less parental modelling, and whose parents perceived more barriers have less odds of practicing an extracurricular sport. In addition, present results suggest that girls and children living in the urban setting may be a high risk population when it comes to be physically active. Being that PA, including sport, was more frequent in normal weight children and that different forms of PA were a predictor of general and abdominal obesity, this may in part explain why the prevalence of obesity indicators were higher in girls than in boys, and why urban children had higher odds of being obese compared with their non-urban counterparts. Helping to overcome the psychological, physical, and social barriers, taken in consideration the physical and social characteristics of the place of residence, could be an important strategy for confronting physical inactivity in children as well as the public health problem. By identifying barriers in different domains, this study reinforces the theories defending that actions to promote PA are most effective when they enable alterations in different factors and include multiple levels of influence, starting in the nuclear family, but including teachers, schools, and government policies.

Chapter 11. References

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Appendix 1: Study authorization

Exmo(a)s Sr(a)s.

O **pedido de autorização** do inquérito n.º 0043300004, com a designação Determinantes sociais, culturais e ambientais que influenciam os padrões de actividade física e os valores de obesidade de crianças dos 5-10 anos, registado em 07-02-2013, **foi aprovado**.

Avaliação do inquérito:

Exmo(a) Senhor(a) Dr(a) Cristina Maria Proença Padez

Venho por este meio informar que o pedido de realização de inquérito em meio escolar é aprovado uma vez que, submetido a análise, cumpre os requisitos devendo atender-se às observações aduzidas.

Com os melhores cumprimentos

José Vitor Pedroso

Diretor de Serviços de Projetos Educativos

DGE

Appendix 2: Authorization of child's participation in the study and parental questionnaire

Departamento de Ciências da
FCTUC FACULDADE DE CIÊNCIAS E TECNOLOGIA
UNIVERSIDADE DE COIMBRA

Determinantes sociais, culturais e ambientais que influenciam os padrões de atividade física e os valores de obesidade de crianças dos 6-10 anos

Os estudos de **obesidade** desenvolvidos em Portugal revelaram dados preocupantes: os valores encontrados são dos mais elevados da Europa, particularmente entre crianças e adolescentes. Sabendo que o excesso de peso tem consequências negativas para a saúde é essencial que se façam mais estudos, por um lado para entender os fatores que influenciam a obesidade e por outro para perceber se as políticas aplicadas até ao momento têm surtido algum efeito no combate a esta tendência.

Este projeto envolverá escolas de ensino básico de Coimbra e da Lousã. Vamos pesar o seu filho(a) numa balança apropriada, medir a altura e o perímetro da barriga, e fazer-lhe algumas perguntas sobre a prática de atividade física. As **medidas** são simples, efetuadas por pessoas devidamente treinadas, sem qualquer risco ou desconforto para a criança. No próprio dia, vai ficar a saber quanto pesa e mede o seu filho pois vamos enviar um cartão com os respetivos dados. Estas medidas serão conjugadas com alguns dados familiares (inquérito anexo) que serão extremamente úteis para complementar os dados sobre o comportamento desportivo da criança. Para que este projeto possa ser efetuado é imprescindível a sua colaboração e por isso pedimos-lhe que responda ao inquérito que se segue com a certeza de que as informações obtidas serão de grande utilidade e contribuirão para a prevenção da obesidade nas crianças. Para que possamos avaliar o seu filho, precisamos que nos dê a sua autorização por escrito, no termo de consentimento anexo ao inquérito, e que devolva todos os papéis logo que possível. **O inquérito é anónimo, dado que a folha onde pedimos o nome do seu filho – o termo de consentimento – será manuseada apenas pelo(a) professor(a) e ficará na escola.**

Este projeto é coordenado pelo **Centro de Investigação em Antropologia e Saúde** do Departamento de Ciências da Vida, da Universidade de Coimbra. Colocamo-nos à sua inteira disposição para esclarecer qualquer dúvida ou informação mais detalhada pelo telefone 239 854114 do Departamento de Ciências da Vida, da Universidade de Coimbra, ou por correio eletrónico para cpadez@antrop.uc.pt.

Obrigada pela sua colaboração.

A Coordenadora do Projeto e Coordenadora do Centro Investigação em Antropologia e Saúde

(Professora Doutora, Cristina Padez)

Determinantes sociais, culturais e ambientais que influenciam os padrões de atividade física e os valores de obesidade de crianças dos 6-10 anos

Termo de consentimento

Eu _____ Encarregado de educação do aluno(a) _____ N.º _____ a frequentar a Turma _____ do Ano _____ da Escola Básica _____

Dou o meu consentimento para que o meu filho(a) participe neste estudo sobre obesidade e actividade física.

Assinatura: _____

Data _____/_____/ 2013

NOTA: Quando devolver o inquérito deve destacar e ficar com o duplicado (parte inferior desta folha). A parte superior na qual consta o nome do encarregado de educação e da criança ficará na Escola. Assim, garantimos que o inquérito e as medidas realizadas nas crianças serão anónimos.

…….....

Duplicado para o encarregado de educação

Determinantes sociais, culturais e ambientais que influenciam os padrões de atividade física e os valores de obesidade de crianças dos 6 aos 10 anos

Termo de consentimento

Eu _____ Encarregado de educação do aluno(a) _____ N.º _____ a frequentar a Turma _____ do Ano _____ da Escola Básica _____

Dou o meu consentimento para que o meu filho(a) participe neste estudo sobre obesidade e actividade física.

Assinatura: _____

Data _____/_____/ 2013

NOTA: Quando devolver o inquérito deve destacar e ficar com o duplicado (parte inferior desta folha). A parte superior na qual consta o nome do encarregado de educação e da criança ficará na Escola. Assim, garantimos que o inquérito e as medidas realizadas nas crianças serão anónimos.

Determinantes sociais, culturais e ambientais que influenciam os padrões de atividade física e os valores de obesidade de crianças dos 6-10 anos

O formulário encontra-se dividido em quatro partes:

1ª Parte = dados da criança	3ª Parte = dados dos pais
2ª Parte = questões	4ª Parte = dados do agregado familiar

1. Dados da criança

Data de nascimento: _____/_____/_____ Idade: _____ anos **1)** Sexo: Feminino ☐ Masculino ☐

2) Nome da escola: _____ **3)** Ano de escolaridade: _____

4) É possível, por motivos de segurança e/ou distância, o seu filho deslocar-se a pé ou de bicicleta para a escola?

Sim ☐ Não ☐

5) De que forma é feita**, habitualmente**, a **deslocação** do seu filho de casa para a escola e da escola para casa?

A pé ☐ De transportes públicos ☐

De carro ☐ Outro ☐

De bicicleta ☐ Qual?_____

6) O que acha dos **espaços que a escola oferece ao seu filho para este exercer atividades físicas** (em aulas e nos intervalos)? Pode escolher mais do que uma opção.

Suficientes ☐ Devia ter mais ☐

Limpos ☐ Não tem espaços suficientes no Inverno ☐

Bem preservados ☐ Perigosos ☐

7) A escola oferece **aulas de Educação Física**? Sim ☐ Não ☐

7.1) Se sim, o seu filho frequenta? Não ☐

Sim ☐ Quantas vezes por semana? _____

Quanto tempo dura cada aula? _____ minutos

7.2) Se sim, o seu filho já **faltou a aulas de Educação Física** sem ser por motivos de saúde?

Não ☐

Sim ☐ Porquê? _____

7.3) Se sim, a **escola informa-o** regularmente sobre a prestação do seu filho nas aulas de Educação Física?

Sim ☐ Ocasionalmente ☐ Nunca ☐

8) A escola alguma vez lhe falou sobre a importância que o desporto tem para a criança, na medida que lhe proporciona vários benefícios ao nível da saúde, desempenho cognitivo, comportamento social, entre outros?

Sim ☐ Ocasionalmente ☐ Nunca ☐

9) O seu filho pratica, **para além da atividade física na escola**, alguma atividade desportiva num **clube ou outra associação desportiva, nos seus tempos livres**? Sim ☐ Não ☐

9.1) Se respondeu **sim**, preencha, por favor, o quadro seguinte, identificando as atividades e indicando quantas vezes por semana e o tempo (número de horas e/ou minutos) que o seu filho despende nessas atividades.

	Dias úteis		Sábado	Domingo
Atividades (dança, natação, atletismo, patinagem, futebol, etc.)	Nº de vezes por semana	Tempo (horas e/ou minutos)	Tempo (horas e/ou minutos)	Tempo (horas e/ou minutos)

10) Se o seu filho frequenta **outras** atividades extracurriculares, ou seja, fora do período escolar, sem ser na área desportiva**, indique quais e o tempo** (número de horas e/ou minutos) **por semana** que a criança dispensa a essas atividades.

	Dias úteis		Sábado	Domingo
Atividades (teatro, música, expressão artística, escuteiros, etc.)	Nº de vezes por semana	Tempo (horas e/ou minutos)	Tempo (horas e/ou minutos)	Tempo (horas e/ou minutos)

11) Assinale (com um **X**) as instalações desportivas que existem na sua área de residência (área que rodeia a habitação e onde se pode deslocar facilmente a pé).

	Instalações que existem na área de residência (X)	**Instalações que a criança frequenta (X)**
Polivalente descoberto		
Ginásio		
Piscina		
Pavilhão		
Campo de futebol		
Parques verdes		
Parques infantis		
Outras _____		

11.1) Se o seu filho **se desloca a alguma destas instalações** como costuma faze-lo:

Sozinho ☐ Com os pais ☐ Com os amigos ☐ Com familiares ☐ Com vizinhos ☐

Outros ☐ _____

12) A próxima questão refere-se às **atividades sedentárias** do seu filho. Indique (com um **X**), por favor, o tempo gasto pela criança em atividades desta natureza:

	Tempo por semana	Nenhum	Até 1 hora	1 Hora	2 Horas	3 Horas	4 Horas	5 Horas	Mais de 5 horas
A ver televisão	**Dias úteis**								
	Sábado								
	Domingo								

	Tempo por semana	Nenhum	Até 1 hora	1 Hora	2 Horas	3 Horas	4 Horas	5 Horas	Mais de 5 horas
A usar o computador	**Dias úteis**								
	Sábado								
	Domingo								

	Tempo por semana	Nenhum	Até 1 hora	1 Hora	2 Horas	3 Horas	4 Horas	5 Horas	Mais de 5 horas
A usar consolas eletrónicas	**Dias úteis**								
	Sábado								
	Domingo								

13) Qual a sua opinião sobre a quantidade de tempo que o seu filho **dedica a atividades sedentárias**?

É pouco tempo ☐ É uma quantidade de tempo normal ☐ É muito tempo ☐

14) Qual a sua opinião sobre a quantidade de tempo que o seu filho **dedica a atividades físicas na escola**?

É pouco tempo ☐ É uma quantidade de tempo normal ☐ É muito tempo ☐

15) Qual a sua opinião sobre a quantidade de tempo que o seu filho **dedica a atividades físicas fora da escola**?

É pouco tempo ☐ É uma quantidade de tempo normal ☐ É muito tempo ☐

16) De seguida indique (**X**), por favor, quanto tempo por semana o seu filho dedica a **brincadeiras ativas** (como correr, saltar, ou seja, atividades que o façam correr):

Correr, saltar, jogar à bola, andar de bicicleta, etc.			
Tempo por semana	**Dias úteis**	**Sábado**	**Domingo**
Nenhuma			
Até 1 hora			
1 hora			
2 horas			
3 horas			
4 horas			
5 horas			
Mais de 5 horas			

17) De seguida indique (**X**), por favor, quanto tempo por semana o seu filho dedica a **brincadeiras dentro de casa** (que necessitam de pouco ou nenhum esforço físico):

Ler, puzzles, brincar com bonecas ou carros, etc.			
Tempo por semana	**Dias úteis**	**Sábado**	**Domingo**
Nenhuma			
Até 1 hora			
1 hora			
2 horas			
3 horas			
4 horas			
5 horas			
Mais de 5 horas			

18) Como descreveria o seu filho no que diz respeito ao **peso em relação com a idade**:

Magro ☐ Peso adequado ☐ Algum peso a mais ☐ Muito peso a mais ☐

2. Questões

Indique o seu grau de parentesco com a criança (mãe, pai, avó, etc.): _____

As próximas questões deverão ser sempre respondidas tendo em conta a seguinte escala:

1 Discordo completamente	2 Discordo	3 É relativamente verdadeiro	4 Concordo	5 Concordo completamente

	1	**2**	**3**	**4**	**5**
Não tenho tempo livre suficiente para praticar desporto.					
Não consigo pensar em atividades para sugerir ao meu filho(a).					
Considero que o meu filho(a) tem peso a mais para a idade.					
O meu filho(a) não está interessado em fazer desporto.					
Incentivo o meu filho(a) a experimentar desportos novos.					
O meu filho(a) não gosta de atividades ao ar livre.					
Penso que praticar desporto é essencial para uma vida saudável.					
Não tenho tempo para levar o meu filho(a) a parques ou parques infantis.					
O meu filho(a) não gosta de atividades em grupo.					
O meu filho(a) não tem amigos para brincar fora da escola.					
As aulas de educação física na escola são essenciais para incutir o gosto pelo desporto nas crianças.					
Penso que é mais vantajoso para o meu filho(a) andar em atividades extracurriculares como a música e o teatro do que em desporto.					

	1	2	3	4	5
Acredito que as aulas de educação física na escola são exercício físico suficiente para o meu filho(a).					
Acho que o desporto é uma atividade de rapazes.					
Preocupa-me que o meu filho(a) possa vir a ser um adolescente com excesso de peso.					
Existem mais desportos para rapazes do que para raparigas.					
O meu filho(a) queria praticar um desporto que não existe na nossa área de residência.					
O meu filho(a) prefere brincar com jogos eletrónicos/computador e/ou ver televisão do que ter brincadeiras ativas.					
O meu filho(a) queria praticar um desporto que é demasiado caro (por exemplo, transporte, inscrição no clube, equipamento).					
O meu filho(a) não tem tempo livre para praticar atividades extracurriculares, sejam ou não desportivas.					
É importante incutir o gosto pelo desporto nas crianças.					
O meu filho(a) tem poucas ou nenhumas capacidades atléticas/desportivas.					
Penso que a razão mais importante para fazer desporto é de nível estético, para melhorar a forma do corpo.					
A sociedade exerce mais pressão sobre os rapazes para praticarem desporto do que sobre as raparigas.					
A minha atitude em relação ao desporto influencia o nível de atividade física do meu filho(a).					
A comunidade/bairro onde vivo incentiva a prática desportiva.					
Acredito que o desporto torna as raparigas mais “masculinas”.					
Tenho medo de deixar o meu filho(a) brincar na rua e/ou espaços ao ar livre próximos de casa.					
Existem desportos que são só para raparigas.					
Tento ser um modelo de comportamento para o meu filho(a), no que diz respeito à prática desportiva.					
Existem desportos que são indicados só para rapazes.					
Penso que é mais importante para um rapaz praticar desporto do que para uma rapariga.					
Não me importava que o meu filho(a) se dedicasse ao desporto e fizesse carreira profissional disso.					
De modo geral, consigo ter tempo para partilhar com o meu filho(a) algumas das suas atividades preferidas.					
Digo muitas vezes ao meu filho(a) que praticar desporto é importante.					

- Se o seu filho(a) **ESTÁ** inscrito num clube/associação desportiva enumere as seguintes afirmações de 1 (discordo completamente) a 5 (concordo completamente). Se o seu filho(a) **não está** inscrito passe à questão seguinte.

	1	2	3	4	5
Não tenho tempo para ir buscar e levar o meu filho(a) à instituição desportiva.					
O meu filho(a) só anda nesse clube porque a instituição se responsabiliza pelo transporte.					
O meu filho(a) só anda nesse clube porque fica perto da nossa área de residência.					
Vou assistir a competições ou eventos desportivos importantes do meu filho(a).					
Assisto às aulas desportivas do meu filho(a).					
O clube/associação tem desportos mais apropriados para rapazes.					
Foi o meu filho(a) que quis praticar este desporto.					
A escolha do clube/equipa foi um requerimento mínimo para inscrever o meu filho(a).					
O clube/associação tem maior oferta desportiva para raparigas.					
Os rapazes têm mais facilidade para praticar desporto.					
Fui eu que, primeiramente, inscrevi o meu filho(a) neste desporto sem ele me pedir.					
Desde que o meu filho(a) pratica desporto a minha vida mudou para melhor.					
Praticar desporto fez com que o meu filho(a) se tornasse uma pessoa melhor.					
Desde que o meu filho(a) pratica desporto eu também dedico mais tempo à atividade física.					
O desporto fez com que o meu filho(a) melhorasse o seu rendimento escolar.					
Tenho orgulho nas exibições do meu filho(a).					
O meu filho(a) pratica este desporto só por divertimento.					
Costumo dizer ao meu filho(a) que tenho orgulho que ele faça atividades físicas.					
O meu filho(a) pode vir a fazer carreira neste, ou noutro, desporto.					

- Se o seu filho(a) **NÃO ESTÁ** inscrito num clube/associação desportiva enumere as seguintes afirmações de 1 (discordo completamente) a 5 (concordo completamente). Se o seu filho(a) **está** inscrito passe à fase seguinte.

	1	2	3	4	5
Não encontro um clube/associação desportiva que tenha o desporto que o meu filho(a) quer praticar.					
Não vejo qualquer benefício para o meu filho(a) praticar desporto.					
Não encontro um clube/associação que tenha o desporto que eu quero que o meu filho(a) pratique.					
O meu filho(a) tem dificuldade em fazer amigos.					
O meu filho(a) já passa demasiado tempo em brincadeiras ativas e não precisa de fazer mais desporto.					
Não existe qualquer oferta desportiva na minha área de residência.					
O meu filho(a) tem problemas de saúde que o impedem de praticar desporto.					
Não tenho tempo para acompanhar o meu filho(a) a aulas/treinos desportivos.					
Não tenho possibilidades financeiras para inscreve-lo num desporto.					
Eu queria inscrever o meu filho(a) num desporto mas ele não quer.					
O meu filho(a) sente-se mal quando pratica atividades físicas.					
O meu filho(a) não tem tempo para praticar desporto fora da escola.					
O exercício que ele pratica na escola é suficiente.					
O meu filho(a) tem peso a menos para a idade.					
O meu filho(a) não gosta de desportos.					

1) Quão importante é para si o seu filho(a) ser fisicamente ativo?

Muito importante ☐ Importante ☐ Pouco importante ☐ Nada importante ☐

2) Que razões desencorajam ou limitam a prática de exercício físico por parte do seu filho(a) (pode escolher mais do que uma opção)

Falta de tempo	☐	Custos e despesas	☐
Saúde	☐	Falta de interesse da criança	☐
Localização dos espaços desportivos/transporte	☐	O meu filho sente-se cansado	☐
Inexistência de infraestruturas desportivas	☐	Nenhuma razão	☐

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3. Dados dos pais

3.1. Dados do PAI

1) Data de nascimento ___/___/_____; 2) Idade ___ anos; 3) Peso _____Kg; 4) Estatura _____ metros

5) Como descreveria o seu peso:

Muito magro ☐ Magro ☐ Com o peso normal ☐
Um pouco acima do peso normal ☐ Muito acima do peso normal ☐

6) Escolaridade

Não sabe ler e/ou escrever	☐	Ensino complementar (11º/12º ano)	☐
Ensino básico (4ª classe)	☐	Ensino superior	☐
Ciclo preparatório (6º ano)	☐	Outro	☐
Ensino secundário (9º ano)	☐	Qual? _____	

7) Está a trabalhar neste momento? Sim ☐ Desempregado ☐ Aposentado ☐

7.1) Se está a trabalhar, qual a sua profissão? (diga exatamente que faz) _____

7.2) Se está a trabalhar, é possível deslocar-se para o seu local de emprego sem recorrer a veículos motorizados? Sim ☐ Não ☐

7.3) Qual **o modo de transporte** que regularmente usa para se deslocar para o trabalho?

Carro ☐ Transporte público ☐ A pé ☐ Bicicleta ☐ Outro _____

8) Pratica desporto com regularidade?

Não tenho tempo ☐ Não gosto de desporto ☐ Não posso porque tenho um problema de saúde ☐
Pratico desporto num ginásio/clube/associação ☐ Pratico ao ar livre ☐

8.1. Se respondeu **afirmativamente**, indique qual o desporto e quantas horas/minutos por semana:

Desporto	Horas/minutos por semana	Horas/minutos ao fim-de-semana

8.2) Se respondeu **negativamente**:

Já alguma vez praticou desporto de forma regular? Não ☐
Sim ☐

Se sim, qual? _____ Com que idade? _____ anos

9) Indique (com um **X**), por favor, em média, **quanto tempo por semana e ao fim de semana**, dedica a determinadas atividades **sedentárias** (apenas nos referimos ao tempo fora do horário de trabalho):

A ver televisão	**Tempo por semana**	**Nenhum**	**Até 1 hora**	**1 Hora**	**2 Horas**	**3 Horas**	**4 Horas**	**5 Horas**	**Mais de 5 horas**
	Dias úteis								
	Sábado								
	Domingo								

A usar o computador	**Tempo por semana**	**Nenhum**	**Até 1 hora**	**1 Hora**	**2 Horas**	**3 Horas**	**4 Horas**	**5 Horas**	**Mais de 5 horas**
	Dias úteis								
	Sábado								
	Domingo								

A usar consolas eletrónicas	**Tempo por semana**	**Nenhum**	**Até 1 hora**	**1 Hora**	**2 Horas**	**3 Horas**	**4 Horas**	**5 Horas**	**Mais de 5 horas**
	Dias úteis								
	Sábado								
	Domingo								

10) Tendo em conta a sua atividade física considera-se:

Inativo ☐ Ativo ☐
Pouco ativo ☐ Muito ativo ☐

11) Considera que o exercício que pratica é:

Insuficiente ☐ Suficiente ☐ Excessivo ☐

3.2. Dados da MÃE

1) Data de nascimento ___/___/_____; 2) Idade ___ anos; 3) Peso _____Kg; 4) Estatura _____ metros

5) Como descreveria o seu peso:

Muito magro ☐ Magro ☐ Com o peso normal ☐
Um pouco acima do peso normal ☐ Muito acima do peso normal ☐

6) Escolaridade

Não sabe ler e/ou escrever ☐ Ensino complementar (11º/12º ano) ☐
Ensino básico (4ª classe) ☐ Ensino superior ☐
Ciclo preparatório (6º ano) ☐ Outro ☐
Ensino secundário (9º ano) ☐ Qual? _____

7) Está a trabalhar neste momento? Sim ☐ Desempregado ☐ Aposentado ☐

7.1) Se está a trabalhar, qual a sua profissão? (diga exatamente que faz) _____

7.2) Se está a trabalhar, é possível deslocar-se para o seu local de emprego sem recorrer a veículos motorizados? Sim ☐ Não ☐

7.3) Qual **o modo de transporte** que regularmente usa para se deslocar para o trabalho?

Carro ☐ Transporte público ☐ A pé ☐ Bicicleta ☐ Outro _____

8) Pratica desporto com regularidade?

Não tenho tempo ☐ Não gosto de desporto ☐ Não posso porque tenho um problema de saúde ☐
Pratico desporto num ginásio/clube/associação ☐ Pratico ao ar livre ☐

8.1. Se respondeu **afirmativamente**, indique qual o desporto e quantas horas/minutos por semana:

Desporto	Horas/minutos por semana	Horas/minutos ao fim-de-semana

8.2) Se respondeu **negativamente**:

Já alguma vez praticou desporto de forma regular? Não ☐
Sim ☐

Se sim, qual? _____ Com que idade? _____ anos

9) Indique (com um **X**), por favor, em média, **quanto tempo por semana e ao fim de semana**, dedica a determinadas atividades **sedentárias** (apenas nos referimos ao tempo fora do horário de trabalho):

	Tempo por semana	Nenhum	Até 1 hora	1 Hora	2 Horas	3 Horas	4 Horas	5 Horas	Mais de 5 horas
A ver televisão	**Dias úteis**								
	Sábado								
	Domingo								

	Tempo por semana	Nenhum	Até 1 hora	1 Hora	2 Horas	3 Horas	4 Horas	5 Horas	Mais de 5 horas
A usar o computador	**Dias úteis**								
	Sábado								
	Domingo								

	Tempo por semana	Nenhum	Até 1 hora	1 Hora	2 Horas	3 Horas	4 Horas	5 Horas	Mais de 5 horas
A usar consolas eletrónicas	**Dias úteis**								
	Sábado								
	Domingo								

10) Tendo em conta a sua atividade física considera-se:

Inativo ☐ Ativo ☐
Pouco ativo ☐ Muito ativo ☐

11) Considera que o exercício que pratica é:

Insuficiente ☐ Suficiente ☐ Excessivo ☐

4. Dados do agregado familiar

1. Qual o rendimento familiar médio mensal?

Menos de 500 euros ☐
Entre 500 a 1000 euros ☐
Entre 1000 a 1500 euros ☐
Entre 1500 a 2000 euros ☐
Mais de 2000 euros ☐

2. Se o seu filho tem **irmãos ou irmãs** preencha o quadro seguinte:

Data de nascimento	Sexo		Pratica desporto fora do horário escolar?	
	Feminino	Masculino	Não	Sim – quantas horas por semana?
____/____/_____				
____/____/_____				
____/____/_____				
____/____/_____				
____/____/_____				

Para avaliarmos as características da sua área de residência é necessário que indique o seu código postal e o nome da rua. POR FAVOR, **NÃO** INDIQUE O NUMERO DA SUA CASA/APARTAMENTO.

NOME da RUA _____CÓDIGO POSTAL _____-_____

Obrigado pela colaboração.

Appendix 3: Interview of the children – guide (only for the interviewer)

Determinantes sociais, culturais e ambientais que influenciam os padrões de atividade física e os valores de obesidade de crianças dos 6-10 anos

●Entrevista ●

	N.S.	N.C.	Conc.
Eu posso ser fisicamente ativo (correr, saltar, jogar à bola, apanhada, saltar à corda, andar de bicicleta) todos os dias depois da escola			
A minha família encoraja-me a fazer desporto			
Os meus amigos fazem atividade física comigo durante o intervalo			
No meu tempo livre prefiro correr e saltar do que ver TV e jogar consola/PC			
Não tenho tempo para ir ao parque ou jardins infantis			
Fazer desporto é mais importante para os rapazes do que para as raparigas			
Se eu quiser entrar num desporto os meus pais deixam-me			
Acho que sou bom a desporto/educação física			
Existem desportos que só os rapazes podem fazer			
Quero fazer carreira em desporto			
Existem desportos que só as raparigas podem fazer			
Faço desporto mesmo no inverno/quando está frio ou a chover			
Fazer desporto faz com que as pessoas sejam mais saudáveis			
Só gosto de fazer desporto ou atividade física se tiver companhia			
Ao pé de minha casa tenho locais onde posso correr, saltar, andar de bicicleta, jogar à bola ou ter outras brincadeiras			
Quando estou em casa passo mais tempo em brincadeiras ativas do que sentado			
Os rapazes/homens são melhores a desporto do que as raparigas/mulheres			
Costumo (ou já vi) desporto com mulheres/equipas femininas na TV			
As pessoas que eu admiro fazem desporto/atividade física			

Já tive dias em que quis fazer desporto mas não tinha companhia			
Os meus pais acham que só os meninos devem fazer desporto			

Nota: N.S.=não sei/não quer responder; N.C.=não concordo; Conc.=concordo

Observações: _____

_____

_____

_____

_____

_____

_____

_____

_____

1. Os teus pais fazem desporto contigo durante o fim de semana? (X)

	Nunca		Às vezes		Sempre

Observações: _____

2. Os teus pais fazem desporto contigo durante a semana, depois da escola? (X)

	Nunca		Às vezes		Sempre

Observações: _____

3. Qual o teu desporto favorito? _____ e _____
4. Tens objetos em casa para fazer desporto? (Quais e quantos) (X)

Obs:_____

_____

Bola futebol	Bola basquete	Passadeira	Patins	Bicicleta	Balizas	Baloiços	Piscina
Raquetes	Corda de saltar	Trampolim	Skate				

5. Tendo em mente a **última semana** qual das opções melhor descreve o teu comportamento no que diz respeito à atividade física (X):

___ a maior parte do tempo livre estive envolvido em atividades que não exigiam esforço físico;

___ por vezes (1-2) envolvi-me em atividades físicas;

___ várias vezes (3-4) envolvi-me em atividades físicas;

___ a maior parte das vezes (5-6) estive envolvido em atividades físicas;

___ todos os dias (7) pratiquei algum tipo de atividade física.

6. Qual a tua opinião sobre desporto?

____ não gosto ____ gosto mais ou menos ____ gosto muito

7. Achas que o exercício que fazes é suficiente?

____ sim ____não, preciso de fazer mais ____não, vou fazer mais ____N.S.

8. Achas que vais praticar desporto quando fores mais velho? _____sim; _____não

•Medidas antropométricas•

Altura _____cm

Peso _____kg

Perímetro da barriga _____cm

Appendix 4: Other tables

Table A4.1. Frequency of fathers and mothers that self-reported to practice physical activity.

	Mother	Father	X^2; p-value
% of parents that practice PA	39.3	46.2	36.20; p<0.001

Note. PA=physical activity; p-values are the result of chi-square test; p-value below 0.5 was considered significant.

Table A4.2. Frequency of children that followed the recommended guidelines for watching television (TV), using the computer (PC) and playing with electronic games (El. G.), according to the place of residence.

Screen time		Girls		p	Boys		p
		Urban	Non-urban		Urban	Non-urban	
TV weekdays	<2h/day	80.8	77.7	0.43	75.5	78.4	0.50
TV Saturdays	<2h/day	25.0	31.9	0.12	29.1	27.3	0.69
TV Sundays	<2h/day	24.7	28.3	0.40	29.8	27.1	0.55
PC weekdays	<1h/day	90.9	94.4	0.19	89.7	93.1	0.23
PC Saturdays	<1h/day	83.6	87.4	0.28	83.0	78.6	0.27
PC Sundays	<1h/day	82.5	86.4	0.28	82.9	77.9	0.21
El. G. weekdays	<1h/day	98.2	100.0	0.07	90.3	93.0	0.33
El. G. Saturdays	<1h/day	85.8	85.2	0.86	57.4	68.4	0.02
El. G. Sundays	<1h/day	85.7	86.8	0.75	58.2	66.8	0.08

Note. P-values are the result of chi-square test; p-value below 0.5 was considered significant.

Table A4.3. Frequency of children that followed the recommended guidelines for watching television (TV), using the computer (PC) and playing with electronic games (El. G.), according to sex.

Screen time		Girls	Boys	X^2; p-value
TV weekdays	<2h/day	79.4	76.9	0.74; p=0.39
TV Saturdays	<2h/day	28.1	28.2	0.00; p=0.97
TV Sundays	<2h/day	26.3	28.5	0.48; p=0.49
PC weekdays	<1h/day	92.5	91.3	0.33; p=0.57
PC Saturdays	<1h/day	85.3	80.9	2.85; p=0.09
PC Sundays	<1h/day	84.3	80.5	2.00; p=0.16
El. G. weekdays	<1h/day	99.0	91.6	24.43; p<0.001
El. G. Saturdays	<1h/day	85.5	62.8	54.18; p<0.001
El. G. Sundays	<1h/day	86.2	62.4	59.45; p<0.001

Note. P-values are the result of chi-square test; p-value below 0.5 was considered significant.

Table A4.4. Frequency of children that practiced an extracurricular sport, according to age groups.

Extracurricular sport	Age groups (%)					p-value
	6	7	8	9	10	
Yes - total	65.1	67.8	72.4	66.3	64.3	0.53

Note. P-values are the result of chi-square test; p-value below 0.5 was considered significant.

Table A4.5. Frequency of girls that were classified as overweight, obese, and having abdominal obesity, according to their age.

Obesity indicators	Age groups (%)					p-value
	6	7	8	9	10	
Overweight	14.7	17.1	12.8	20.5	21.6	0.40
Obese	8.8	6.0	11.6	10.2	1.4	0.46
Abdominal obesity	28.6	27.1	22.8	26.7	20.3	0.81

Note. P-values are the result of chi-square test; p-value below 0.5 was considered significant.

Table A4.6. Frequency of boys that were classified as overweight, obese, and having abdominal obesity, according to their age.

Obesity indicators	Age groups (%)					p-value
	6	7	8	9	10	
Overweight	14.3	11.7	13.9	18.4	14.6	0.74
Obese	8.2	3.6	3.0	6.6	2.1	0.80
Abdominal obesity	30.6	13.2	14.9	21.3	25.0	0.11

Note. P-values are the result of chi-square test; p-value below 0.5 was considered significant.

Appendix 5 – Dissemination of the project to date with the support of *Fundação para a Ciência e Tecnologia*

a) Articles in peer review international journals

Rodrigues D, Padez C, Machado-Rodrigues AM (2017). Perceived psychological, cultural, and environmental barriers to sport in children living in urban and non-urban settings in the Midlands, Portugal. *Sport Sciences for Health* (), 1-7. DOI: 10.1007/s11332-017-0382-5 [in press].

Rodrigues D, Padez C, Machado-Rodrigues AM (2018). Active parents, active children: the importance of parental organised physical activity in children's extracurricular sport participation. *Journal of Child Health Care*, 22(1): 159-170.

Rodrigues D, Padez C, Machado-Rodrigues AM (2018). Child participation in sports is associated with children's and parents' behavioral patterns. [under review in the *American Journal of Human Biology*].

Rodrigues D, Padez C, Machado-Rodrigues AM (2018). Environmental and socio-demographic variables associated with 6-10-year-old children's school travel in urban and non-urban settings. [under review in the Journal of Urban Health].

Rodrigues D, Padez C, Machado-Rodrigues AM (2018). Parental perception of barriers to children's participation in sports in Portugal and the relationships between children's sex, age, SES and urbanization. [ready to be submitted].

Rodrigues D, Padez C, Rodrigues PRM, Rowe DA, Machado-Rodrigues AM (2018). Children's perceptions of stereotypes about gender in sport and physical activity. [ready to be submitted].

b) Articles in peer review national journals

Rodrigues D, Padez C, Machado-Rodrigues AM (2018). Prevalence of abdominal obesity and excess weight among Portuguese children and why abdominal obesity should be included in pediatric practice. *Acta Médica Portuguesa*, 31 (3): 159-164.

c) Other articles

Bentham J, et al. (2017) Worldwide trends in children's and adolescents' body mass index, underweight, overweight and obesity, in comparison with adults, from 1975 to 2016: a pooled analysis of 2,416 population-based measurement studies with 128.9 million participants (NCD Risk Factor Collaboration). *Lancet*, 390 (10113): 2627-2642. DOI: 10.1016/S0140-6736(17)32129-3.

d) Abstracts and proceedings of international and national meetings

Rodrigues D, Padez C, Machado-Rodrigues AM (2017). The number of obesity indicators is related with children's physical activity. *21º Congresso Português de Obesidade* (Aveiro, Portugal). 24-26 November.

Rodrigues D, Padez C, Machado-Rodrigues AM (2017). Does proximity to recreational facilities decrease the risk of both general and abdominal obesity in 6-to 10-year-old children? *8th Conference of the HEPA Europe* (Zagreb, Croatia). 15-17 November.

Rodrigues D, Padez C, Machado-Rodrigues AM (2017). Do you like to be physically active? Parents and children enjoyment of physical activities as a predictor of children participation in extracurricular sport. *8th Conference of the HEPA Europe* (Zagreb, Croatia). 15-17 November.

Rodrigues D, Padez C, Machado-Rodrigues AM (2017). Why waist circumference and abdominal obesity should be included in pediatric practice. *3rd International Conference on Childhood Obesity – CIOI 2017* (Lisbon, Portugal). 05-08 July.

Rodrigues D, Padez C, Marôco J, Machado-Rodrigues AM (2017). Parental perceived barriers/opinions on sport and children's sport participation in different geographic settings. *International Society of Behavioral Nutrition and Physical Activity* (ISBNPA) (Victoria, Canada). 07-10 June.

Rodrigues D, Padez C, Machado-Rodrigues AM (2017). Association of proximity to sports facilities and parental perceived barriers with sport participation in children from Portugal. *International Society of Behavioral Nutrition and Physical Activity* (ISBNPA) (Victoria, Canada). 07-10 June.

Rodrigues D, Padez C, Machado-Rodrigues AM (2016). Association of sport participation and sedentary behaviours with the risk of obesity in Portuguese children. *20º Congresso Português de Obesidade* (Porto, Portugal). 18-20 November.

Rodrigues D, Padez C, Machado-Rodrigues AM (2015). Gender differences in sports involvement: a case of children's self-stereotypes ideas. *International Society of Behavioral Nutrition and Physical Activity* (ISBNPA) (Edinburg, Scotland, United Kingdom). 03-06 June.

Rodrigues D, Padez C, Machado-Rodrigues AM (2015). Sedentary behaviors in the Portuguese population: an exploratory study about screen-time patterns in school-aged children. *International Society of Behavioral Nutrition and Physical Activity* (ISBNPA) (Edinburg, Scotland, United Kingdom). 03-06 June.

Rodrigues D, Padez C, Machado-Rodrigues AM (2015). Gender differences in sports involvement: a case of children's self-stereotyped ideas. *II Bioanthropological Meeting: Life, death and in between* (Coimbra, Portugal). 29-30 May.

Rodrigues D, Padez C, Machado-Rodrigues AM (2014). Should parents do sport in order to increase their children's sport participation? *International Society of Behavioral Nutrition and Physical Activity* (ISBNPA) (San Diego, California, United States of America). 21-24 May.

Rodrigues D, Padez C, Machado-Rodrigues AM (2014). The importance of parental influence in their child's extracurricular sports involvement. *International Society of Behavioral Nutrition and Physical Activity* (ISBNPA) (San Diego, California, United States of America). 21-24 May.