Healthy eating and physical activity intervention in preschool children to prevent obesity: a randomized controlled trial

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Palavras-chave: OBESIDADE; PRÉ-ESCOLA; INGESTÃO ALIMENTAR; ATIVIDADE FÍSICA; INTERVENÇÃO SOCIO-ECOLÓGICA

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Resumo

Introdução: A célere mudança no estilo alimentar, de atividade física e sedentarismo conduziram a um grande desafio de saúde pública, dado que a prevalência da obesidade tem aumentado rapidamente e com uma tendência especialmente alarmante nos mais jovens. Assim, a prevenção precoce é universalmente considerada como a melhor abordagem, sendo que as escolas são consideradas um ambiente potencial para intervir, nomeadamente as pré-escolas. **Objetivo:** Estudar o impacto duma intervenção socio-ecológica (SE) em ingestão alimentar (IA), comportamento alimentar (CA), atividade física (AF) e comportamento sedentário (CS) para prevenir a obesidade em crianças pré-escolares portuguesas. **Métodos:** Neste estudo randomizado controlado participaram 211 crianças pré-escolares, alocadas em grupo experimental (GE) e grupo controlo (GC). Durante seis meses, fez-se uma intervenção SE relativamente a IA, CA, AF e CS, baseada na escola e na família. Foram realizadas avaliações antropométricas, de IA, CA, AF e CS, antes e após a intervenção. O índice de massa corporal (IMC) foi categorizado usando o critério de referência da Organização Mundial da Saúde (OMS). Realizou-se a tradução e estudo de fiabilidade de dois questionários. Fizeram-se ajustamentos para fatores confundidores. **Resultados:** Os questionários traduzidos mostraram uma fiabilidade satisfatória. A prevalência de baixo peso (2,4%), excesso de peso (13,3%) e obesidade (10,4%) foi semelhante entre sexos. Antes da intervenção: IA semelhante entre sexos e categorias de IMC; rapazes com mais minutos de AF vigorosa que as raparigas; 85,6% das crianças cumpriam as recomendações de 9000 passos/dia (rapazes cumpriam mais que raparigas, em dias de semana) e crianças com excesso de peso/obesidade registaram mais passos em dias de fim de semana. Após a intervenção: redução significativa do IMC z-score (p=0,038) no GE e aumento do mesmo no GC; variações positivas na ingestão de fibra (p=0,041), sopa de hortícolas (p=0,034), fruta (p=0,038), hortícolas/fruta (p=0,042) e água (p=0,034); no entanto, não foram encontradas diferenças significativas em relação ao CA, AF ou CS. **Conclusão:** Esta intervenção SE de seis meses, baseada na pré-escola/família, apresenta um resultado de IMC que suporta este modelo de combate à obesidade infantil. **Palavras-chave:** OBESIDADE; PRÉ-ESCOLA; INGESTÃO ALIMENTAR; ATIVIDADE FÍSICA; INTERVENÇÃO SOCIO-ECOLÓGICA

Abstract

Background: Rapid changes in diets, physical activity and sedentary lifestyles led to a major public health challenge, as the prevalence of obesity is rising rapidly and the trend is especially alarming at younger ages. Thus, early prevention is universally regarded as the best approach, and schools are considered a potential environment to intervene, namely preschools. **Aim:** This research aimed to study the impact of a socio-ecological intervention on dietary intake (DI), eating behavior (EB), physical activity (PA) and sedentary behavior (SB) to prevent obesity in Portuguese preschool children. **Methods:** This randomized control trial had the participation of 211 preschool children, allocated into experimental group (EG) and control group (CG). A six-month socio-ecological intervention on DI, EB, PA and SB was developed with a school-family based framework. Anthropometric, DI, EB, PA, SB and socioeconomic status (SES) assessments were performed at baseline and post-intervention. Body mass index (BMI) was categorized using the World Health Organization's (WHO) growth reference. The translation and reliability study of two questionnaires were performed. Adjustments for confounder factors were made. **Results:** The translation of questionnaires led to a satisfactory reliability of the respective tools. The prevalence of underweight (2.4%), overweight (13.3%) and obesity (10.4%) was similar between sexes. At baseline: DI similar between sexes and BMI categories; boys engaged in more vigorous PA minutes than girls; 85.6% of children met the 9000 steps/day recommendations (more boys in compliance, on weekdays); and overweight/ obese children registered more steps on weekend days. At post-intervention: significant reduction of BMI z-score (p=0.038) in the EG and increase thereof in the CG; positive changes were obtained in the intake of dietary fiber (p=0.041), vegetable soup (p=0.034), fruit (p=0.038), vegetables/fruit (p=0.042) and water (p=0.034); however, significant differences were not found regarding EB, PA or SB. **Conclusion:** This six-month socio-ecological intervention, based on the preschool-family provided a BMI outcome that supports this model to tackle childhood obesity. **Key-words:** OBESITY; PRESCHOOL; DIETARY INTAKE; PHYSICAL ACTIVITY; SOCIO-ECOLOGIC INTERVENTION

Résumé

Introduction: Le changement rapide de style de l'alimentation, l'activité physique et la sédentarité conduit à un défi majeur de santé publique, étant donné que la prévalence de l'obésité a augmenté rapidement et avec une tendance particulièrement alarmante chez les jeunes. Ainsi, la prévention précoce est universellement considéré comme la meilleure approche, et les écoles sont considérées comme un environnement potentiel d'intervenir, nommément le préscolaires. **Objectif:** Etudier l'impact d'une intervention socio-écologique (SE) de l'apport alimentaire (AA), comportement alimentaire (CA), l'activité physique (AF) et le comportement sédentaire (CS) pour prévenir l'obésité chez les enfants d'âge préscolaire portugais. **Méthodes:** Dans cette étude, randomisée et contrôlée, ont participé 211 enfants d'âge préscolaire, répartis dans un groupe expérimental (GE) et un groupe de contrôle (GC). Pendant six mois, une intervention SE a été faite relative à AA, CA, AF et CS, à l'école et la famille. Des évaluations anthropométriques ont été effectuées, AA, CA, AF et CS avant et après l'intervention. L'indice de masse corporelle (IMC) a été catégorisé selon le critère de référence de l'Organisation Mondiale de la Santé (OMS). La traduction et l'étude de la fiabilité de deux questionnaires a été faite. On a procédé à des ajustements pour les facteurs confondants. **Résultats:** Les questionnaires traduits ont montré une fiabilité satisfaisante. La prévalence du déficit pondéral (2,4%), surpoids (13,3%) et l'obésité (10,4%) était similaire entre les sexes. Avant l'intervention: AA similaire entre les sexes et les catégories d'IMC; garçons avec plus de minutes de AF vigoureuse que les filles; 85,6% des enfants ont accompli les recommandations de 9000 pas/jour (garçons accomplissaient plus que les filles, pendant les jours de semaine) et les enfants en surpoids/obésité ont registré plus de pas pendant les jours de fin de semaine. Après l'intervention: réduction significative de l'IMC z-score (p=0,038) dans le EG et une augmentation du même dans le CG; des changements positifs dans l'apport en fibres (p=0,041), soupe de légumes (p=0,034), fruits (p=0,038), légumes/fruits (p=0,042) et eau (p=0,034); cependant, il n'y avait pas de différences significatives relative au CA, AF ou CS. **Conclusion:** Cette intervention SE pendant six mois, basée sur le préscolaire/famille, donne un résultat de IMC qui soutient ce modèle de combat de l'obésité infantile. **Mots-clés:** OBESITE; PRESCOLAIRE; APPORT ALIMENTAIRE; ACTIVITE PHYSIQUE; INTERVENTION SOCIO-ECOLOGIQUE

Abbreviations and acronyms

AND	Academy of Nutrition and Dietetics
AR	adiposity rebound
BIA	bioelectrical impedance analysis
BMI	Body Mass Index
CDC	Centers for Disease Control and Prevention
CNPD	Comissão Nacional de Proteção de Dados
DALYs	disability adjusted life years
DI	dietary intake
EU	European Union
CG	control group
EG	experimental group
ICC	intra-class correlation
IOTF	International Obesity Task Force
LPA	low physical activity
MOHQ	Meals in Our Household Questionnaire
MPA	moderate physical activity
MVPA	moderate-vigorous physical activity
NCDs	no communicable diseases
OECD	Organisation for Economic Co-Operation and Development
PA	physical activity
Pre-PAQ	Preschool-age Children's Physical Activity Questionnaire
SB	sedentary behavior(s)
SD	standard deviation
SES	socio-economic status
TPA	total physical activity
VPA	vigorous physical activity
WHO	World Health Organization

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1. Introduction

Health is influenced by either diet or by physical activity (PA) or by both (WHO, 2004). Rapid changes in diet and lifestyles that have occurred with industrialization, urbanization, economic development and market globalization (WHO, 2003), have resulted in an obesogenic environment (Doak et al., 2006; Kremers et al., 2006; Wells, 2012), which refers to the role environmental factors may play in determining both nutrition and PA styles (Jones et al., 2007; Moreno et al., 2013). Changes in world food economy are reflected in shifting dietary patterns, as in the increased consumption of energy-dense diets high in fat and low in unrefined carbohydrates. On the other hand, these patterns are combined with a decline in energy expenditure that is associated with a sedentary lifestyle (WHO, 2003). To summarize, hyper-caloric diets, low levels of PA and SB are important determinants of overweight and obesity in adults as well as in young people.

Overweight and obesity are serious public health challenges (Karnik & Kanekar, 2012; Lobstein et al., 2004; Wang & Lobstein, 2006), whose prevalence is rapidly rising and this trend is especially alarming in children and adolescents (Branca et al., 2007). Due to this rapid prevalence increase and the associated health consequences, obesity is considered one of the most serious health challenges of the early 21st century (WHO, 2010a; WHO, 2012b).

Obesity is a chronic disease, prevalent in both developed and developing countries, and affecting adults as well as children, replacing the more traditional public health concerns, including under-nutrition and infectious diseases, as one of the most significant contributors to poor health (WHO, 2000). Many low- and middle-income countries are neglecting overweight and obesity as major health threats, with the endorsement of policies to tackle under-nutrition, but they lack in policies to halt the growing burden of diseases due to the rise of overweight and obesity. More than 75% of overweight children live in developing countries, with the prevalence in Africa almost doubling in the last 20 years (WHO, 2013e).

Until 1980, fewer than one in ten people were obese in the Organization for Economic Co-Operation and Development (OECD) countries (OECD, 2014). Since 1980, worldwide obesity has nearly doubled (WHO, 2014e). The obesity epidemic continues to spread, and no OECD country has seen a reversal of trends since the epidemic began (OECD, 2014).

In Portugal, the dimension of the problem was assessed for the first time with a nationwide survey conducted in 1995-1998, in which almost half of the sample (49,6%) was overweight/ obese (do Carmo et al., 2006). The results found in 2003-2005 show that more than half of the adult sample (53,6%) already had excessive weight (do Carmo et al., 2008). Regarding obesity in younger people, the pioneering nationwide representative survey assessed the prevalence of overweight and obesity in Portuguese children between 7 and 9 years of age found 31,5% of overweight/ obesity (Padez et al., 2004). Other studies conducted with Portuguese children and adolescents (Antunes & Moreira, 2011; Moreira, 2007; A. Rito et al., 2012; Sardinha et al., 2011) reveal that Portugal followed the trend of other European countries, namely Mediterranean (Branca et al., 2007; Lobstein, 2010; Wang & Lobstein, 2006).

Childhood obesity is now recognized as a major medical and public health problem (Speiser et al., 2005) because it can adversely affect almost every organ system and often has serious consequences (Han et al., 2010), as in being an independent contribution to the development of adult morbidity and to increase the risk of multiple diseases including diabetes, metabolic syndrome, hyper-androgenism, heart disease, hypertension, asthma and other respiratory problems, sleep disorders, nonalcoholic fatty liver disease, gallbladder disease and orthopedic, dermatologic, neurologic and psychosocial problems (Branca et al., 2007; Han et al., 2010; Kumanyika et al., 2008; Speiser et al., 2005; Stewart, 2011).

Given the tracking of obesity and associated risk factors from childhood through to adulthood, and the limited success of available treatment programs, it is likely that prevention will provide the only method of containing this epidemic (Ells et al., 2005). However, obesity prevention is a complex issue, requiring a thorough understanding of causes and determinants of the obesity

epidemic, so as to bring about changes not only in individual and family behaviors but also in the marketplace and the social and built environments (Koplan et al., 2005). Until now, most approaches have focused on changing the behavior of individuals regarding diet and exercise and it seems that these strategies have had little impact on the growing increase of the obesity epidemic (Dehghan et al., 2005). Hence, appropriate preventive interventions are essential. Given that about 50% of the adults are overweight and obese in many countries, and it has proven difficult to reduce excessive weight once it becomes established, children should be considered the priority population for early intervention strategies (Dehghan et al., 2005). Priority engagements include policies to improve food and built environments, cross-cutting actions (such as leadership, public health policies, and monitoring), and much greater funding for prevention programs (Gortmaker et al., 2012; Sallis & Glanz, 2009).

The most suitable settings for childhood obesity preventive interventions are school settings and home-based settings (Kumanyika et al., 2008; Lobstein et al., 2004). Concerning schools, they influence the lives of most children and should therefore provide an ideal platform for the education and promotion of healthy diets, PA and other healthy behaviors (Ells et al., 2005), given that children spend a good part of their day at school, being given opportunity of PA and of eating several meals (Kumanyika et al., 2008). There is strong evidence to show that school-based interventions should include a balanced diet and a PA component in the curriculum taught by trained teachers. They should also ensure parental involvement, provide a supportive environment, include a food service with healthy choices, and offer a PA program (WHO, 2009). Whilst much research has focused upon school-aged children, similar efforts in preschool children have been lacking (Ells et al., 2005).

A review of school-based childhood obesity prevention programs shows that the most effective school-based obesity intervention programs should be guided by a behavioral theoretical framework, as much as they should include an experimental research design that includes the intervention components of dietary habit modification, PA modification, healthy lifestyle education, and parental involvement (Campbell & Hesketh, 2007; De Bourdeaudhuij et al.,

2011; Wofford, 2008). Nevertheless, most of the research on school-based obesity intervention is developed in the United States and therefore, its applicability in European countries is debatable, without taking into account the differences in educational and cultural systems, as well as obesity levels (Branca et al., 2007). Moreover, it is important to conduct studies reflecting the specific regional and/ or national reality in the prevention of childhood obesity.

In this context, since 2006, the Regional Health Authority of Algarve has been developing a regional program to counteract child obesity, particularly focusing on school children, under our coordination, which has contributed to stabilize the prevalence of childhood obesity in the Algarve (Rito et al., 2012). Nevertheless, because we intend to test the best practices to prevent obesity as early as possible in the school curriculum, and preschool must have its due opportunities for action, we decided to develop our investigation in this area. To our best knowledge, there is a lack of research with randomized controlled trial developed in Portugal at preschool level, managing simultaneous interventions on promoting healthy eating, PA, and reducing SB. Furthermore, there are some knowledge gaps (Cattaneo et al., 2010; Reilly et al., 2006; Vale et al., 2011) and inconsistencies that deserve to be investigated. Systematic reviews and meta-analysis of school-based interventions or programs to promote healthy nutrition, PA and/ or reduce SB show inconsistent results, for both outcomes in eating/ physical behavior and anthropometric impact, while some show positive results (Doak et al., 2006; Eliakim et al., 2007; Gonzalez-Suarez et al., 2009; Hesketh & Campbell, 2010; Leung et al., 2012; Niederer, Burgi, et al., 2013; Waters et al., 2011). We have yet found that other reviews and meta-analysis reveal incoherence (Kanekar & Sharma, 2008; Summerbell et al., 2005; Van Cauwenberghe et al., 2010) or weak evidence for the effectiveness of interventions to prevent childhood obesity (Hills et al., 2011).

In this way, we developed a randomized controlled trial, with the whole population of public preschools in the Faro council. The intervention program with the experimental group (EG) was based on the social ecological model (Bronfenbrenner, 1994). It has been identified as an effective approach in the promotion of healthy lifestyles (Lobstein et al., 2004), with multiple levels of

influence on behavior, including the psychobiological (individual child), the social and cultural microsystem (parents, siblings, teachers, peers, etc.), and the environmental exosystem (schools, including PA and food) (Niederer et al., 2009; Sallis & Glanz, 2009).

Beforehand, to perform the research, two questionnaires in the English language were translated into Portuguese, and the respective reliability study was held in order to be utilized in our research: “Meals in Our Household Questionnaire” and “Pre-PAQ: Preschool-age Children’s Physical Activity Questionnaire”.

From the above, besides having performed the study of reliability of the so mentioned questionnaires, we tried to assess the impact of the intervention program developed with children and caregivers, as well as school environment, having performed the following studies:

Reliability of the “Meals in Our Household Questionnaire” in Portuguese Preschool Children

Reliability of the “Pre-PAQ: Preschool-age Children’s Physical Activity Questionnaire” in Portuguese Preschool Children

Nutritional status, dietary intake, physical activity and socio economic status of preschool children in Southern Portugal

Impact of a socio-ecological intervention on body mass index, dietary intake and physical activity in Portuguese preschool children: a randomized controlled trial

Eating behavior and body mass index in Portuguese preschool children: results from a socio-ecological intervention

Additionally to the thesis studies, we have prepared a manuscript, based on the literature review that we have done, with the title "*Determinantes do peso corporal de crianças em idade pré-escolar"*, published in the "*Revista Factores de Risco (34, Out-Dez, 2014, 26-33)*, and available in the appendices.

The dissertation structure comprises eight chapters: (1) Introduction, (2) Literature review, (3) Aims, (4) Methods, (5) Studies, (6) Global discussion with conclusions, (7) References and (8) Appendices.

2. Literature review

2.1. Historical note on obesity

Throughout most of human history, weight gain and fat storage have been viewed as signs of health and prosperity. In times of hard labor and frequent food shortages, securing an adequate energy intake to meet requirements was the major nutritional concern (WHO, 2000). However, anthropometric data from skeletons over a time span of more than 30 000 years provide evidence that Paleolithic hunter-gatherers were generally healthy—they were taller and had a healthier pelvis than present-day humans—when they died of accident and trauma in their mid-30s (Spitzer, 2010).

A historical convergence of forces, both biological and technological, has led to the obesity epidemic, as explained by anthropology. During millennia of frequent food scarcities, natural selection probably favored people with parsimonious energy metabolism, known as the thrifty gene hypothesis (Neel, 1962). Moreover, the advent of agriculture about 14 000 years ago ensured more stable food supplies, but daily life activities still needed substantial energy expenditure until about 50 years ago, when radical changes occurred in food availability and energy expenditure (Han et al., 2010). Another curious fact is that *homo sapiens sapiens* has existed for several thousands of years nevertheless, the main progress of human civilization, like writing, the wheel, cities, social organization, etc., are no more than 5000 years old, and that is allowing man to become sedentary and to use less effort to perform any given tasks (Garcia & dos Santos, 2009). The obesity epidemic is probably the result of an evolutionary legacy interacting with our technologically advanced and consumer society (Han et al., 2010).

However, the explanations for the history of human obesity history remain controversial. David Haslam and Neville Rigby suggest in their Art of Medicine essay that throughout the human history, either through early pieces of figurative art, depictions of obesity, or through the observations reported by Hippocrates or William Wadd, among others, it is possible to conclude from the

past that the potential to become obese is certainly not new, but the development of obesity on the scale of a global population pandemic certainly is (Haslam & Rigby, 2010).

2.2. No communicable diseases and obesity

Until late in the 20th century, chronic under-nutrition was the primary human nutritional concern. However, within recent decades, obesity has emerged as a new issue of similar global importance (Wells, 2012). Paradoxically, its rapid increase has not been accompanied by a matching reduction in the prevalence of under-nutrition (FAO, 2013; WHO, 2013d). In this way, the "global obesity epidemic", as the World Health Organization (WHO) designated it (WHO, 2000), remains poorly understood, partly because it has emerged alongside persistent under-nutrition in many populations (Wells, 2012). Overweight and obesity are linked to more deaths worldwide than underweight, thus being an important challenge, given that around 3.4 million adults are dying each year as a result of being overweight or obese. In addition, 44% of the diabetes burden, 23% of the ischemic heart disease burden and between 7% and 41% of certain cancer burdens are attributable to overweight and obesity (WHO, 2014e). In the poorest countries, even though infectious diseases and under-nutrition dominate their current disease burden, the major risk factors for chronic diseases are spreading (WHO, 2004), given the epidemic context of obesity. The prevalence of overweight and obesity is increasing in developing countries, and even in low-income groups in richer countries (WHO, 2004), meaning that poverty is a risk factor.

According to the *Global action plan for the prevention and control of no communicable diseases* (NCDs), 2013-2020 (WHO, 2013a), mainly cardiovascular diseases, cancers, chronic respiratory diseases and diabetes are the "world's biggest killers", given that more than 36 million people die annually from NCDs, corresponding to approximately 63% of global deaths (WHO, 2013a), of which the most occur in low- and middle-income countries, and almost a quarter occur in people under 60 years of age (Lobstein &

Brinsden, 2014). By 2030, NCDs are expected to cause four times as many deaths as the combined figure for infectious diseases, and maternal, perinatal and malnutrition-related conditions (Lobstein & Brinsden, 2014). Although tobacco, alcohol, poor diets and SB may be primarily responsible, as a whole, for NCDs, the rapid rise in obesity prevalence worldwide indicates that diet and lack of PA are replacing tobacco as the leading cause of preventable diseases (Lobstein & Brinsden, 2014), highlighting that halting the rise in obesity is one of the global targets of health management (WHO, 2013a). Besides the significant health consequences, obesity and NCDs pose a major economic burden to countries, causing lower productivity, reduced earning capacity and increased household costs (Lobstein & Brinsden, 2014), and representing a threat to human development (WHO, 2008a). Furthermore, in terms of disability adjusted life years (DALYs), the chronic diseases represent the greatest public health burden, in terms of direct cost to society and government (WHO, 2003).

Concerning the inequities in overweight and obesity, the situation is truly more complicated. For example, overweight and obesity are responsible for about 9–12% of deaths in the older European Union (EU) Member States and 16–20% of deaths in the 12 Member States that joined the EU in 2004 and 2007. Similarly, overweight and obesity are responsible for around 10% of the total disease burden DALYs in western and central European countries (Loring & Robertson, 2014).

Considering the latest database (WHO, 2014e): (1) worldwide obesity has nearly doubled since 1980, (2) in 2008, more than 1,4 billion adults were overweight, of which over 200 million men and nearly 300 million women were obese, (3) 35% of adults aged 20 and over were overweight in 2008, and 11% were obese, (4) 65% of the world's population live in countries where overweight and obesity kills more people than underweight and (5) more than 40 million children under the age of 5 were overweight or obese in 2012 (WHO, 2014e).

The consensus among public health experts is that changes in genes, biology, and psychology at the individual level cannot explain the rapid rise in obesity, so the explanation must lie in broader environmental, policy, and

societal changes (Neel, 1962; Sallis & Glanz, 2009), as developed from exposure to the ‘‘obesogenic niche,’’ comprising diverse factors predisposing to weight gain (Wells, 2012). Though obesity has multiple causes, it results mainly in a chronic energy imbalance involving both DI and PA patterns (Kremers et al., 2006; Rennie et al., 2005). Although apparently straightforward, these behaviors result from complex interactions across a number of relevant social, environmental, and policy contexts (Koplan et al., 2005).

Food and food products have become commodities produced and traded in a market that has expanded from an essentially local base to an increasingly global one. These patterns are combined with a decline in energy expenditure that is associated with a sedentary lifestyle: motorized transport, labor-saving devices in the home, the phasing out of physically demanding manual tasks in the workplace, and leisure time that is preponderantly devoted to physically undemanding pastimes (WHO, 2003).

Considering that forecasts suggest that high rates of obesity will affect future population health and economics, it has become imperative to take action, with several segments, such as governments, international organizations, private sector and civil society, contributing complementarily with actions in a coordinated approach (WHO, 2013a), integrating interventions across society as a whole (individuals, families, local, national, and international) that recognize the individual choices as the result of a wider context shaper (Gortmaker et al., 2012).

In this context and recognizing the heavy and growing burden of NCDs, a global strategy is addressed considering the two of main risk factors, diet and PA, given that they are the leading causes of these diseases (WHO, 2004).

2.3. Definition of childhood obesity

Overweight and obesity are terms used to describe a condition of abnormal or excessive fat accumulation in adipose tissue, above the ideal for good health (Waters et al., 2011; WHO, 2000). This extra fat results from the excess energy stored in fat cells that enlarge and/ or increase in number, by

hypertrophy and/ or hyperplasia mechanisms, respectively (Bray, 2004). The underlying disease is the undesirable positive energy balance and weight gain arising from fat cells that is the pathological lesion of obesity (Bray, 2004). However, obese individuals differ not only in the amount of excess fat that they store, but also in the regional distribution of fat within the body. The distribution of fat induced by weight gain affects the risks associated with obesity, and the kinds of disease that thereby derive. Indeed, excess abdominal fat is as great a risk factor for disease as is excess body fat *per se* (WHO, 2000).

Ideal measurements of body fat in populations should be reliable and well correlate with body fat in both sexes and across all ages and ethnic groups, but is impracticable for epidemiological use (Cole et al., 2000; Dietz & Bellizzi, 1999). Furthermore, because individuals of different heights or body builds may have similar fat masses yet substantially different proportions of total body fat, and because obesity connotes a condition of excess body fat, body fat expressed as a percentage of weight (percentage body fat) is the most relevant measure against which anthropometric measurements should be correlated. Nevertheless, currently the body mass index (BMI) cutoff points is used to determine weight status, as underweight, healthy weight, overweight or obesity, for adults as well children and adolescents (Cole et al., 2000; Cole et al., 2007; Waters et al., 2011). Thus, BMI has been increasingly accepted as a valid indirect measure of adiposity in school-age children and adolescents for survey purposes, leading to various approaches to selecting appropriate BMI cut-off values to take account of the fluctuations in BMI during normal growth (Lobstein, 2010; Rolland-Cachera, 2011).

BMI, calculated as weight in kilograms divided by square of the height in meters (Kg/m^2), is a simple index of weight for height commonly used to classify underweight, overweight and obesity (WHO, 2000). Nonetheless, the criteria for assessing childhood obesity have been subject to debate and research and there is no consensus as to a cutoff point for excess fatness of overweight or obesity in children and adolescents (Dehghan et al., 2005; Gupta et al., 2012), and several standard BMI cutoffs have been developed, namely:

(1) Growth reference recommended by the International Obesity Task Force (IOTF) (Cole et al., 2000; Cole et al., 2007) – it defines thinness (referred to underweight by CDC), overweight and obesity as BMI for age cut off points that correspond to BMI of <18.5, ≥25.0 and ≥30.0 kg/m^2 at the age of 18 years, respectively;

(2) Centers for Disease Control and Prevention (CDC) Growth Reference (CDC, 2012) – it defines underweight, overweight and obesity as BMI for age <5th; ≥85th and <95th; and ≥95th percentile, respectively. This growth reference was adopted by the Portuguese Ministry of Health from 2005 onwards (DGS, 2006a), and some Portuguese studies analyzed the data with this criteria.

(3) WHO Growth Reference (de Onis, Onyango, et al., 2007) – it defines thinness, overweight and obesity as BMI for age <–2 standard deviation (SD), >+1 SD (equivalent to a BMI of 25.0 kg/m^2 at 19 years of age) and >+2 SD (equivalent to a BMI of 30.0 kg/m^2 at 19 years of age), respectively. The WHO standards are based on a sample of healthy breastfed infants, the reason why they provide a better tool than the CDC 2000 growth charts for monitoring the growth of breast-fed infants (de Onis, Garza, et al., 2007; Rolland-Cachera, 2011) therefore, it is being widely and preferably used by most countries. This growth reference has been adopted by the Portuguese Ministry of Health since 2013 (DGS, 2013), replacing the CDC Growth Reference. Interestingly, WHO percentages frequently exceeded the IOTF percentages (Quelly & Lieberman, 2011).

Other methods to measure the percentage of body fat have been used extensively as underwater weighing (densitometry), multi-frequency bioelectrical impedance analysis (BIA) and magnetic resonance imaging, waist circumference (WC), or skin fold thickness. Nevertheless, any method should be used with caution because children change their body shape as they progress through the normal growth (Dehghan et al., 2005).

2.4. Prevalence of childhood obesity

Overweight and obesity are serious public health challenges (Karnik & Kanekar, 2012; Lobstein et al., 2004; Wang & Lobstein, 2006), whose prevalence is rising rapidly and the trend is especially alarming in children and adolescents (Branca et al., 2007). The prevalence of childhood obesity has been increasing since 1971 (Dehghan et al., 2005), and in some countries the number of overweight children has trebled since 1980 (WHO, 2012b).

The prevalence of excess weight among children is increasing in both developed and developing countries, although overweight is high among the poor in rich countries, and the rich in poorer countries (Lobstein et al., 2004; Waters et al., 2011), a paradox between poverty and obesity that occurs throughout the world (Levine, 2011; Tanumihardjo et al., 2007). Nevertheless, current estimates suggest that the rate of obesity in developed countries is double that in developing countries, but in terms of absolute numbers, prevalence is much higher in developing countries (WHO, 2010b). Therefore, children in lower and middle income countries are at risk, especially those growing up in urban environments and able to afford a western lifestyle (Wang & Lobstein, 2006). A new demographic transition in developing countries is producing rapid increases in BMI, particularly among the young (WHO, 2002). The highest prevalence of overweight among infants and young children is in upper-middle-income populations, while the fastest rise in overweight is in the lower-middle-income group (WHO, 2010a).

Over the past three decades the prevalence of child overweight and obesity has increased substantially and globally. About 170 million children/adolescents (aged < 18 years) are estimated to be overweight (WHO, 2012b), of which more than 40 million are under 5 years, with more than 30 million overweight children living in developing countries and 10 million in developed countries (WHO, 2014e). Due to this rapid prevalence increase and the associated health consequences, obesity is considered one of the most serious health challenges of the early 21st century (WHO, 2010a; WHO, 2012b).

In fact, the last decades have seen an unprecedented increase in the prevalence of child obesity in most children's age groups and in most regions of the world, registering a particularly high annual increase in parts of Europe and North America (Lobstein, 2010). Northern European countries tend to have lower prevalence levels than southern European countries (Lobstein, 2010). For example, in Scandinavian countries the prevalence of childhood obesity is lower when compared to Mediterranean countries (Livingstone, 2001). Higher child obesity prevalence levels have been recorded in several southern European countries like Italy, Greece, Spain or Cyprus (Lobstein, 2010), of which Portugal is one that holds a higher childhood obesity prevalence (Antunes & Moreira, 2011; A. Rito et al., 2012; Sardinha et al., 2011). According to a new press release published by the WHO Regional Office for Europe, among 11-year-old boys and girls, the prevalence of overweight was highest in Greece (33%), Portugal (32%), Ireland (30%) and Spain (30%) and lowest in the Netherlands (13%) and Switzerland (11%) (WHO, 2014d). The reasons for a north–south gradient in Europe are not clear, and genetic factors are unlikely to be the explanation, as all countries in western Europe have shown a marked increase in prevalence in recent decades, probably justified by the child's household or family income, amongst other variables (Lobstein, 2010).

Regarding particularly the preschool children in particular, there has been observed a recent high prevalence of overweight and obesity in middle and high income countries, among both the well-off and lower income segments of populations, in both rural and urban areas, and among all ethnic and racial groups represented in an international study (Quelly & Lieberman, 2011).

Worldwide, in the period between 1990 and 2010, there was a relative increase of 21% (first decade) and 31% (second decade) in the prevalence of early childhood overweight and obesity, whereas the forecast for the relative increase in the present decade (2010–2020) is 36% (de Onis et al., 2010). Quelly and Lieberman (2011) conducted a literature review, in 14 different countries between 1998 and 2008, and found different prevalence of overweight and obesity for preschool boys and girls (Quelly & Lieberman, 2011) as summarized in **Table 1**.

Table 1. Prevalence of overweight and obesity in preschool boys and girls (adapted from the study of Quelly and Lieberman, 2011).

	Overweight		Obesity	
	Boys	Girls	Boys	Girls
Minimum	6.9% IOTF Bahrain	4.5% IOTF Bahrain	2.3% IOTF Sweden	2.1% IOTF Arab Emirates
Maximum	27.6% CDC USA	26.3% IOTF Australia	24.6% CDC USA	20.4% CDC USA

Therefore, the global prevalence of overweight in preschool children ranged from a minimum of 6.9% (IOTF criteria) in boys and 4.5% (IOTF criteria) in girls, both from Bahrain, to a maximum of 27.6% (CDC criteria) in boys in the United States of America and 26.3% (IOTF criteria) in girls in Australia. The prevalence of obesity in preschool children ranged from a minimum of 2.3% (IOTF criteria) in boys in Sweden and 2.1% (IOTF criteria) in girls in the Arab Emirates, to a maximum of 24.6% (CDC criteria) in boys and 20.4% (IOTF criteria) in girls, both in the USA.

In the United States of America, a country where the problematic of obesity has been studied longer, among preschool children aged 2–5 years, obesity increased from 5.0% to 12.1% between 1976–1980 and 2009–2010 (Fryar et al., 2012; Ogden et al., 2012), but between 2009-2010 and 2011-2012, there was a significant decrease in obesity to 8.4% (Ogden et al., 2014). This last surveillance suggests that the rapid increases in obesity prevalence, seen in the 1980s and 1990s, have not continued in this decade and may be levelling off, but more research is needed to understand why these changes may be occurring (Ogden et al., 2012).

In a study performed with data from children aged 2 to 19 years in nine countries (Australia, China, England, France, Netherlands, New Zealand, Sweden, Switzerland and USA), the prevalence of overweight and obesity appears to be stabilizing at different levels depending on the country (Olds et al., 2011). Nevertheless, the relatively minor changes in child overweight and obesity seen in recent years should not be a reason for complacency (OECD, 2014).

In Europe, Cattaneo and colleagues (2010), synthesized available information on the prevalence of overweight and obesity in preschool children from 18 European countries, and they reported a prevalence of overweight plus obesity at 4 years of age, ranging from a minimum of 11.8% in Romania to a maximum of 32.3% in Spain (Cattaneo et al., 2010). Countries in the Mediterranean region and the British Isles report higher rates than those in middle, northern and eastern Europe, and rates are generally higher in girls than in boys (Cattaneo et al., 2010).

Table 2. Overweight and Obesity Prevalence in Portuguese Preschool children.

Study reference	Portuguese region	Age range (years)	Sample size	Reference criteria	Prevalence (%)		
					Overweight	Obesity	Overweight and Obesity
Rito 2006	Coimbra[a,b,c]	3-4	2361	IOTF	16.9	6.7	23.6
Gomes 2010	Évora[a]	2-6	275	CDC	25.4	11.6	36.1
Duarte 2011	Beira Interior[a,b,d]	3-6	1111	CDC	15.6	12.0	27.7
Vale 2011	Porto[a]	3-6	625	IOTF	23.7	9.4	33.1
Aparício 2013	Several[a,e]	3-6	1424	CDC	16.9	17.4	34.3
Lourenço 2014	Sintra[b,c]	3-4	300	CDC	13.6	17.0	30.6

[a] Public preschools
[b] Private preschools
[c] Private institutions of social solidarity (public/private preschools)
[d] Municipalities of Castelo Branco, Idanha-a-Nova, Penamacor e Vila Velha de Ródão
[e] Children living in several regions of Portugal (Viseu - 40,9%, Lamego - 24,6%, Vila Real - 18,3%, Évora - 12,7% e Leiria - 3,5%)

In Portugal, only a few overweight and obesity prevalence preschool children studies have been conducted to date, and there is no initiative surveillance to monitor the prevalence trend. Researching in August 2014, in electronic database Medline/PubMed and SportDiscus published data on overweight and obesity prevalence in Portuguese preschool children, with search terms such as “Portugal”, “overweight”, “obesity”, “children” and “preschool”, five studies that address this subject were identified (Aparício et al., 2013; Gomes et al., 2010; Lourenço et al., 2014; Rito, 2006; Vale et al., 2011). Given the small number of studies in Portugal that addressed overweight and obesity in children, a time frame for the search was not taken into account. An additional hand-searching of doctoral theses was preformed, and a study that

addressed overweight and obesity prevalence in Portuguese preschool children was identified (Duarte, 2011), as displayed in **Table 2**.

Whilst comparisons may be problematic because of different definitions and methods of data collection and analysis, according to study data conducted in Portugal, there is a high overweight and obesity prevalence in preschool children, when related to other European countries, maintaining the trend of the Mediterranean region.

Thus, in Portugal, the prevalence of overweight in preschool children ranged from a minimum of 13.6% (CDC criteria) in Sintra, to a maximum of 25.4% (CDC criteria) in Évora. The prevalence of obesity in preschool children ranged from a minimum of 6.7% (IOTF criteria) in Coimbra, to a maximum of 17.4% (CDC criteria) in several parts of Portugal. The prevalence of overweight and obesity in preschool children ranged from a minimum of 23.6% (IOTF criteria) in Coimbra, to a maximum of 36.1% (CDC criteria) in Évora. However, the data should be analyzed with caution because the lower obesity prevalence is observed in the study with younger age and IOTF criteria (Rito, 2006). Notwithstanding this fact, it can be seen that the most recent studies show higher obesity prevalence that the first one performed, which might mean that overweight and obesity in Portuguese preschool children has been increasing.

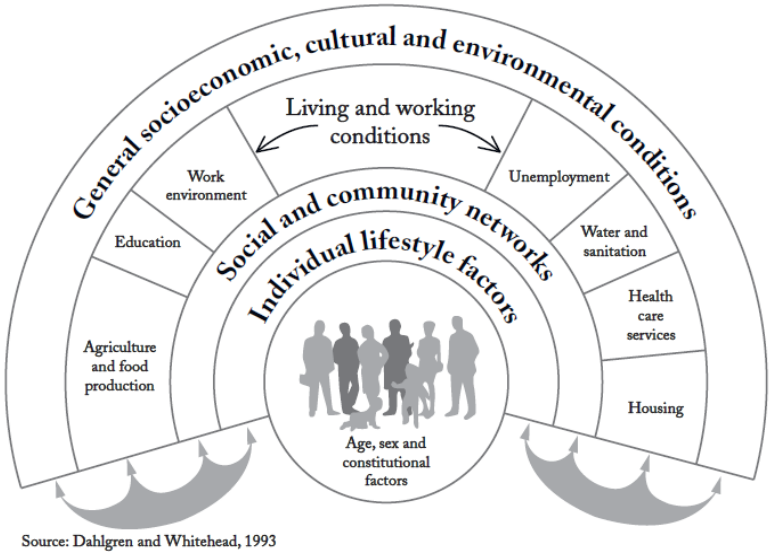
2.5. Determinants or risk factors of childhood obesity

Obesity, once considered a personal health issue, is increasingly prevalent among families, social networks, and also worldwide, and is therefore deemed as a social health issue (Penhollow & Rhoads, 2014) with catastrophic consequences in NCDs etiology around the world. Obesity is the most prevalent disorder among children and adolescents throughout the world (Wang & Lobstein, 2006), being a multifactorial health problem (Cason, 2006; De Craemer et al., 2012). Regarding the increased prevalence of overweight and obesity among youth and the risk of subsequent chronic disease in adulthood, it is important to determine the correlates of obesity in youth (Mota et al., 2006). A greater understanding of the causes of obesity will provide a rational basis for

the development of effective interventions to prevent overweight and obesity in young children between the age of 4 and 6 years (De Craemer et al., 2012; Rennie et al., 2005).

These risk factors or determinants on the development of obesity in childhood, and subsequently in adulthood, involve interactions among multiple causes that are personal (e.g., dietary and PA patterns, taste and PA preferences); environmental (e.g., home, school, and community); societal (e.g., food advertising, social network, and peer influences); healthcare-related (e.g., access and provider counseling); and physiological (e.g., intrauterine and early life "programming," appetite and satiety mechanisms, and genetic predisposition) (Pratt et al., 2008).

Figure 1. The main determinants of health (Dahlgren & Whitehead, 2007).



In this context, first of all, it is important to reflect about the determinants for the general health of the population, which can be conceptualized as rainbow-like layers of influence (Dahlgren & Whitehead, 2007). In the center of the figure (**Figure 1**), individuals possess age, gender and constitutional characteristics that influence their health and that are largely fixed. Surrounding them, however, are influences that are theoretically modifiable by policy. First, there are personal behavior factors, such as dietary habits, PA and smoking. Second, individuals interact with their peers and immediate community and are

influenced by them. Next, a person's ability to maintain their health, in the third layer, is influenced by their living and working conditions, food supply, and access to essential goods and services. Finally, as mediator of population health, economic, cultural and environmental influences prevail in the overall society. This model for describing health determinants emphasizes interactions: individual lifestyles are embedded in social norms and networks, and in living and working conditions, which in turn are related to the wider socioeconomic and cultural environment (Dahlgren & Whitehead, 2007; Whitehead et al., 2001).

The determinants of health that can be influenced by individual, commercial or political decisions can be positive health factors, protective factors, or risk factors (Dahlgren & Whitehead, 2007). The positive health factors contribute to the maintenance of health, such as economic security, adequate housing and food security. The protective factors eliminate the risk of or facilitate resistance to disease, as in immunization against a variety of infectious diseases, psychosocial factors (such as social support) (WHO, 2002), PA or healthy diets (such as the Mediterranean diet). The risk factors cause health problems and diseases that are potentially preventable for example, social or economic conditions, environments or lifestyles related to health hazards, such as nutritional, sedentary or smoking habits (Dahlgren & Whitehead, 2007).

In this context, and as obesity results from complex interacting factors, the etiology can be globally summarized into genetic, behavioral, and environmental determinants or risk factors (Karnik & Kanekar, 2012).

Genetic factors may influence the metabolism, by changing the body fat content, energy intake and energy expenditure (Karnik & Kanekar, 2012). Nonetheless, contrary to a popular misconception, at most 1–2% of total of childhood obesity cases are directly caused by primary diseases in which obesity is a secondary clinical feature (Ells et al., 2005; Lobstein et al., 2004). Actually, in a small number of cases, childhood obesity is due to genetic or endocrine causes. We should consider leptin deficiency or medical causes such as hypothyroidism and growth hormone deficiency or side effects due to drugs

such steroids (Dehghan et al., 2005), or genetic disorders (Prader-Willi syndrome, Cushing's syndrome, Down syndrome, *etc.*) that predispose to child obesity (Gupta et al., 2012; Lobstein et al., 2004). Besides the genetic causes of a clinical context, parent obesity is an important factor in predicting adult obesity of their offspring, and that offspring of obese parents who themselves were obese in childhood may be at particular risk (Parsons et al., 1999). Moreover, mothers born large for their gestational age run an increased risk of giving birth to infants that are large for their gestational age, when compared to mothers not born large for their gestational age, so that maternal overweight increases this risk even further (Ahlsson et al., 2007).

Children have a rapid increase in BMI during the first year of life, after which it declines and reaches a minimum, the point of maximal leanness, called the adiposity rebound (AR), on average, at 5 to 7 years of age, before beginning a gradual increase through adolescence and most of adulthood (Ebbeling et al., 2002; Whitaker et al., 1998). The time of AR may be a critical period in childhood for the development of obesity, because when it happens earlier, it increases the risk of fatness in childhood, and that predicts higher BMI in adolescence and in early adulthood (Agostoni et al., 2011; Ebbeling et al., 2002; Lobstein et al., 2004; Rolland-Cachera et al., 2006; Whitaker et al., 1998). Under-nutrition in fetal life or during the first years after birth may program a thrifty metabolism that will exert adverse effects later in life, especially if the growing child is exposed to over-nutrition (Rolland-Cachera et al., 2006). Moreover, parental obesity is associated with an earlier AR (Dorosty et al., 2000).

Despite biological susceptibility helping explain inter-individual differences in weight gain, the recent rapid increase in the overall prevalence of obesity in children demonstrates that behavioral factors are central to the causation of obesity (Rennie et al., 2005), particularly the interaction of specific nutrition, PA and sedentary and eating behavior, which determines a chronic energy imbalance, mostly a positive energy balance (De Craemer et al., 2012; Kremers et al., 2006; Moreno et al., 2013), which accumulated over time may culminate in over weight (Rennie et al., 2005). As overweight and obesity result

from an energy imbalance, a disruption between energy consumed and energy expended, nutrition and PA seem to be important etiological factors (Hills et al., 2011; Karnik & Kanekar, 2012). In other words, poor diet and lack of PA are fundamental factors (Larson et al., 2011).

In developing countries, rapid changing dietary practices and a sedentary lifestyle have led to a recently increasing prevalence of childhood obesity (Mexico, Brazil, India, and Argentina), and important determinants of childhood obesity include high socioeconomic status, residence in metropolitan cities, female gender, unawareness and false beliefs about nutrition, marketing by transnational food companies, increasing academic stress, and poor facilities for PA (Gupta et al., 2012).

In others countries, like Portugal, dietary risk factors for obesity in children include high energy density foods (Manios et al., 2009; Proctor et al., 2003; WHO, 2003), intake of free sugars (Morenga et al., 2013), high consumption of sugar-sweetened beverages (Grimes et al., 2013; Malik et al., 2006; Morenga et al., 2013; Pabayo et al., 2012), specifically between meals (Dubois et al., 2007), and salt intake (Grimes et al., 2013). Although the relation between sugar-sweetened beverage consumption and the development of obesity in children and adolescents has been reported in some studies, conclusive evidence is not available in others (Forshee et al., 2008; Valente et al., 2011; Van Baak & Astrup, 2009). On dietary protective factors in childhood obesity, it is worth mentioning an inverse relationship to the water consumption (Dubois et al., 2007; Muckelbauer et al., 2009), and dietary fiber intake (Brauchla et al., 2012; Kimm, 1995; Williams, 2006), especially in toddlers with a lower meal frequency (Buyken et al., 2008). It is common to associate the consumption of fruits and vegetables as an obesity prevention strategy (Gentile et al., 2009; WHO, 2003), because of their richness in water and fiber, and lowness in energy density.

Regarding eating behaviors factors to childhood obesity on its familiar environment, there is an inverse association with high meal frequency (Antonogeorgos et al., 2012; Franko et al., 2008; Mota et al., 2008; Toschke et al., 2009), regular breakfast consumption (Antonogeorgos et al., 2012; Mota et

al., 2008; Pearson et al., 2009a; Rampersaud et al., 2005; Szajewska & Ruszczynski, 2010; Toschke et al., 2009), family meals (Berge et al., 2013; Cason, 2006; Fiese et al., 2012; Fiese & Schwartz, 2008; Fruh et al., 2011; Fulkerson et al., 2014; Fulkerson et al., 2008; Gable et al., 2007; Godfrey et al., 2013; Hammons & Fiese, 2011; Martin-Biggers et al., 2014), and family dinner in particular (Anderson & Whitaker, 2010; Rockett, 2007; Taveras et al., 2005). Family meals may, therefore, have relevance for the prevention of childhood overweight, because regular family meals give parents the scope to be positive role models to their children by targeting their own dietary behaviors (Pearson et al., 2009a), to provide their children with nutritious and healthy choices, increasing intake of dietary components related to improved health, decreasing intake of components that are recommended to be consumed in limited amounts (Fulkerson et al., 2014; Martin-Biggers et al., 2014; Pearson et al., 2009a), and to monitor the children's portion sizes intake (Fulkerson et al., 2014). The benefits of having a family meal, however, can be undermined if the family consumes fast food, watches television at mealtimes, or has a chaotic atmosphere (Martin-Biggers et al., 2014).

As risk factors in eating behaviors for childhood obesity in its familiar setting there is a positive association with large portion sizes foods (Croker et al., 2009; Fulkerson et al., 2014; Ledikwe et al., 2005; Lioret et al., 2009), energy-dense and nutrient-poor foods (Lioret et al., 2009; Prentice & Jebb, 2003) and the parents eating patterns in particular (Kudlová & Schneidrová, 2012). Child-feeding practices consist of a wide range of behaviors, beyond modeling eating behaviors, including coercing or pressuring children to eat specific foods or meals, rewarding behaviors with highly palatable, energy-dense, favorite foods, withholding food as punishment, restricting food intake, concern about or feeling responsibility for a child's weight, and determining the availability and accessibility of specific foods, both healthy and unhealthy (Stang & Loth, 2011). There are two primary aspects of control: restriction, which involves restricting the children's access to "junk food" or restricting the total amount of food, and pressure, which involves pressuring children to eat healthy foods or pressuring them to eat more in general (Johannsen et al., 2006).

Parents may use a combination of these two methods to obtain a desired result, for example, pressuring a child to eat healthy foods by using bribes or rewards consisting of sugary snacks that are otherwise restricted (Sherry et al., 2004). The restriction and the pressure-to-eat food-related parenting practices can negatively impact on the children's current and future DI, and the differences in use of these practices may contribute, in part, to the disparities that exist in the prevalence of overweight and obesity (Loth et al., 2013). Thus, parental feeding restriction is generally associated with increased child energy intake and weight (Faith et al., 2004). Therefore, parents play a very important role in the children's early eating behaviors (Bost et al., 2014). In this context, the family meal structure and its environment, the children's mealtime behavior and its impact on the family, the parental concerns about children's diet and the use of food as a reward, are new research areas that should be developed, constituting a good basis for intervening in families, intending to promote healthier family mealtime as a way to prevent early childhood obesity.

Energy expenditure, like energy intake, is an important factor in the development of, or protection against obesity (Lobstein et al., 2004). Concerning energy expenditure, through PA, it has been hypothesized that its decline among all age groups has heavily contributed to rising rates of obesity all around the world (Dehghan et al., 2005). Formerly, most PA was obtained during work, household chores, and transportation, but today these requirements for movement have been greatly reduced owing to automation and computers at work, labor-saving devices at home, and building and transportation practices that require driving for most trips (Sallis & Glanz, 2009). Concerning children in particular, it has been noted that in many settings, a large proportion of them nowadays lack the required amount of PA, and spend most of their time in front of the television sets, play video games, and using computers, not meeting the recommended PA guidelines (Hills et al., 2011; Hinkley, Salmon, Okely, Crawford, et al., 2012; Karnik & Kanekar, 2012). To sum up, PA is a multidimensional behavior, and the opportunity for children to participate in adequate levels of PA may be influenced by a number of variables across several domains (Hinkley et al., 2008).

Regarding the correlates between PA and child obesity, first of all, it is known that there is a direct relationship with the healthy weight status of children through higher levels of energy expenditure (Hills et al., 2011). Consistently associated with children's PA, therefore as protective factors for childhood obesity, we can highlight the male gender (Hills et al., 2011; Sallis et al., 2000), the intention to be active, previous PA, program/ facility access, time spent outdoors, healthy diet, parental overweight status (Sallis et al., 2000), and home activity equipment (Rosenberg et al., 2010). As risk factors for childhood obesity, with an inverse association, stand out perceived barriers (Sallis et al., 2000) and electronic devices, namely having television in the bedroom (Rosenberg et al., 2010).

Concerning the correlates of preschool children's PA behaviors boys are more active than girls, children with active parents tend to be more active, and children who spend more time outdoors are more active than children who spend less time outdoors (Hinkley et al., 2008). Age is another consistent correlate, with children spending approximately 10% less time engaged in PA for each advancing year of age (Hinkley, Salmon, Okely, Hesketh, et al., 2012). Moreover, a significant proportion of overweight children may be at increased risk for further gains in adiposity because of low levels of PA during the preschool day (Reilly, 2010; Trost et al., 2003; Tucker, 2008).

A concurrent problem is that today's young people spend more time than previous generations did in sedentary pursuits, including watching television and engaging in screen-based games; hence, active behavior has been displaced by these inactive recreational choices, which has contributed to reductions in activity-related energy expenditure (Hills et al., 2010).

The impact of TV viewing on childhood obesity became relevant when Dietz and Gortmaker (1985) found a positive association between TV watching and obesity among children (Dietz & Gortmaker, 1985), namely television advertising (Zimmerman & Bell, 2010). Actually, four mechanisms have been proposed in attempt to explain how TV impacts weight gain: (1) TV displaces time that would otherwise be used for PA; (2) TV viewing promotes between meal snacking and therefore a greater total daily caloric intake; (3) TV program

content can exert a negative influence on children's food choices, and (4) TV watching decreases one's metabolic rate (Bryant et al., 2007).

Commonly, three dichotomous indicators described the children TV behaviors with positive correlation with childhood obesity: habitual television exposure time (Anderson & Whitaker, 2010; Braithwaite et al., 2013; Gable et al., 2007; Haines et al., 2013; Lissner et al., 2012; Proctor et al., 2003); television viewing during mealtimes (Dubois et al., 2008; Lissner et al., 2012); and having televisions in their bedrooms (Dennison et al., 2002; Lissner et al., 2012; Rosenberg et al., 2010). Additionally, television viewing is positively associated with the intake of high-fat, high-sugar foods (Lissner et al., 2012; Manios et al., 2009), sweet beverages, snacks and inversely associated with fruit and vegetables (De Craemer et al., 2012).

Teachers and parents used to assume that preschool-aged children are very active (i.e., continually running around) and usually conclude that young children engage sufficient activity; however, several risk factors have resulted in the dramatic increase of SB. Thus, their perceptions have conducted to a potential overestimation of PA levels in children, may result in a decreased emphasis placed on the importance of encouraging and supporting active lifestyles in this age group (Tucker, 2008), being also an acceptable risk factor of children obesity.

In terms of energy balance, it is possible for children to combine physically active behavior (e.g. participate in sport and exercise) with SB (e.g. computer games), within the same day, but in essence, the most important issue is that energy expenditure is equal to energy intake (Hills et al., 2007).

Other risk factors may be related to childhood obesity, such as sleep pattern, although this behavior has been much less studied than dietary intake and PA. Epidemiological studies suggest that short sleep duration may be associated with the increase risk of childhood obesity development (Anderson & Whitaker, 2010; Cappuccio et al., 2008; Dev et al., 2013; Haines et al., 2013; Padez et al., 2009; Xiaoli et al., 2008), even after controlling socio-demographic factors (Jones & Fiese, 2014). As a matter of fact, a recent study provides evidence that shorter nighttime sleep duration has a linear association with

higher energy intake early in life, a plausible mechanism through which shorter sleep contributes to adiposity (Fisher et al., 2014).

The environment provides both the setting and the resources for individuals to use motivation, self-efficacy, communication skills, and knowledge to perform specific behavior (Currie & al., 2012; Martin-Biggers et al., 2014), wherein various settings can be seen: home, school, and community (Karnik & Kanekar, 2012). Home environment factors include the physical environment, such as availability and accessibility of food and PA opportunities, as well as behavioral environments, such as self-efficacy to change, self-regulation abilities, and feeding practices parents use with their children (Martin-Biggers et al., 2014). School environment covers the neighborhood around the school as well as the school grounds, buildings and facilities, impacting in children's adiposity, through diet and PA (Harrison & Jones, 2012), given that schools can provide nutritious food and offer opportunities to encourage PA (Story et al., 2006b; Story et al., 2009) through school food (lunch, snacks or breakfast), physical education, recess and school PA (Pate et al., 2013). Community nutrition and PA environment factors can include proximity of food retailers, food environment, neighborhood food environments, food outlets, fast food restaurants, supermarkets, green spaces, residential density, parks, public open spaces, sprawl indices, PA facilities, playgrounds, sidewalks, trails, connectivity, built environment and neighborhood (Pate et al., 2013).

Socioeconomic environment, additionally, is also an important risk factor in childhood obesity, there is some evidence that, in contemporary populations, children of the lowest socio-economic status (SES) in high-income countries have raised obesity rates (De Moira et al., 2010). Similarly, children in urban areas are more likely to be obese than those in rural areas in many countries, including those with high and low-middle incomes (Wang & Lobstein, 2006). In many poverty-dense regions, people go hungry and are unable to access affordable healthy food, even when funds are available. Moreover, there is an association between sedentariness and obesity for people who live in the same regions, who may be less able to afford gym membership, sports clothing, and/or exercise equipment (Levine, 2011). Food insecurity is complex, and the

paradox is that not only can it lead to under nutrition and recurring hunger, but also to over nutrition, which can lead to overweight and obesity (Tanumihardjo et al., 2007) like children living in households experiencing food insufficiency (Dubois et al., 2006).

In developed countries there is a significant trend observed between obesity and lower SES (Branca et al., 2007; Waters et al., 2011), while in some developing countries the contrary is found, with children from relatively affluent families being more vulnerable to obesity (Waters et al., 2011). Summarizing, belonging to the lower SES group confers strong protection against obesity in low-income economies (Monteiro et al., 2004). The prevalence of obesity in Europe is rising in many countries, and rising fastest in low socioeconomic population groups, especially in children (Loring & Robertson, 2014).

Lastly, literacy is also a stronger factor of individual's health status, because it is associated with multiple modifiable risk factors, mainly behavioral determinants, such as the lack of PA or poor dietary habits (Santos, 2010; WHO, 2013c). Some recent studies highlight the potential role of parental health literacy in addressing school-aged children overweight (Chari et al., 2014; White et al., 2013). In a recent WHO publication is even mentioned that the literacy is a stronger predictor of an individual's health status than income, employment status, education level and racial or ethnic group (WHO, 2013c).

2.6. Consequences of childhood obesity

Childhood obesity is a multisystem disease with potentially devastating consequences (Ebbeling et al., 2002). The increasing prevalence and severity of childhood obesity has provided greater wide variety of comorbidities and complications, affecting virtually every organ system in an adverse manner, which would only occur in adulthood, have now been shown to occur in children and adolescents (Daniels, 2009; Karnik & Kanekar, 2012). Notwithstanding, although obesity is one of the key risk factors for no communicable diseases and its related comorbidities, it should be considered as a disease in its own right (WHO, 2000). Many health‐related problems are associated with obesity in

children, namely physical, psychological, and social (Karnik & Kanekar, 2012), besides economic problems (Lobstein et al., 2004).

From the physical point of view, the effects of obesity result from the increased mass of adipose tissue and the increased secretion of pathogenic products from fat cells, allowing an easy division of disadvantages of obesity into those produced by the fat mass and those produced by the metabolic effects of fat cells (Bray, 2004) leading to several disorders in multiple systems, as has been reported for different studies (Daniels, 2009; Dietz, 1998; Ebbeling et al., 2002; Han et al., 2010; Lobstein et al., 2004; Speiser et al., 2005) as presented in **Table 3**.

Table 3. Physical health problems related to childhood obesity.

System and disorder		Daniels, 2009	Dietz, 1998	Ebbeling, 2002	Han, 2010	Lobstein, 2004	Speiser, 2005
Cardiovascular	Hypertension	X	X	X	X	X	X
	Heart disease					X	X
	Atherosclerosis	X			X		
Metabolic	Type 2 diabetes	X	X	X	X	X	X
	Metabolic syndrome	X					
	Dyslipidemia	X	X		X	X	X
Pulmonary	Asthma	X		X	X	X	X
	Obstructive sleep apnea	X	X	X	X	X	X
Gastrointestinal	Nonalcoholic fatty liver	X	X	X	X	X	X
	Gallbladder disease		X	X		X	X
	Gastro-esophageal reflux	X			X	X	X
Other	Polycystic ovary syndrome	X	X	X		X	X
	Orthopedic problems	X	X	X	X	X	X
	Endocrine changes			X		X	X
	Pseudo tumor cerebri			x			X

Obesity in children and adolescents may have its most immediate consequences in the psychological and social domains, as an increased prevalence of depression (Daniels, 2009; Ebbeling et al., 2002; Karnik & Kanekar, 2012), low self-esteem (Ebbeling et al., 2002; Stewart, 2011), reduced social network, bullying, social isolation (WHO, 2012a; WHO, 2012b), weight stigma (Karnik & Kanekar, 2012; Lobstein et al., 2004; Rowlinson, 2011), decreased quality of life (Han et al., 2010), and low social state with the believe that obesity is connected on character weaknesses (Cassell, 1995). The most widespread consequences of childhood obesity are psychosocial, because obese children become targets of early and systematic discrimination,

sometimes as an effect of the body size on socialization (Dietz, 1998). Adults who do not know the age of overweight children, often confuse them with other older with different chronological age, leading to frustration on the part of the children with a sense of failure because such expectations cannot be fulfilled (Dietz, 1998).

Given the rapid increase in the prevalence of childhood obesity, the health consequences are likely to be underestimated, and depend partly on the age of onset and duration of obesity, because obese children suffer from both short-term and long-term health consequences (Branca et al., 2007). Obesity during childhood and adolescence is an important determinant of whether an individual will become obese as an adult or not (Mota et al., 2006). Thus, childhood obesity increases the risk of obesity in adulthood (Waters et al., 2011; Whitaker et al., 1997), and with it the risk of earlier onset of obesity-related chronic disease (Lawlor & Chaturvedi, 2006; Lobstein, 2010).

Besides the physical, psychological and social problems, the direct burden of obesity and related diseases upon the medical services, other indirect costs are also incurred, for example, the lost educational opportunity and hence lost economic contribution, the lost days of employment by a parent or career in the family if the child requires medical attention (Lobstein et al., 2004). Pereira & Mateus (2003) developed a study in Portugal, which demonstrates that the problem of obesity carries with high economic loss to the country, in which the value of indirect costs is 40.2% of the total cost of obesity (Pereira & Mateus, 2003).

Overweight children are more likely to become overweight in adulthood than are lean children (Guo et al., 2002; Wang & Lobstein, 2006), especially in high rates of overweight and obesity among preschoolers with premature adiposity rebound growth adults (Quelly & Lieberman, 2011). Studies have demonstrated, for example, that approximately one half of overweight school-age children and about one-third of overweight preschool children remain obese as adults (Serdula et al., 1993; Wang & Lobstein, 2006), or that 30% of girls and 10% of boys who were obese as children were also obese adults (Goran, 2001). The risk of an obese child becoming an obese adult increases from 25%

before 6 years of age to 75% during adolescence (Baker et al., 2010). Hence, prevention of obesity in children and adolescents has been argued as a public health priority to combat the obesity epidemic (Lobstein et al., 2004; Wang & Lobstein, 2006; WHO, 2012a).

2.7. Prevention of childhood obesity

Prevention, especially in young people, is universally viewed as the best approach to reversing the rising global prevalence of obesity (Han et al., 2010; Koplan et al., 2005; Pratt et al., 2008; Wofford, 2008; WHO, 2000) considering that dietary habits (Kudlová & Schneidrová, 2012) and PA behavior (Jones et al., 2011) are formed early in life, with impact on short- and long-term functioning, health and wellbeing (Waters et al., 2011). The prevention of obesity is not only possible but is the most realistic and cost effective approach for dealing with childhood obesity (Ebbeling et al., 2002; Livingstone, 2001; Lobstein et al., 2004) as it is for adult obesity (WHO, 2000). Besides, pediatric obesity prevention programs must be placed, as early as possible (Campbell et al., 2008; Salsberry & Reagan, 2005), to protect proper growth and development over time and to reduce the risk of producing adverse effects (Ells et al., 2005).

Children are often considered the priority population for intervention strategies because: firstly, weight loss in adulthood is difficult and there are a greater number of potential interventions for children than for adults; secondly, it is difficult to reduce excessive weight in adults once it becomes established (Dehghan et al., 2005). Interventions targeted at childhood targeted are likely to become effective because children and adolescents are generally more sensitive than adults to outside influences (parents, media, and peers) and may consider interventions particularly attractive (Kumanyika et al., 2008). Furthermore, given that eating, PA and SB are predominantly learnt in the first years of life, intervening early is a good time, when obesity prevention may be most effective (Campbell et al., 2008; Campbell et al., 2013; Story et al., 2009).

Actions to prevent childhood obesity need to be taken in multiple settings involving whole communities, incorporating a variety of approaches, including a wide range of stakeholders, and for a longer time (Bartrina, 2013; Economos & Tovar, 2012). In fact, scientific evidence recommends, primarily, obesity prevention interventions in young children, including interventions that target high-risk populations, such as children in low-income families, using multicomponent and multilevel approaches in multiple settings (e.g., home, school, community, health care, built environment, public policy, and social marketing) (Pratt et al., 2008). Moreover, interventions must be adapted to the local context and use the existing community social structures (WHO, 2009), predominantly focusing on children and families and on the environments in which they live (Story et al., 2009).

Childhood obesity prevention may include primary prevention of overweight or obesity itself, secondary prevention or avoidance of weight regains following weight loss, and prevention of further weight increases in obese children unable to lose weight (Dehghan et al., 2005). Prior interventions must be concerted in public health efforts, with a culturally appropriate parental and caregiver education, home lifestyle changes, dietary and exercise modifications that will reverse the current trajectory (Quelly & Lieberman, 2011).

Childhood obesity problem can be reduced by educating children and parents about healthy nutrition and encouraging them to be physically active (Karnik & Kanekar, 2012). The parent's intervention becomes even more important if we consider that obesity is a strong predictor of overweight in children, reflecting not only a genetic predisposition to weight gain, but also environmental effects (Maffeis et al., 1998; Trost et al., 2003), mainly because parents are receptive to and capable of some behavioral changes that may promote a healthy weight in their young children (Campbell & Hesketh, 2007). Thus, at a household or family level, parents can influence their child's dietary practices, PA, SB, and finally weight status (Gruber & Haldeman, 2009; Hawkins et al., 2009; Ritchie et al., 2005; Snethen et al., 2006; Waters et al., 2011), and they can learn how to create a healthy nutrition environment in their home, in providing opportunities for PA, discouraging SB such as TV watching,

and working as role models themselves (Lindsay et al., 2006). Positive family modelling is vital to the establishment of lifelong healthy habits (Wofford, 2008), mostly when early intervention takes place with effective parent approach to obesity prevention (Brotman et al., 2012).

Concerning younger children, parents and caregivers play an important role in forming the dietary habits of toddlers and preschoolers; therefore, it is necessary to provide nutrition messages on the improvement of family eating habits and food preferences (Kudlová & Schneidrová, 2012), given that the way parents eat affects the environment in which they feed their children (Johannsen et al., 2006). Furthermore, family intervention programs about active living habits, involving parents directly, can have effects such as the significant decrease in the children's sedentary time and increasing their PA (O'Dwyer et al., 2012). To conclude, parents are often key to the development of a home environment that fosters healthy eating and participation in PA, so their role is likely critical to most solutions to combating obesity (Gruber & Haldeman, 2009), particularly if children are raised in authoritative environments characterized by parental encouragement of positive behaviors (Sleddens et al., 2011).

Schools have an important role in supporting young people's wellbeing and in acting as buffers against negative health behavior (Currie & al., 2012). Additionally, schools offer regular contact with children in their waking time and provide opportunities for nutrition education and promotion of PA both within the formal curriculum, and informally via the provision of appropriate facilities within the school environment such as healthy school meals, break-time snack provision and playground equipment (Branca et al., 2007; Kumanyika et al., 2008; Lobstein et al., 2004; Sallis & Glanz, 2009; Story et al., 2006b).

Therefore, schools have been found to be a potentially fruitful environment for intervention (Dahlgren & Whitehead, 2007; Moreno et al., 2013; Story et al., 2009), and also as a universal catchment setting for children (Han et al., 2010). Schools do not only influence the knowledge and attitudes of children but they also provide opportunities for experiential learning and the development of a sense of self-efficacy. Furthermore the school can also

provide links with the family and the wider community (Lobstein et al., 2004). So, schools are a natural setting for influencing both the children's food and PA environments of children. Notwithstanding, other particular settings, such as preschool institutions and after-school care services, must have similar opportunities for action (Dehghan et al., 2005).

Regarding early childhood interventions, as we summarize further ahead, there is emerging evidence demonstrating the effectiveness of obesity prevention interventions targeting children attending early childcare settings, such as preschools or kindergartens (de Onis et al., 2010; Gupta et al., 2012; Hesketh & Campbell, 2010; Wofford, 2008). Given this, it is reasonable to posit that early childhood provides a unique and circumscribed opportunity within which to establish lifestyle behaviors that will promote health and minimize the risk of the development of obesity (Campbell et al., 2008), mainly because young children may be more amenable to changing behaviors than older children (Skouteris et al., 2012; Wofford, 2008).

Until a few years ago school-based interventions at the preschool level were scarce (Cattaneo et al., 2010; Lindsay et al., 2006), and the majority of studies targeted children aged 6-12 years (Waters et al., 2011). Therefore, preschool-aged children and child-care settings have received comparatively little attention (Hoelscher et al., 2013; Story et al., 2006a), being sometimes neglected although potentially important for obesity prevention (Cardon & De Bourdeaudhuij, 2008). Nevertheless, the recent early childhood obesity prevention literature of interventions to prevent obesity, promote healthy eating, PA, and/or reduce SB in 0–5 year olds, suggests that this is a new and developing research area (Campbell & Hesketh, 2007; Hesketh & Campbell, 2010) some with excellent and promising results (Niederer, Burgi, et al., 2013; Silva-Sanigorski et al., 2010; Trost et al., 2008) and with longer term effects (Nemet et al., 2013).

2.8. Recommendations to preschool children

Nutritional and PA recommendations that are available from nutrition, PA and pediatric-focused organizations are primarily generalized, focusing on

children of all ages. Few recommendations are specific to preschool-aged children. The following is a review of available recommendations that focus specifically on nutrition and PA for prevention of child obesity.

2.8.1. Dietary intake and eating behavior

Age-appropriate energy and nutrient intakes are essential to support normal growth and development, to prevent acute nutrition problems, to promote learning and academic success, and to reduce the risk of child obesity (Ogata & Hayes, 2014). Considering the multiple factors involved in energy balance, energy intake should be individually determined, taking into account energy expenditure and growth (Agostoni et al., 2011).

Table 4 The main determinants of health (Agostoni et al., 2011; Hoelscher et al., 2013; Ogata & Hayes, 2014).

Dietary intake	The ingestion of slowly absorbed carbohydrate (CHO) should be promoted, while limiting the supply of rapidly absorbed CHO and simple sugars. Plant foods, low in energy density and high in complex carbohydrates, fiber, and water, can be used as the main food, contributing to a better balanced diet. Sugar-sweetened beverages are a significant contributor to energy intake. Plain water should be promoted as the main source of fluids for children. Healthy food options should be promoted for snacking, avoiding snack foods with high energy density and low nutritional value. Food portion sizes should be appropriate for age and body size.
Eating behavior	Given the apparent inverse association between number of daily meals and obesity development, it is appropriate that children older than 2 years of age eat at least 4 meals per day. Children should be encouraged to eat breakfast every day. Regular family meals should be encouraged. Regular consumption of fast food with large portion sizes and high energy density should be avoided. Television viewing during meals and exposure to food advertising should be restricted.

Regarding the DI and eating behavior to prevent child obesity, there are recommendations with scientific evidence proffered in some institutional position papers (Agostoni et al., 2011; Hoelscher et al., 2013; Ogata & Hayes, 2014) presented on the **Table 4**.

2.8.2. Physical activity and sedentary behavior

PA is beneficial in all stages of the formative years of any given person, and active play is important in the physical, mental and social aspects of growth and development (Hills et al., 2007; Hills et al., 2010), helping to set a pattern of participation in PA across a person's lifespan (Huang et al., 2009). For example, the development of specific motor competence in early childhood is associated to the improvement of motor proficiency beyond preschool years (Malina, 2010).

In the preschool period and as far as obesity is concerned, PA seems to be a protective factor against it, whereas SB – television viewing, in particular – appears to be obesogenic (De Craemer et al., 2012). Thus, establishing and maintaining adequate levels of PA in young children is an important public health issue to be addressed in the search for long-term preventive effects (Tucker, 2008).

Guidelines for the preschool years have recently been developed in several countries, but there is a lack of consensus on the recommended amount, duration and intensity of PA for preschool children (Skouteris et al., 2012). This may be due to insufficient literature on the relationship between PA and optimal dose–responses for health outcomes in overweight or obese preschool children, in particular for maintaining a healthy weight (Cliff & Janssen, 2011). Besides, young children's PA does not occur in easily distinguishable blocks of exercise, because of preschool children's natural inclination to be active in intermittent bouts (Cliff & Janssen, 2011; Skouteris et al., 2012).

Current preschool PA recommendations include all daily movements and estimate time that children should engage in all types of PA, light-to-vigorous intensity (Skouteris et al., 2012). To our best knowledge, most guidelines/recommendations are proposed by government organizations of several countries (Australian Government, 2012; CSEP, 2011; NASPE, 2010; UK Government, 2011) presented on the **Table 5**.

Table 5. Recommendations on physical activity and sedentary behavior for preschool children (Australian Government, 2012; CSEP, 2011; NASPE, 2010; UK Government, 2011).

United States of America 2010	Preschoolers should accumulate at least 60 minutes of structured physical activity each day. Preschoolers should engage in at least 60 minutes and up to several hours of unstructured physical activity each day, and should not be sedentary for more than 60 minutes at a time, except when sleeping.
United Kingdom 2011	Children of pre-school age who are capable of walking unaided should be physically active daily for at least 180 minutes (3 hours), spread throughout the day. All under 5 years should minimize the amount of time spent being sedentary (being restrained or sitting) for extended periods (except time spent sleeping).
Canada 2011	Preschoolers (3 to 4 years) should accumulate at least 180 min of physical activity at any intensity spread throughout the day, including a variety of activities in different environments, activities that develop movement skills, and progression toward at least 60 min of energetic play by 5 years of age. Preschoolers (3 to 4 years) should minimize the time spend being sedentary during waking hours. This includes prolonged sitting or being restrained for more than one hour at a time. Children (2 to 4 years) should be limited to less than one hour per day of screen time; less is better.
Australia 2012	Preschoolers (3 to 5 years) should be physically active every day for at least three hours, spread throughout the day. Children (2 to 5 years) sitting, watching television and using other electronic media (DVDs, computer and other electronic games) should be limited to less than one hour per day.

2.9. Interventions in child obesity

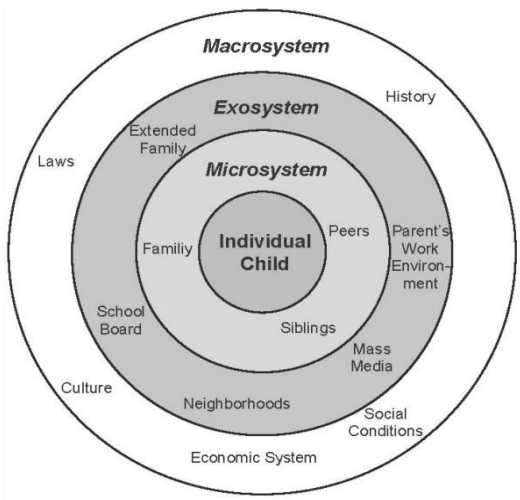
The WHO warns to the global target related to overweight, throw an action plan that should be jointly implemented by Member States and international partners to achieve, by the year 2025, no increase in childhood overweight (WHO, 2014a).

Experience in the field of public health suggests that the most cost-effective initiatives are likely to be with a large population and use integrated, multi-sectorial, multi-disciplinary, comprehensive and sustainable approaches, involving a wide variety of complementary actions which address the individual, the community, the environment, and the society (Lobstein & Brinsden, 2014).

The different sectors involved in developing strategic policy plans should also be involved in implementation, reaching consensus on the significance of the problem, sharing responsibility for improving the situation and involving the national, regional and local authorities and organizations (Branca et al., 2007). Addressing the various determinants of health, it is essential to look for its interconnection, with a mix of biophysical, psychological, social and environment factors, reinforcing the importance of developing multifaceted strategies (WHO, 2013b).

The ecological model (**Figure 2**) is characterized by multiple levels of environmental influences on behaviors: (1) the “individual child” is the core of the model representing the genetic, physiologic, and socio-cultural identity; (2) the “microsystem”, consists of immediate environments with which a child interacts (parents, siblings, teachers, peers, etc.); (3) the “mesosystem” represents interconnections between two or more microsystems (e.g. relations among parents and teachers); (4) the “exosystem” includes environments with which the child doesn't usually interact directly, but that can still affect her (schools, including PA and food environment); and (5) the “macrosystem” is the larger social, economic, cultural, and political system (Bronfenbrenner, 1986; Niederer et al., 2009; Penhollow & Rhoads, 2014; Sallis & Glanz, 2009; Sallis et al., 2008).

Figure 2. Bronfenbrenner's Ecological Model (Niederer et al., 2009).



These ecological models related to health behavior emphasize the environmental and policy contexts of behavior, while incorporating social and psychological influences, leading to the explicit consideration of multiple levels of influence; thereby, leading to the development of more comprehensive interventions (Sallis et al., 2008), and recognizing the importance of social determinants (WHO, 2013b).

Social determinants are especially important to address because not only can they directly influence health (such as the effects of poor housing or sanitation) but, more importantly, they also influence the genuine options and choices people have, their life chances and circumstances, which in turn affect their personal decisions and choices and their lifestyles (WHO, 2013b). Low-income groups are less able to act on new information and lack of money is often their deciding factor when purchasing food (Loring & Robertson, 2014). Building a robust and appropriate policy response on the social and environmental determinants of health can effectively address many types of inequalities, substantially contributing to wellbeing and/or reducing the negative consequences of being in poor health (Whitehead & Dahlgren, 2007; WHO, 2013b). Actually, if obesity is most prevalent in socially disadvantaged groups, interventions with these populations are claimed, thus there will be a greater chance of reducing overall prevalence and as a result, obesity inequities may likely be reduced (Loring & Robertson, 2014).

Understanding the mechanisms through which environmental factors may influence obesity aid in developing community-level intervention strategies to curb the epidemic of obesity (Papas et al., 2007). However, the different ecological contexts of the child's home, school, and community may contribute to childhood overweight/obesity in a diverse weighting; the majority of variation in childhood overweight/obesity is explained by the child and family level, 71%, than the school level, 27%, and at last the community level, 2% (Boonpleng et al., 2013). Therefore, overweight/obesity prevention efforts should focus primarily on child, family, and school factors and then community factors, to be more effective (Boonpleng et al., 2013).

Primary prevention programs show the greatest impact on obesity by promoting healthy diets and sufficient PA in youngsters (De Bourdeaudhuij et al., 2011), through multilevel and multicomponent interventions in multiple settings, involving home, schools, built environment recreational centers, and primary health care (Pratt et al., 2013).

Family interventions must involve parents to support activities in the home setting to encourage children to be more active, eat more nutritious foods and spend less time engaged in screen-based activities, and it provides evidence of effectiveness on obesity (Sleddens et al., 2011; Waters et al., 2011).

School-based interventions should integrate behavioral and environmental approaches using a systems-level approach targeting the multilevel structure of the socioecological model as well as interactions and relationships between levels (Hoelscher et al., 2013), and simultaneously focus on DI and PA (Hoelscher et al., 2013; Pratt et al., 2013). These environmental interventions might include, for example, organized physical activities during breaks, or before and after school; improved availability of PA opportunities in and around the school environment; increased physical education lesson time; improved availability or accessibility of healthy food options; and restricted availability and accessibility of unhealthy food options (De Bourdeaudhuij et al., 2011).

In the specific context of preschools and kindergartens, there are studies showing that the kindergarten staffs are key players in the successful preschool setting of such interventions programs with potential efficacy (Androutsos et al., 2014; Jones et al., 2011; Nemet et al., 2013). Additionally, evidence encourages involving teachers in training programs and making them dedicated interventionists, as a way to decrease the overweight epidemic (Rosário et al., 2012).

To sum it up, evidence suggests that implementing individual and environmental strategies simultaneously at several levels of the social structure (individual, interpersonal, organizational, community, or societal) is most effective (Sherry, 2005). Priorities for research include obesity-prevention

interventions in young children, including interventions that target high-risk populations such as minorities, and children in low-income families, using multicomponent and multilevel approaches, like home-school community–school, or home–community (Pratt et al., 2008).

In the framework of ongoing literature review, we performed a research, in September 2014, in electronic database Medline/PubMed, searching published papers, with search terms such “children”, “overweight”, “obesity”, “preschool”, “intervention”, “nutrition” and “physical activity”, aimed to identify intervention programs with effectiveness in the prevention of childhood obesity. Studies with intervention programs in nutrition and PA, performed with preschool children were included, and if developed at school or at school-home settings. Selection was also performed by the similarity with our intervention program on **Table 6.** (Alkon et al., 2014; de Silva-Sanigorski et al., 2012; Hardy et al., 2010; Herman et al., 2012; Jouret et al., 2009; Kain et al., 2012; Natale et al., 2014; Nemet et al., 2013; Niederer, Bürgi, et al., 2013; Slusser et al., 2012).

Table 6. Review of international intervention programs on overweight and/or obesity prevent.

Author (year)/Study Age target/Country	n	Intervention program	Duration	Findings and conclusions
Alkon et al. (2014) *NAP SACC intervention* 3 to 5 years old Mexico	209	Intervention included educational workshops for child care providers and parents on nutrition and physical activity and consultation visits provided by trained nurse child care health consultants	7 months	The intervention, increases provider knowledge, improves center policies, and lowers BMI for children in child care centers.
Niederer et al. (2013) *Ballabeina* 5.2 (± 0.6) years old Switzerland	652	The intervention included a playful physical activity program and lessons on nutrition, media use and sleep.	1 school year	This multidimensional intervention was equally and for some adiposity measures even more effective in high-risk preschoolers and represents a promising option for these children
Kain et al. (2012) *Kain's study* 4 to 7 years old Chile	597	The main aspects of the intervention were: training of teachers so they could apply an educational program on healthy eating, increase in physical education classes from 3 to 4 per week, and improvement of their quality	3 years	Decrease in BMI Z-score of the obese children, an improvement in fitness in the normal BMI and food knowledge in all the children, obesity increased at follow-up.

Table 6. Review of international intervention programs on overweight and/or obesity prevent *(continued)*.

Author (year)/Study Age target/Country	n	Intervention program	Duration	Findings and conclusions
de Silva-Sanigorski (2012) *Romp & Chomp* 0 to 5 years old Australia	12000	The intervention focused on capacity building and policy implementation (nutrition and active play) within various early childhood settings (preschools, day care, family, etc.). The intervention approach was family-centered, settings-based, and aimed at societal change.	4 years	The results provide confidence that obesity prevention interventions in children's settings can be effective. However, significant efforts must be directed toward developing strategies that invest in policies, capacity building, staff support, and parent engagement.
Herman et al. (2012) *Eat Healthy, Stay Active* 3 to 5 years old United States	496 staff 438 parents 112 pre-schools	The intervention consisted of core trainings and reinforcing activities for staff and parents that aligned with children's curricula.	6 months	This intervention showed promising initial results, with potential effectiveness as an intervention to promote healthier behaviors among adults and children in Head Start settings.
Slusser et al. (2012) *Slusser's study* 2 to 4 years old United States	121	Seven weekly classes with 2 booster classes were delivered to low-income Latino parents.	1 year	Parent training is effective to reduce the risk of overweight in preschool Latino children living in low-income households. The findings need to be examined in a larger sample of children.
Zask et al. (2012) *Tooty Fruity Vegie* 3 to 6 years old Australia	31 pre-schools (13 control)	The intervention consists in a multi-component approach with healthy eating and physical activity strategies, developed in preschools.	10 months	This intervention in preschools produced significant changes in children's food intake, movement skills and indicators of weight status.

Table 6. Review of international intervention programs on overweight and/or obesity prevent *(continued)*.

Author (year)/Study Age target/Country	n	Intervention program	Duration	Findings and conclusions
Nemet et al. (2011) *Nemet's study* 3.8 to 6.8 years old Israel	725 (249 control)	A kindergarten dietary-physical activity intervention applied by the kindergarten teachers, who attended an all-day seminar in which they were prepared and trained by the study team for build and perform the intervention preschool staff.	1 school year	The intervention had no effect on BMI changes between the groups, but improved nutrition and physical activity knowledge and preferences, improved fitness, and decreased the percent of overweight children.
Hardy et al. (2010) *Munch and Move* 4.4 years old (mean) Australia	430	A low-intensity, state-wide, professional development program designed to support early childhood professionals to promote healthy eating and physical activity among children in their care.	2 years	The findings suggest that a low intensity preschool healthy weight intervention program can improve certain weight related behaviors, namely reduced sweetened drinks.
Jouret et al. (2009) *EPIPOI* 2.5 to 5 years old France	200 parents and their children	The reinforced strategy was provided to children in the intervention group with an education program focused on promoting healthy nutrition habits and physical activity, as well as to reducing television watching underwent screening.	2 years	Results suggest that simple measures involving increasing awareness on overweight and health, and periodic monitoring of weight and height, could be useful to reduce overweight in young children from underprivileged areas.

2.10. Overview on the best intervention practice

Considering the literature review performed, position papers, systematic reviews, and meta-analyses studies, a theoretical model, can be synthesized. Given the lack of specific studies in preschool, we present recommendations for the best intervention practice in child obesity primary prevention, as follows:

(1) Children must be considered the priority population for intervention because early obesity prevention is the most cost effective approach to halt the global obesity problem (Campbell & Hesketh, 2007; Koplan et al., 2005; Parsons et al., 1999; Wofford, 2008).

(2) Interventions with a parental/family home component are effective (Campbell & Hesketh, 2007; Hesketh & Campbell, 2010; Hoelscher et al., 2013; Koplan et al., 2005; Pearson et al., 2009b; Waters et al., 2011; Wofford, 2008).

(3) Convincing evidence show that school and childcare based interventions are effective (De Bourdeaudhuij et al., 2011; Gonzalez-Suarez et al., 2009; Harrison & Jones, 2012; Hesketh & Campbell, 2010; Hoelscher et al., 2013; Katz et al., 2008; Koplan et al., 2005; Van Cauwenberghe et al., 2010) and particularly in preschools (Wofford, 2008).

(4) Interventions that focus simultaneous on diet and PA provide better and more relevant effects (De Bourdeaudhuij et al., 2011; Hoelscher et al., 2013; Katz et al., 2008; Waters et al., 2011).

(5) Improved availability or accessibility of healthy food options through school (De Bourdeaudhuij et al., 2011; Waters et al., 2011).

(6) Promoting PA school interventions are effective (De Bourdeaudhuij et al., 2011; Doak et al., 2006; Sherry, 2005; Waters et al., 2011).

(7) Interventions focused on decreasing of SB are effective (Leung et al., 2012) particularly reducing television viewing (Doak et al., 2006; Sherry, 2005).

(8) Interventions with support for teachers and other staff to implement promotion strategies on diet and PA (Waters et al., 2011).

(9) Longer-running programs were more effective (Gonzalez-Suarez et al., 2009).

3. Aims

The general purpose of this research is to evaluate the impact of a socio ecologic intervention program on promoting healthy eating and PA in preschool children to prevent obesity. Additionally, before starting the actual research, two questionnaires were translated into Portuguese language, and respective reliability study was held in order to use them in our assessments.

According to the formulated aims, data analysis was organized in five studies, each based on specific objectives:

Study I

(I) To get the “Meals in Our Household Questionnaire” translated with an acceptable reliability to be used in the assessments to describe the domains of meals in home environment;

Study II

(II) To get “Pre-PAQ: Preschool-age Children’s Physical Activity Questionnaire” translated with an acceptable reliability to be used in the assessments to describe the domains of children’s PA, parent’s PA and environment for PA;

Study III

(III) To characterize the nutritional status, DI, PA, SB and SES of the preschool children studied;

(IV) To report some significant associations between nutritional status, DI, PA, SB and SES;

Study IV

(V) To reduce the mean BMI z-score in the children intervened;

(VI) To increase the intake of dietary fiber, vegetable soup, fruit, vegetable/fruit and water in the children intervened;

(VII) To increase the daily PA in the children intervened;

(VIII) To reduce the SB in the children intervened;

Study V

(IX) To report some significant associations between nutritional status and eating behavior;

(X) To improve the eating behaviors in the children intervened.

4. Methods

This study is a prospective scientific experiment with a randomized controlled trial (RCT) design (Stanley, 2007), which intends to test the efficacy of an intervention of socio-ecological model, involving all preschool children from public preschools of Faro municipality, at the Algarve, Portugal.

4.1. Ethical aspects

Research protocol was approved by the Scientific Council of the Faculty of Sports of Porto University. Ethical approval was achieved by both the Portuguese Data Protection Authority (CNPD - Comissão Nacional de Proteção de Dados, Process Nr. 6263/2013) and the local Health Ethical Committee of Algarve Regional Health Administration of Health Ministry. In addition, permission for school surveys implementation was obtained through the registration Nr. 0399500001 by the Education Ministry, and further, agreement from Algarve Regional Education Authority and School Directions was attained.

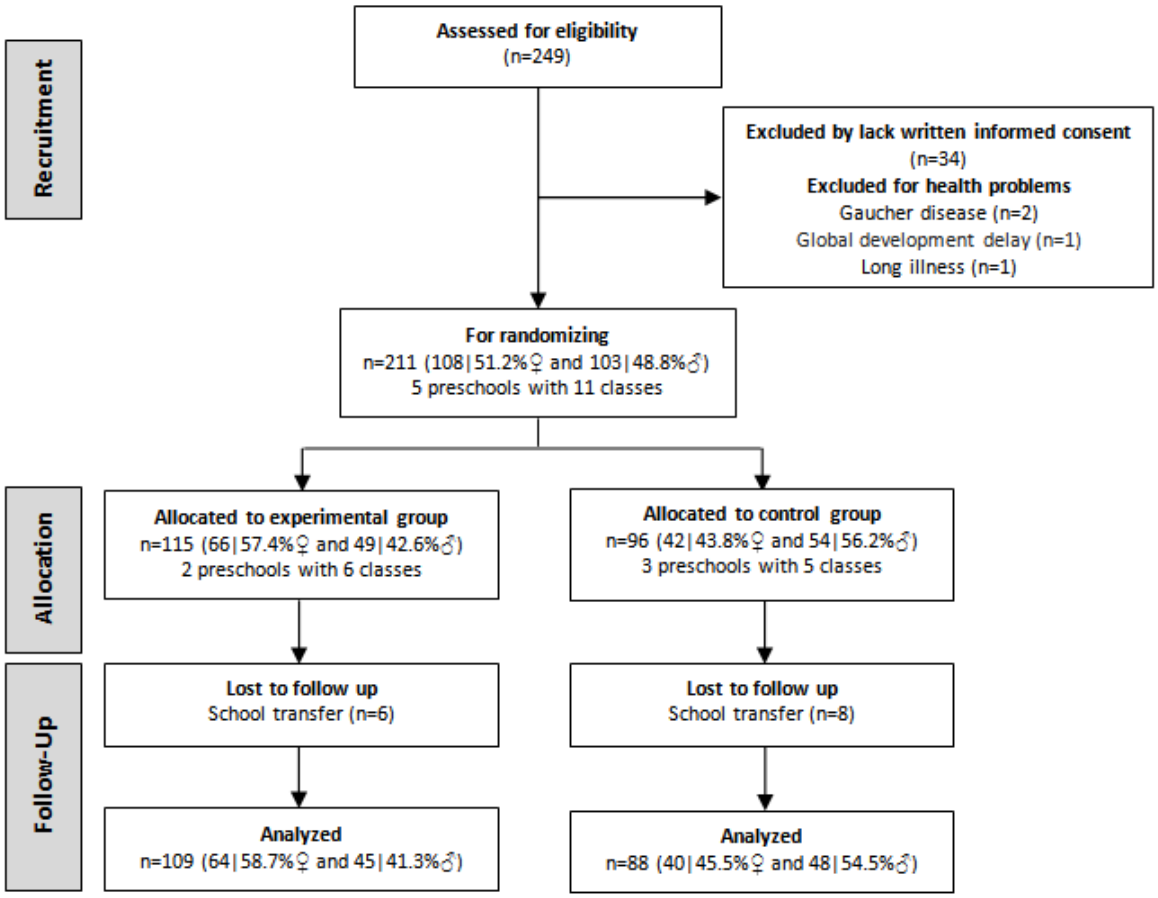
Children's parents participating received oral explanation and written information about the study by coordinator's research. Prior data collection, parents of all children participating provided written informed consent, according with ethical standards laid down in the Helsinki Declaration (WMA, 2013) (Appendix I).

4.2. Participants and study design

Complying with all ethical aspects, the recruitment of the study participants was carried out, during 2013/2014. As mentioned above, this study was performed involving preschool children from all public preschools from Faro municipality ("Jardim de Infância do Carmo", "Jardim de Infância da Conceição", "Jardim de "Infância do Montenegro", "Jardim de Infância de St.ª Bárbara de

Nexe" and "Jardim de Infância de Bordeira"). These five preschools have a total of 11 classrooms, with children's aged between three years old and the age of entry into basic school (five to six, exceptionally seven years old).

Figure 3. Flowchart of the participants on the study.



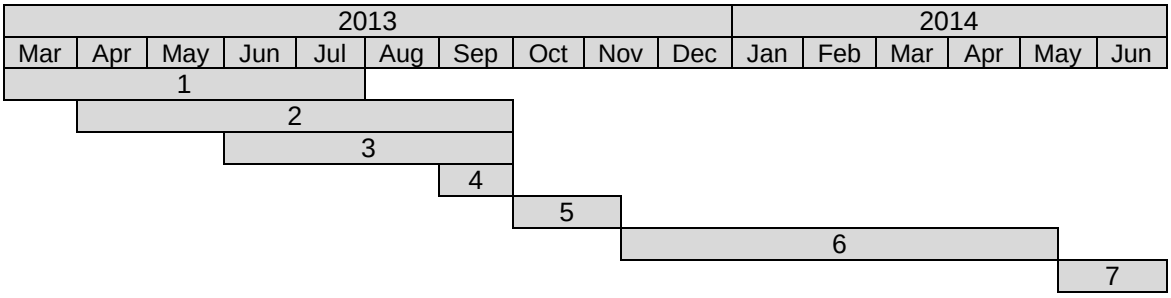
At the time of recruitment, all parents of children attending preschool were contacted (n=249), covering the 11 classrooms of five preschools existing in Faro municipality. Out of these, parents of 215 children provided written informed consent (86%), of which four were excluded due to health problems with a significant physical and/or intellectual disability (two with Gaucher disease, one with global development delay, and one by long illness). Therefore, the population studied was of 211 participants, aged 5.3 (±0.5) years, 108 females (51.2%) and 103 males (48.8%). First of all, children

admitted were assessed after eligibility and recruitment, but before having been randomly allocated, to the experimental group (EG) and the control group (CG).

For the selection and randomization, an informatics random number generator was used. For practical reasons, and to avoid the effect of contamination, preschool classes integrated in the same school building were randomized into the same group: six classes in EG (n=115) and five classes in CG (n=96), being the classes the unit of randomization.

The study was conducted over a period of preparation and planning, after which the study itself developed as presented in **Figure 4**. Upon completion of the post-intervention assessment was carried out data processing and analyzing the results.

Figure 4. Chronogram of the study phases.



Legend: (1) Translation into Portuguese language and validity of two questionnaires; (2) Ethical approval; (3) Fieldwork preparation; (4) Training of kindergarten teachers; (5) Baseline assessment and classes randomization; (6) Intervention; and (7) Post-intervention assessment.

Within the period of preparation and planning the study itself, the translation, cultural adaptation and psychometric properties test of two questionnaires originally in English language were performed, “Meals in Our Household Questionnaire” and “Pre-PAQ: Preschool-age Children’s Physical Activity Questionnaire”. From this preparatory work two studies resulted, which are part of this thesis:

Study I - Reliability of the “Meals in Our Household Questionnaire” in Portuguese Preschool Children;

Study II - Reliability of the “Pre-PAQ: Preschool-age Children’s Physical Activity Questionnaire” in Portuguese Preschool Children.

4.3. Data collection

For all children included in the study, caregivers were asked to fill in a questionnaire (Appendix II) and the food record of 3-day. It was also requested authorization to use the pedometer. Anthropometric measurements were performed in all children included.

4.3.1. Anthropometry

All children were assessed by the same two trained technicians in anthropometric measurements using a standardized procedure (WHO, 2008b). Height, weight and body composition were determined wearing light clothes, no shoes, no socks, and after urination and wherever possible in the morning. Height was measured in meters, to the nearest millimeter using a portable stadiometer (Seca® model 214), with the head positioned according to the Frankfort plane. Weight was measured in kilograms, to the nearest decigram, using a digital balance with body composition analyzer (Tanita® model BC 418). Height and weight measures were converted in BMI, expressed in kg/m^2, for each participant. BMI was standardized for age and sex, and specific prevalence of underweight, normal, overweight and obesity was determined using the three different criteria: IOTF cut-points (Cole et al., 2000; Cole et al., 2007), WHO cut-offs (de Onis, Onyango, et al., 2007), and CDC reference (CDC, 2012), allowing the comparison of prevalence data in any study. BMI z-score and its changes were calculated using the WHO Anthro software (version 3.2.2, January 2011).

According to Cattaneo (2010), European countries must adopt the new WHO standard for growth monitoring and surveillance, because it covers all age groups from birth to 5 years of age, and removes the gender bias associated when IOTF reference and cut-offs is used. Therefore, to perform comparison BMI and BMI z-score data, between baseline and post-intervention, WHO reference was used only.

Given the WHO recommendation, WC was measured in centimeters, directly on the skin, midway between the lower margin of the last palpable rib

and the top of the iliac crest, in erect position, with arms by sides, feet together, without clothing covering the waist area and at the end of a gentle expiration (WHO, 2011), with an accuracy of 5mm, using a flexible and non-elastic measuring tape (Seca® model 201).

Height, weight and WC were assessed under the same conditions, with the same equipment and by the same trained researcher to minimize inter-observer error, both in baseline and post-intervention moments. The average of two measurements was used for height and WC, and when there was disagreement between these measures (>0.5cm for height or >0.3cm for waist), a third measure was recorded.

Body composition was assessed by BIA, measured by a tetra polar single frequency device (Tanita® model BC 418), having been obtained measurement data for each body part, right and left legs/ arms, and trunk, beyond the whole body, expressed in fat percentage (%).

4.3.2. Eating behavior and dietary intake

Eating behavior of children was measured using the *Children's Eating Behaviour Questionnaire* (CEBQ) (Wardle et al., 2001) translated and validated into Portuguese language (Viana & Sinde, 2008), and by the *Meals in Our Household Questionnaire* (Anderson et al., 2012) also translated and validated into Portuguese language (Sancho, Pinto, et al., 2014). The CEBQ consists of 35 items comprising eight scales: enjoyment of food, food responsiveness, emotional overeating, desire to drink, satiety responsiveness, slowness in eating, emotional under-eating, and food fussiness. The Meals in Our Household Questionnaire is a new parent-report questionnaire that measures six domains, two of which were used: "structure of family meals" and "use of food as reward". In order to better understand the eating behavior including procedures in buying food, in the context of preparation of meals, we introduced into "structure of family meals" domain, two more questions: "Buying of food is done with a previously prepared list" and "In buying food, I read the nutrition labelling".

Dietary and nutritional intake was obtained by 3-day food record (2 weekdays and 1 weekend, when possible) according to the available data. Parents or caregivers were instructed to record all foods and beverages consumed by their child (reporting the brand name if applicable) and the amount (in grams, units or household measures) in a diary provided. In order to convert foods into nutrients, the software Food Processor SQL® version (2004-2005 ESHA Research, Salem, Oregon) was used, which is based on the Food Composition Table of the United States of America Department of Agriculture. For typically Portuguese foods or culinary dishes, new codes were created with national nutritional information. Dietary reference intakes (DRIs) from North American, for children aged 4 to 8 years old, was used to analyze the energy and macronutrients and fiber intake, and the estimated energy requirement (EER) was calculated by the same DRIs (NAS, 2005). Still concerning the number of days food record, most of the participants (53.4%) only recorded one day, 4.6% recorded two days and 42% recorded three days. Nevertheless, to our sample, when seeing the participants with at least 1-day of food record stated as an usual day of food intake, a repeated-measures ANOVA showed that DI is similar ($p>0.05$), regardless of the number of days of food record. This nutritional and dietary information was related to a total of 174 participants.

Nutritional intake was analyzed in terms of energy, macronutrients (carbohydrates, fat and protein), sugar and fiber. For DI, and taking into account the association between some food items and childhood obesity, seven main food groups were defined: (1) total vegetables (cabbage, spinach, broccoli, lettuce, peppers, tomatoes, cucumbers, onions, carrots, etc.); (2) vegetable soup; (3) fruit (fresh fruit, including tropical fruit); (4) sweets and pastries (other biscuits apart from simple ones, croissants, doughnuts, cakes, chocolates, chocolate snacks, quince jam, compote, jelly, honey, sugar, candy); (5) energy dense snack foods (crisps and other fried snacks, patties, croquettes and other savory pastry products (6) sugar-sweetened beverages (cola, ice tea and sodas) and (7) water (including herbal infusions).

4.3.3. Physical Activity

PA of children was subjectively measured using the Preschool-age Children's Physical Activity Questionnaire (Pre-PAQ) (Dwyer et al., 2011). The Pre-PAQ is a tool to estimate the level of PA in young children (3-5 years) in a socio-ecologic perspective, considering three days spent in the family environment, the last weekday and a weekend (Saturday and Sunday) the family spent together, not necessarily on consecutive days, across four large domains: (1) children demographic data; (2) parents physical activities and SB, as well as how they stimulate to an active lifestyle; (3) home characteristics and neighborhood contexts as determinant factors to PA; and (4) children PA in general and particularly in the last weekday and two weekend days.

Daily PA was objectively measured using pedometers (Kenz Lifecorder® model PLUS, Japan). The simple step output, using this simple device, is actually widely accepted by researchers, practitioners, and the general public for assessing, tracking, and communicating PA doses, allowing to do the connection between research and practice, with important implications for the promotion of health (Tudor-Locke et al., 2013). In addition, Pagels et al (2011) found a moderately high correlation between preschool children's pedometer-determined step counts and total engagement in PA during preschool time (Pagels et al., 2011), which allows us to believe that the use of pedometers is a good method to assess the PA of children in our study.

A pedometer is a small, lightweight, uniaxial device, producing 'raw' output in steps. Trost et al. (2010) indicate that a 7-day monitoring protocol provides reliable estimates of usual PA behavior in children (Trost et al., 2000), yet Addy (2014) admits it as having acceptable reliability, at least, 5-day monitoring, whenever it is not possible to register full seven days of measurement (Addy et al., 2014). In our study, according to an analysis of variance (ANOVA), we did not find differences between the mean number of steps in five, six or more days of record ($F=0.659$, $p=0.580$), which allowed us to use all data to further assess the participants' PA. Therefore, we defined five or more consecutive days, which included at least one day of weekend monitoring, with a minimum of valid eight hours of daily steps records.

Pedometer data were treated with specific software (PAAS Lifestyle Coach®). Pedometer output was interpreted using a specific association between steps per day and the recommendations of diary PA, through the engagement of 180 minutes of total PA, including 60 minutes of MVPA (Australian Government, 2012; CSEP, 2011; UK Government, 2011). Early studies have pointed to 13037 steps per day (Tanaka & Tanaka, 2009), 9980 steps per day (Cardon & De Bourdeaudhuij, 2007), having Tudor-Locke et al (2011) indicated 13000-14000 steps per day for preschool children in their study (Tudor-Locke et al., 2011). Nonetheless, more recent studies indicate a minimum of 6000 steps per day (Gabel et al., 2013) and 9000 steps per day (Vale et al., 2014). According to Vale et al. (2014), the discrepancy between prior studies in this area may be related, at least in part, to the different instruments and methodology used as well as cultural and environmental differences in the daily lifestyle of preschool-aged children from different countries. From a methodological point of view, we will follow the cut point stated by Vale et al. (2014), a compliance of more than 9000 steps per day, because it differentiates light intensity PA from SB more accurately (Vale et al., 2014). Thus, children will be classified as meeting the minimum of steps per day (>9000: sufficiently active) or not meeting them (≤9000: insufficiently active).

4.3.4. Socio-demographic data

Socio-demographic data were assessed with the study questionnaire filled in by parents, about family characteristics, that may have a potential influence in childhood obesity, namely: mother's and father's nutritional status, self-reported height and weight; mother's and father's education and occupational levels; watching TV profile; and sleep characteristics. Additionally, socio-demographic data were also assessed through the school echelons assigned from the social intervention of the Ministry of Education: A (greater intervention), B (less intervention), and without intervention.

According to Portuguese Education System, the parent's education level was organized into six categories, having subsequently been recoded into three

categories (**Table 7**): basic or less (≤9 school years), secondary (10–12 school years) and college/university (>12 school years).

Table 7. Parent's education level recoding.

"1º Ciclo do Ensino Básico (Primária)" "2º Ciclo do Ensino Básico (6º Ano)" "3º Ciclo do Ensino Básico (9º Ano)"	Up to 9 years
"Ensino Secundário (12º Ano)"	10 to 12 years
"Bacharelato/ Licenciatura" "Mestrado/ Doutoramento"	> 12 years

According to the Portuguese Classification of Occupations (INE, 2011) the parent's occupation level was organized in ten categories, having subsequently been recoded into four categories, 1 to 4, being 4 the highest level (**Table 8**), beyond the status of unemployed.

Table 8. Parent's occupation level recoding.

"Trabalhadores não qualificados"	1
"Operadores de instalações e máquinas e trabalhadores da montagem" "Trabalhadores qualificados da indústria, construção e artífices" "Agricultores e trabalhadores qualificados da agricultura, da pesca e da floresta" "Trabalhadores dos serviços pessoais, de proteção e segurança e vendedores" "Pessoal administrativo"	2
"Técnicos e profissões de nível intermédio"	3
"Especialistas das atividades intelectuais e científicas" "Representantes do poder legislativo/ órgãos executivos, dirigentes e gestores" "Profissões das Forças Armadas – Quadros superiores"	4

Thus, employment status was divided into: (1) unqualified workers, (2) operators of machinery and equipment, qualified workers in industry, construction, agriculture, fishery and forestry, artisans, personal service workers, safety and protective service providers, sellers and administrative staff, (3) mid-level technicians and professionals, and (4) specialists in intellectual and scientific occupations, representatives of legislative branch offices and

agencies, officers, directors and executive officers and armed forces members, and in another level the unemployed.

Whereas that the school echelons assigned from the social intervention of the Ministry of Education have not shown any association with the children nutritional status, the SES was basically analyzed from father and mother education and occupation.

4.4. Statistical analysis

Data were analyzed with IBM-SPSS software versions 21.0 or 22.0 (SPSS Inc., Chicago, IL, USA). The participants' description and characterization were summarized by tables and graphs representing the frequency or presenting mean values, median values, standard deviation, or interquartile range for the variables. Other variables were also presented with central tendency and dispersion statistics. For all inferential statistical procedures, statistical significance was set at 0.05.

The Kolmogorov-Smirnov test was used to assess adherence to the Normal distribution for all variables involved in statistical inference and, accordingly, parametric or non-parametric statistical procedures were used. On the overall, comparisons between two groups, where made using Student's t-test or Mann-Whitney's test, while a one-way analysis of variance (ANOVA) or the Kruskal Wallis test were used for multiple group comparisons. For categorical variables, all the necessary crosstabs were computed and the chi-square test was used to assess statistical significance. Both parametric and non-parametric correlations where computed, and Pearson's correlation coefficient was used when both variables to correlate followed a Normal distribution. In all other instances, Spearman's correlation coefficient was used.

The description of the statistical analysis is presented based on the specificity of each study in order to be easier reporting procedures.

Study I: The reliability for the test-retest procedure was analyzed through descriptive statistics and by the Spearman's correlation coefficient. Internal consistency was assessed with Cronbach's alpha, using the interpretation

proposed by Nunnally & Bernstein to consider the adequacy of reliability measures (Nunnally, 1994). Construct validity was assessed by Spearman's correlation coefficients between the scores in each of the questionnaire's domains.

Study II: reliability was assessed using the intra-class correlation coefficient (ICC) for ordinal and continuous variables, and using the kappa statistics for nominal variables. Reliability was interpreted according to the criteria proposed by Altman, stating that ICC or kappa below 0.20 represent poor agreement, 0.21 to 0.40 represents fair agreement, 0.41 to 0.60 represents moderate agreement, 0.61 to 0.80 represents good agreement and 0.81 to 1.00 represents very good agreement (Altman, 1991). Mean differences between test and retest administrations in daily minutes of engaging in different levels of PA were interpreted with the Wicoxon's signed-rank test for paired samples.

Study III: The paired-samples statistical procedures used Wilcoxon's signed rank test or Friedman's test. Differences between BMI categories and steps categories were computed with Fisher's exact test. To better assess group differences, the results were interpreted after adjustment for sex and both father and mother's socioeconomic status, by using an analysis of covariance.

Study IV: Besides the aforementioned tests used overall, BMI was expressed in BMI/age percentile or converted to z-score. Whenever possible, results were also interpreted after adjustment for sex, both father and mother's socioeconomic status, and for baseline energy intake, using an analysis of covariance.

Study V: Paired-samples procedures were analyzed by Wicoxon's signed-rank test and changes in food behavior were summarized and analyzed with the chi-square test.

4.5. Intervention design

This intervention was based on the social ecological theoretical model (Bronfenbrenner, 1994), which has been identified as an effective approach in promotion of healthy lifestyles (Lobstein et al., 2004), and in the prevention of

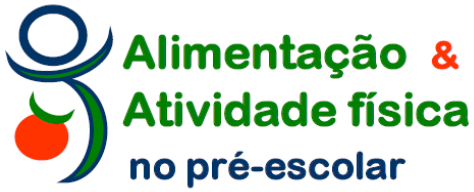
childhood obesity in particular (Penhollow & Rhoads, 2014). Regarding the socio ecologic framework, preschoolers' behaviors are influenced by the attitudes and behaviors of members of their larger network which includes parents, siblings, peer preschoolers and teachers (De Bock et al., 2010).

In this study, although the main target group is the preschool children, the intervention was held at microsystem level, with parents, kindergarten teachers and preschool staff, and at exosystem level, in school environment. Kindergarten teachers and parents are the two main influence factors for preschoolers (Niederer et al., 2009). Parents, particularly, are key to developing a home environment that fosters healthy lifestyles (Brotman et al., 2012; Hawkins et al., 2009; Ritchie et al., 2005), shaping children's dietary practices (Gruber & Haldeman, 2009; Mitchell et al., 2013; Pearson et al., 2009b), PA (Gruber & Haldeman, 2009; O'Dwyer et al., 2012), and SB (O'Dwyer et al., 2012). The pivotal role of teachers can foster positive healthy styles and provide good modelling and social learning opportunities (Manore et al., 2014). Physical school environment offer many opportunities for develop strategies of providing nutritious food and proposing greater opportunities for PA (Harrison & Jones, 2012; Story et al., 2006b; Story et al., 2009).

Given that behavior change is expected to be maximized when environments and policies support healthy choices, and when individuals are motivated and educated to make those choices (Sallis et al., 2008), a parent-focused, school-based childhood obesity prevention program was held, spanning the child's microsystem, exosystem and part of the mesosystem (Penholow & Rhoads, 2014).

The study team was coordinated by the main research and composed by two nutritionists, and three students of Dietetics and Nutrition. Intervention also had the collaboration of a dance teacher and a chef. Kindergarten teachers and preschool animators developed activities to promote healthy eating and PA with the technical and scientific support of the study team. Within the framework of intervention program an allusive logo to eating and PA in pre-school was created (**Figure 5**).

Figure 5. Logo of the intervention program.



This randomized control trial was conducted for six months, during the school year of 2013/2014, between November 2013 and April 2014. Concerning the duration of the intervention, on the one hand, longer-running programs are considered more effective (Gonzalez-Suarez et al., 2009), on the other hand, comparisons of mean duration time indicate that effective interventions have a relatively shorter duration time (Doak et al., 2006). Anyway, Doak et al. (2009), in a more recent review, concluded that the minimum duration of interventions should be set to at least 6 months, even for preschool studies (Doak et al., 2009), which is in agreement with our study.

Table 9. Contents of "training workshop" with teachers.

(1) Health promotion and healthy lifestyles in childhood obesity prevention
(2) Healthy dietary and eating behaviour
(3) Strategies to increase consumption of fruit, vegetables and water
(4) Strategies to reduced consumption of high sugar drinks and dense energy snacks
(5) Strategies for active play in and out the classroom
(6) How to use media

Prior to the intervention start, in 9 September 2013, six kindergarten teachers associated to EG had a training workshop of six hours with several contents (**Table 9**). In this training workshop, teachers trained skills to help children make healthy choices. Parents and children had monthly interventions (Pinto et al., 2014)

Parents of the EG had six monthly sessions of 60 minutes each, as described in **Table 10**, after working hours. At the end of each session a healthy snack was provided and a leaflet on the subject was delivered.

Table 10. Contents of interventions with parents.

(Month) Subject	Intervention content
(1) Healthy eating	Understand of the concept of a complete, balanced and varied eating. The breakfast. Important role of the water, fruit and vegetables.
(2) Physical activity	Recommendations and benefits of a regular physical activity in the context of the family, at home and outdoor. The importance of the regular structure physical activity.
(3) Eating behaviors and media use	Importance of not using food as a punishment or reward and respect the child's satiety. Importance of limiting TV and other screen to a maximum of 1h/day. Importance of avoid television in the bedroom and during the meals.
(4) Healthy snacks	Importance of this meal between the breakfast and lunch. Opportunity for consumption of fruit, vegetables, water and/or other healthy foods.
(5) Reading food labels	Read and interpretation of nutrition information, on the product packaging, including levels of energy, protein, total fat, saturated fat, carbohydrate, sugars and sodium. Select healthier packaged foods.
(6) Healthy cooking	Demonstrations of cooking ideas for prepare healthy food, including fruits and vegetables. How to actively involve children in preparation of snacks and simple meals.

In order to strengthen the knowledge preschool children and motivation to make healthy choices, a program of interactive puppet theatre was performed, like in other intervention studies with preschool (Fitzgibbon et al., 2005; Zask et al., 2012). This puppet theatre had two protagonists, “Mimi”, a small five year-old girl, and “Joca”, her brother, a small four year-old boy. To reconstruct the usual daily living environment of pre-school children, the puppet theatre also included other characters such as the “Mother”, the “Father”, the “Kindergarten teacher Teté”, and the “Animator Bia”. Children in the EG had six monthly puppet theatre sessions of 30 minutes each, whose themes were in line with the contents of the parents’ sessions, as far as possible, as described in **Table 11**.

With the simultaneous participation of children and parents, an activity was held on a Saturday morning, in a pedagogical environmental farm (Quinta do Peral). Such activity included one hour of pedestrian walk through the countryside, a vegetable and fruit show cooking, performed by a chef, and

tasting. On this farm, children and parents could observe, touch, smell and play with vegetables and fruit from the vegetable garden, as a way to promote their willingness to taste and consume (Heim et al., 2009; Hoelscher et al., 2013; Langellotto & Gupta, 2012; Parmer et al., 2009; Robinson-O'Brien et al., 2009). In the sixth session with children at preschool, a similar methodology of contact with vegetables and fruit was performed to support the nutritional education. In each session informative leaflets were provided, and healthy cooking recipes for preschoolers were delivered at the end of the intervention.

Table 11. Themes of puppet theatre with children.

(Month) Theme	Contents
(1) Mimi and Joca meals	Importance of meals throughout the day, especially breakfast and snacking. Importance of water consumption.
(2) School recess of Mimi and Joca	Importance of physical activity and examples of active play at school recess.
(3) Mimi and Joca learn to use the media	Importance of limiting sedentary games, choosing to be more active, giving examples.
(4) Mimi and Joca buy healthy foods	Importance of vegetables, legumes and fruit consumption. Preparation of soup and salad.
(5) Mimi and Joca learn to avoid sweet foods	Importance of limiting sugary foods and soft drinks, choosing healthier foods like fruit and water.
(6) Mimi and Joca visit a vegetable garden	Visit to a vegetable garden and playful activities with vegetables and fruits, exploring sensorial experiences.

Concerning the preschool environment, several actions were systematically conducted with the EG children, in terms of dietary intervention, eating behavior, PA and SB.

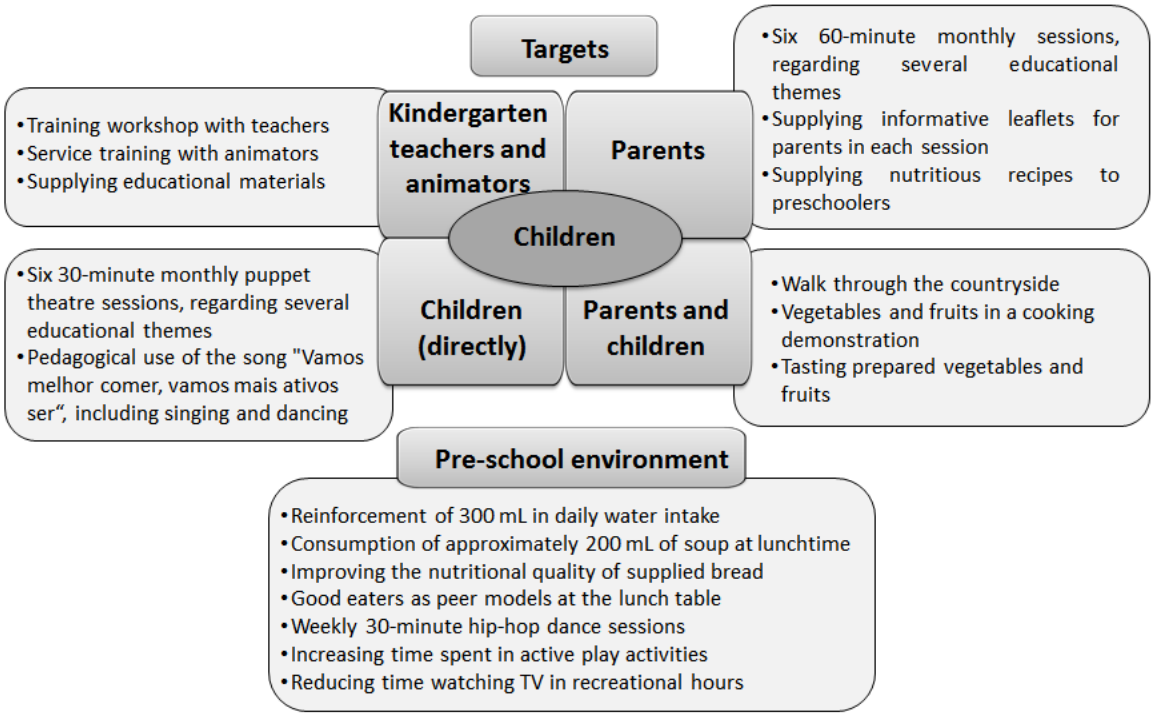
Regarding intervention at DI: (1) the daily water intake was reinforced in 300 mL, through two glasses of water provided in two of the school breaks; (2) the daily consumption of soup at lunchtime was approximately 200 mL; and (3) the nutritional quality of the bread supplied, at lunch and mid-afternoon snack, was improved, given the replacement for wheat and rye bread, and fiber enriched. About eating behavior, at lunch, considering the role of children to serve as peer models as a strategy to promote healthy food consumption, good

eaters were seated closer to children with difficulty in eating these foods, thus being able to produce the improvement of DI (O'Connell et al., 2012).

Regarding PA, opportunities for its practice were strengthened through a weekly session of Hip-Hop dance lasting 30 minutes, conducted by a dance teacher (Mo-suwan et al., 1998), and by the reinforcement of active play activities frequency, in and out. Concerning SB, a reduction of time watching TV in recreational hours was implemented (Braithwaite et al., 2013; Lissner et al., 2012; Vanderloo, 2014).

Music has been seen as a natural part of children's lives and activities, like singing, moving, or dancing, with benefits in terms of learning (Garvis, 2012). The intervention was also assisted by a pedagogical song "*Vamos melhor comer, vamos mais ativos ser*", whose lyrics address some of the behaviors epidemiologically correlated with the prevention of childhood obesity (Appendix III). Additionally, the dance choreography to this song was conducted by Hip-Hop dance teacher.

Figure 6. Intervention program diagram.



Summarizing the study design described above, and considering that children interact with the environment through the context of family and school, the overview of this intervention is presented in **Figure 6**. The implementation of the intervention program occurred as planned. Children of the EG were enrolled in all activities as foreseen. Both the school-based and family-based components of the intervention were feasible, but attendance for the parent intervention sessions was low, like reported in other studies (Fitzgibbon et al., 2013).

Concerning the CG, children and parents did not receive any intervention support or materials during the study period. Observing ethical concerns, at the end of post intervention data collection, leaflets with written information on nutrition and PA were provided.

5. Studies

5.1. Study I

Reliability of the "Meals in Our Household Questionnaire" in Portuguese Preschool Children

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Reliability of the "Meals in Our Household Questionnaire" in Portuguese Preschool Children

Fiabilidade do Questionário "Meals in Our Household Questionnaire" em Crianças Portuguesas do Pré-escolar

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ABSTRACT

Assessment tools of mealtimes in families are limited and there is none which comprehensively measures Portuguese children's mealtime structure, environment, behavior and its effects on the household. This paper aims at translating, culturally adapting and testing the psychometric properties of the Meals in Our Household Questionnaire in Portuguese preschool children. The Meals in Our Household Questionnaire was translated into Portuguese and back-translated into English by an expert translator. Questionnaires were filled in twice by the same participants, with two weeks in-between. The Meals in Our Household Questionnaire reliability analysis included internal consistency, assessed by Cronbach's alpha, and reproducibility, assessed by Spearman's correlation coefficient. We found satisfactory internal consistency across all of the Meals in Our Household Questionnaire domains and moderate to strong test-retest correlations. The questionnaire's translation led to a satisfactory reliable tool to assess parents' perception of the Portuguese preschoolers' family mealtime behaviors and environments, which can be quite useful for healthcare interventions.

KEYWORDS: Eating behavior, Family mealtime, Mealtime behavior, Reliability

RESUMO

Os instrumentos para avaliação das refeições em família são limitados e não existe nenhum que meça de forma abrangente a estrutura, o ambiente, o comportamento e os respectivos efeitos na família, próprio para crianças Portuguesas. Este artigo tem como objectivo traduzir, adaptar culturalmente e testar as propriedades psicométricas do Questionário Sobre as Refeições na Nossa Casa (Meals in Our Household Questionnaire) em crianças portuguesas do ensino pré-escolar. O Questionário Sobre as Refeições na Nossa Casa foi submetido a tradução e retroversão por um tradutor especialista. Os questionários foram preenchidos por duas vezes pelos mesmos participantes, com duas semanas de intervalo. A análise de fiabilidade do Questionário Sobre as Refeições na Nossa Casa incluiu a consistência interna, avaliada pelo alfa de Cronbach, e a reprodutibilidade, avaliada pelo coeficiente de correlação de Spearman. A consistência interna encontrada em todos os domínios do Questionário Sobre as Refeições na Nossa Casa foi satisfatória e as correlações entre teste-reteste foram moderadas a fortes. A tradução do questionário conduziu a um instrumento satisfatoriamente fiável para avaliar a percepção dos pais de crianças pré-escolares portugueses relativamente aos comportamentos e ambiente durante as refeições em família, o qual pode ser bastante útil em intervenções no âmbito da saúde.

PALAVRAS-CHAVE: Comportamento alimentar; Comportamento às refeições; Fiabilidade; Refeições em família

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INTRODUCTION

To share mealtimes is one of the characteristics of the eating environment in Mediterranean countries, which, in its simplest form, joins family and friends around the table, enjoying home cooked meals in a convivial conversation (1, 2). There is increasing evidence that the frequency of shared family mealtimes is associated with many positive dietary outcomes for children and youth (3-6), namely higher intake of fruit (7-9), vegetables (7-10), calcium-rich foods (7-9), grains (8), dietary fiber (7), along with the lower intake of soft drinks (7, 8), fried foods, saturated and trans fat (7), as well as the decreased frequency of skipping breakfast (9). In addition to the nutritional benefits stated above, shared family mealtimes can involve pleasant conversations (4) and freedom from negative moods (11). They have been associated with such diverse outcomes as improved family communication and functioning (4, 10, 12), promotion of language development (13), improved literacy and academic achievement (13), reduced risk of substance abuse (14-17), lower risk of eating disorders (14, 16, 18-20), fewer psychosocial health problems (14, 15, 17, 21), children's enjoyment of eating and hedonic reactions to new food items (22) and an inverse relationship with the risk of pediatric overweight or obesity (4, 10-15, 18, 20, 23, 24).

Recent social changes have created some obstacles to family meals (5, 6, 25), namely the increasing rates of female employment, more parents working nonstandard or shifts, longer journeys to and from work, difficulty in selecting meals and challenges with cooking, and children participating in an increasing number of extracurricular activities. Different child-feeding parental practices may also affect family meals, from coercing children to eat specific foods by promising rewards, or withholding favorite food as punishment, thereby shaping the availability and accessibility to specific food, either healthy or unhealthy food items (26, 27). The restriction and the pressure-to-eat food-related parenting practices can disrupt children's regulation of energy intake (28), with a negative impact on children's dietary intake.

Assessment tools of mealtime behavior and family environment are limited (3) and, to our

best knowledge, there isn't one validated to Portuguese language which comprehensively measures family meal structure and environment, children's mealtime behavior and its impact on the family, parental concerns about children's diet and use of food as a reward. No such tools have been used in preschool and school-aged Portuguese children. Since mealtimes in families with young children may have an impact on the dietary quality and risk of childhood obesity, it seems relevant to have a validated tool to assess different mealtime dimensions. The structure of family meals is one domain that aims at characterizing the preparation of meals and how they are usually consumed (with who, where and what). Nevertheless, it is known that some of the characteristics of these family meals also have a meaningful connection to weight (4). This paper aims at translating, culturally adapting and testing the psychometric properties of the Meals in Our Household Questionnaire (MOHQ) (3) in Portuguese preschool children. As a result, this new tool could allow to develop research on family meals, and to give support to health professionals in assessing family meals' environment. This would constitute a good basis for intervening in families, intending to promote healthier homemade meals.

METHODOLOGY

Participants

The Portuguese version of the MOHQ was applied individually to a convenience sample of parents of preschool children (3 to 6 years of age), which were completed by parents at home, in the same week period, without interference of the researcher. All parents (96 in total) from a private institution of social solidarity (non-profit organized private institution for people of all social conditions) in Faro (Algarve), were invited to take part in the study, 80 of which agreed to complete the questionnaires. A total of 78 parents completed the questionnaire the first time it was presented (Q1 - test) but, due to loss of follow-up, only 49 parents completed the questionnaire the second time around (Q2 – retest), when it was applied two weeks later. Forty-seven questionnaires were filled in twice by the same participants (60.3%), as required in test-retest methodology. Socio-demographic data were recorded only in the Q2-retest, related to parents' professional occupation and education level, given its association with eating behavior. Fifty three percent of the participants' children were boys (n=25). All participants signed an informed consent form to participate in the study. The research protocol was approved by the Scientific Council of the Faculty of Sports of University of Porto and local Health Ethical Committee of Algarve Regional Health Administration of the Ministry of Health. Further procedures complied with the Helsinki Declaration (29).

Data Collection

The original MOHQ consists of a set of questions that characterize mealtime behaviors and environments of 3- to 11-year-old children, considering the previous three months of their lives, across six domains: 1) "Structure of Family Meals" assesses the frequency the child is exposed to traditionally structured family meals; 2) "Problematic Child Mealtime Behaviors" assesses the frequency of problematic behavior the child may exhibit at mealtimes and the extent to which the parent recognizes it as problematic; 3) "Use of Food as a Reward" assesses how frequently the parents use food to reward or manage the child's behavior; 4) "Parental Concern about Child Diet" measures the degree of concern the parent shows about what the child does or does not eat; 5) "Spousal Stress Related to Child's Mealtime Behavior" assesses the extent to which the parent believes the child's mealtime behavior negatively impacts on his or her spouse or partner, and/or whether it is a source of stress in their personal relationship; and 6) "Influence of Child's Food Preferences" measures how much the child's food preferences have impact on what other family members eat (3).

The MOHQ, originally written in English, was translated into Portuguese by two health researchers carrying out the necessary semantic and cultural linguistic adjustments to obtain an adequate correspondence in meaning. Permission for translation and validation was granted by the first author of the original MOHQ validation study (3). The Portuguese version of the MOHQ was translated back into English by an independent expert in the English language, with due specialization and experience in translation from the University of Algarve (who was blinded to the original version). Subsequently, the back-translation was compared to the original version of MOHQ to ensure equivalence between the two versions. The questionnaire was piloted in a convenience sample (n=7) of parents of other preschool children to evaluate its cultural adaptation. No question was identified as being difficult to interpret and the translation of the questionnaire was considered achieved.

The Portuguese version of the questionnaire is available by request to the authors.

Statistical Analysis

Socio-demographics were described as frequencies. The internal consistency of the scale was tested using the Cronbach's alpha coefficient (30). The reproducibility was also analyzed by using Spearman's correlation coefficient between the two tests. Additionally, due to the ordinal nature of the variables in the questionnaire, we also included a paired-sample of Wilcoxon's test to assess test-retest differences in median domain scores (30). We also used Spearman's correlation coefficients to analyze the association between scores in each of the questionnaire's domains. The statistical analysis was conducted using IBM SPSS Statistics (version 22.0, 2013), and the significance level was set at 5%.

RESULTS

Parents Socio-demographic Data

In order to organize socio-demographic information, we just collected data on the parents' professional occupation and education level (n=42). Occupation was categorized into five groups according to skills and specialization, as proposed by the Portuguese National Institute of Statistics, and education was assessed by last academic level completed by participants. Results for occupation category and education level are presented in Table 1.

Reliability

The analysis of internal consistency showed that MOHQ is an overall reliable tool, both in Q1 and Q2 (Table 2). Cronbach´s alpha coefficients ranged between 0.602 for the domain of the structure of family meals and 0.980 for the domain of using food as a reward in the application of the first questionnaire.

The test–retest scoring shows good reproducibility in all domains, as can be inferred by the positive moderate to high correlations in our data, higher than 0.7 for five of the six domains (Table 3).

TABLE 1: Parents' education level and occupation category (n=42)

Education level n (%)		Occupation category n (%)	
<6 years	3 (7.1)	Intellectual and scientific activities	19 (45.2)
6-9 years	10 (23.8)	Technicians and intermediate level jobs	4 (9.5)
10-12 years	5 (11.9)	Administrative services	3 (7.1)
>12 years	24 (57.1)	Personal services, protection and security, and sales	15 (35.7)
		Unemployed	1 (2.4)

TABLE 2: Cronbach's alpha in the test-retest procedure (n=47)

Domains	Cronbach's alpha	
	Q1 (test)	Q2 (retest)
Structure of Family Meals	0.602	0.665
Problematic Child Mealtime Behavior	0.903	0.733
Parental Concern about Child Diet	0.846	0.981
Use of Food as a Reward	0.98	0.901
Spousal Stress	0.759	0.848
Influence of Child's Food Preferences	0.829	0.943

TABLE 3: Domain scores, Wilcoxon's test and test-retest correlation (n=47)

Domains	Q1 score (test)			Q2 score (retest)			Wilcoxon's test p	Test-retest correlation p
	Med[a]	Min[b]	Max[c]	Med[a]	Min[b]	Max[c]		
Structure of Family Meals	40	30	49	39	31	47	0.819	0.867*
Problematic Child Mealtime Behavior	48	23	70	48	27	74	0.741	0.793*
Parental Concern about Child Diet	11	6	22	11	6	21	1.0	0.917*
Use of Food as a Reward	80	19	97	78.5	19	101	0.634	0.725*
Spousal Stress	4	4	13	5	4	14	0.572	0.788*
Influence of Child's Food Preferences	5.5	3	14	6	3	14	0.355	0.603*

[a] Median; [b] Minimum; [c] Maximum; * p<0.001 for Spearman correlation coefficient

TABLE 4: Correlation between domains in Q1 (test) and Q2 (retest) (n=47)

Domains	Spearman's correlation coefficient an statistical significance (p-value)									
	Problematic Child Mealtime Behavior		Parental Concern about Child Diet		Use of Food as a Reward		Spousal Stress		Influence of Child's Food Preferences	
	Q1	Q2	Q1	Q2	Q1	Q2	Q1	Q2	Q1	Q2
Structure of Family Meals	-0.279 (0.1)	-0.174 (0.276)	-0.296 (0.067)	-0.272 (0.078)	0.156 (0.388)	0.250 (0.125)	-0.360 (0.031)	-0.298 (0.066)	-0.087 (0.612)	-0.233 (0.153)
Problematic Child Mealtime Behavior			0.283 (0.072)	0.368 (0.013)	0.430 (0.011)	0.442 (0.004)	0.237 (0.237)	0.262 (0.107)	0.233 (0.165)	0.228 (0.162)
Parental Concern about Child Diet					0.148 (0.367)	-0.086 (0.588)	0.186 (0.244)	0.272 (0.086)	0.108 (0.498)	0.321 (0.041)
Use of Food as a Reward							0.042 (0.814)	-0.054 (0.746)	0.157 (0.368)	-0.102 (0.543)
Spousal Stress									0.144 (0.370)	0.186 (0.243)

TABLE 5: Domain scores and educational level (n = 47)

Domains	Education level				
	<6 years	6-9 years	10-12 years	>12 years	p
Structure of Family Meals	47 (1.4)	40.4 (5.1)	38 (3.5)	38.5 (3.3)	0.104
Problematic Child Mealtime Behavior	53 (14.1)	47.8 (9.4)	51.4 (10.8)	44.8 (10.7)	0.385
Parental Concern about Child Diet	9 (5.2)	13.6 (3.1)	11 (3.9)	10.7 (3.8)	0.095
Use of Food as a Reward	23 (4.2)	65 (26.8)	86.2 (6.7)	70 (21.5)	0.053
Spousal Stress	4 (0.0)	5.7 (2.0)	5.3 (1.3)	6.1 (2.6)	0.385
Influence of Child's Food Preferences	4.3 (1.5)	5.3 (2.3)	6 (2.6)	6.1 (3.1)	0.797

Data presented as mean (SD); Statistical differences between groups assessed with Kruskal-Wallis's test

Furthermore, when comparing median values for each domain using Wilcoxon's paired-samples non-parametric test, the scores were considered statistically similar (p>0.05).

Inter-domains correlations

When analyzing the correlations between the different domains in the test phase (Table 4), we found that families who scored higher on the "Structure of Family Meals" domain showed lower scores in "Problematic Child Mealtime Behavior", "Parental Concern about Child Diet", "Spousal Stress", as evidenced in the negative correlations found between these domains. Nevertheless, the correlation with "Spousal Stress" was the only one we considered statistically significant (p=0.031). High scores in "Problematic Child Mealtime Behaviors" were positively correlated with "Parental Concern about Child Diet", "Use of Food as a Reward", "Spousal Stress" and "Influence of Child's Food Preferences". The only correlation considered statistically significant in this area was the one reported for the "Use of Food as a Reward" (p=0.011). The correlations and level of statistical significance from the data collected during the retest phase are also presented in Table 4.

Between test and retest procedures, only the correlation between "Problematic Child Mealtime Behavior" and "Use of Food as a Reward" was statistically significant. However, the correlation types (positive/ negative) remained the same.

When analyzing the mean scores in all of the MOHQ domains according to caregivers´ educational level, we did not find statistically significant differences (Table 5). However, the score on "Structure of Family Meals" decreases with the education level and the score in the domains "Use of Food as a Reward" and "Influence of Child's Food Preferences" increase with schooling.

DISCUSSION

In the present study, we aimed at describing the adaptation and psychometric properties of the Portuguese version of the MOHQ to address the lack of available tools to assess mealtime environment in Portuguese preschool children's households.

The dimension regarding "Structure of Family Meals" showed Cronbach's alpha values between 0.6 - 0.7, which some authors may consider questionable (30), as the cut-point for considering a measure as reliable has traditionally been 0.70. When analyzing the expected internal consistency after the removal of each of the items in this domain, Cronbach's alpha was lower than 0.6, leading us to believe that, at this point, all items are necessary for the questionnaire's reliability. However, and considering the potential factors that may influence Cronbach's alpha, such as the number of items on a scale or the sample size (31), we believe that the value we report for the "Structure of Family Meals" domain is acceptable in the context of our research.

The correlations in our study are in accordance with studies linking the frequency and quality of family meals to positive child and family outcomes (8, 10,

32). This was also found by the authors of the original MOHQ (3), who propose that this is evidence for the construct validity of the questionnaire.

The MOHQ was translated for researchers interested in understanding mealtimes in families with preschool children living in Portugal or other Portuguese-speaking countries. Yet it is important to acknowledge the limitations of our study, namely the use of a convenience sample and the limited possibility of generalization concerning socio-demographic characteristics. A further limitation of this study is that it is subject to social desirability bias and it is not known whether participants differed in their interpretation or understanding of the questions. Given that socio-demographic data were recorded only at the time of the retest, it is not possible to characterize the socio-demographic specificity of parents who responded to the test and did not respond to retest, not knowing, therefore, to what extent this may be a bias in the study. Additionally, considering that the recording of socio-demographic data was free, from the 47 retest completed questionnaires by the same parents, only 42 presented the respective socio-demographic characteristics. Still, the dropout rate between test and retest was undoubtedly high. However, parents completed the questionnaires voluntarily and without any gratuity or reward. Our results must be cautiously related with the different cultural and socio-demographic backgrounds in the sample; hence cross-national comparisons of MOHQ are not advisable without further studies. Additionally, as the majority of our sample held higher education degrees, further studies analyzing its psychometric properties, in a more diversified sample, are needed to fully assess this tool's usefulness. Despite these shortcomings and gaps, the translation and psychometric properties analysis accomplished in the present study could be crucial to address mealtime behavior and family environment which may cause impact on nutritional intake and hence on the global health of general children and of preschool children in particular.

For nutritionists and dietetics practitioners or other health professionals who counsel families, the application of the questionnaire may allow for the identification of specific or general problems, and consequently may help facilitate discussion with parents about their children's mealtime behavior, their concerns about their child's diet, and their use of food to reward children or manage problematic behavior (3), thus promoting healthier household meals.

CONCLUSIONS

Our results allow us to conclude that the questionnaire's translation and validation analysis led to a satisfactory valid and reliable tool to assess the parent's perception of Portuguese preschoolers' mealtime behaviors and environments, being both a cheap and easy instrument to apply. Although additional studies are needed, results show promising results, which allows us to go a step further in recommending the widespread use of this tool, in the Portuguese language, by researchers aiming at addressing these particular dimensions of eating behavior.

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REFERENCES

1. Costarelli V, Koretsi E, Georgitsogianni E. Health-related quality of life of Greek adolescents: the role of the Mediterranean diet. Quality of Life Research. 2013;22(5):951-6.
2. Hilgers L. The sun-kissed diet. Shape. 1993;13(1):84.
3. Anderson SE, Must A, Curtin C, Bandini LG. Meals in Our Household: Reliability and Initial Validation of a Questionnaire to Assess Child Mealtime Behaviors and Family Mealtime Environments. Journal of the Academy of Nutrition and Dietetics. 2012;112(2):276-84.
4. Fiese BH, Hammons A, Grigsby-Toussaint D. Family mealtimes: a contextual approach to understanding childhood obesity. Economics And Human Biology. 2012;10(4):365-74.
5. Cason KL. Family mealtimes: More than just eating together. Journal of the American Dietetic Association. 2006;106(4):532-3.
6. Quick BL, Fiese BH, Anderson B, Koester BD, Marlin DW. A Formative Evaluation of Shared Family Mealtime for Parents of Toddlers and Young Children. Health Communication. 2011;26(7):656-66.
7. Gillman MW, Rifas-Shiman SL, Frazier AL, Rockett HRH, Camargo CA, Field AE, et al. Family dinner and diet quality among older children and adolescents. Archives of Family Medicine. 2000;9(3):235-40.
8. Neumark-Sztainer D, Hannan PJ, Story M, Croll J, Perry C. Family meal patterns: Associations with sociodemogpaphic characteristics and improved dietary intake among adolescents. Journal of the American Dietetic Association. 2003;103(3):317-22.
9. Videon TM, Manning CK. Influences on adolescent eating patterns: The importance of family meals. Journal of Adolescent Health. 2003;32(5):365-73.
10. Berge JM, Jin SW, Hannan P, Neumark-Sztainer D. Structural and Interpersonal Characteristics of Family Meals: Associations with Adolescent Body Mass Index and Dietary Patterns. Journal of the Academy of Nutrition and Dietetics. 2013;113(6):816-22.
11. Burnier D, Dubois L, Girard M. Arguments at Mealtime and Child Energy Intake. Journal of Nutrition Education and Behavior. 2011;43(6):473-81.
12. Moens E, Braet C, Soetens B. Observation of family functioning at mealtime: A comparison between families of children with and without overweight. Journal of Pediatric Psychology. 2007;32(1):52-63.
13. Fiese BH, Schwartz M. Reclaiming the Family Table: Mealtimes and Child Health and Wellbeing: Social Policy Report. Society for Research in Child Development. 2008;22(4):3-19.
14. Neumark-Sztainer D, Larson NI, Fulkerson JA, Eisenberg ME, Story M. Family meals and adolescents: what have we learned from Project EAT (Eating Among Teens)? Public Health Nutrition. 2010;13(7):1113-21.
15. Eisenberg ME, Olson RE, Neumark-Sztainer D, Story M, Bearinger LH. Correlations between family meals and psychosocial well-being among adolescents. Archives of Pediatrics & Adolescent Medicine. 2004;158(8):792-6.
16. Fulkerson JA, Story M, Mellin A, Leffert N, Neumark-Sztainer D, French SA. Family dinner meal frequency and adolescent development: Relationships with developmental assets and high-risk behaviors. Journal of Adolescent Health. 2006;39(3):337-45.
17. Sen B. The relationship between frequency of family dinner and adolescent problem behaviors after adjusting for other family characteristics. Journal of Adolescence. 2010;33(1):187-96.
18. Hammons AJ, Fiese BH. Is Frequency of Shared Family Meals Related to the Nutritional Health of Children and Adolescents? Pediatrics. 2011;127(6):E1565-E74.
19. Godfrey K, Rhodes P, Hunt C. The relationship between family mealtime interactions and eating disorder in childhood and adolescence: A systematic review. Australian and New Zealand Journal of Family Therapy. 2013;34(1):54-74.
20. Martin-Biggers J, Spaccarotella K, Berhaupt-Glickstein A, Hongu N, Worobey J, Byrd-Bredbenner C. Come and get it! A discussion of family mealtime literature and factors affecting obesity risk. Advances in Nutrition. 2014;5(3):235-47.
21. Fulkerson JA, Neumark-Sztainer D, Hannan PJ, Story M. Family Meal Frequency and Weight Status Among Adolescents: Cross- sectional and 5-year Longitudinal Associations. Obesity. 2008;16(11):2529-34.
22. Wardle J, Guthrie CA, Sanderson S, Rapoport L. Development of the children's eating behaviour questionnaire. Journal of Child Psychology and Psychiatry. 2001;42(7):963-70.
23. Rockett HRH. Family dinner: More than just a meal. Journal of the American Dietetic Association. 2007;107(9):1498-501.
24. Taveras EM, Rifas-Shiman S, Berkey CS, Rockett HRH, Field AE, Frazir AL, et al. Family dinner and adolescent overweight. Obesity Research. 2005;13(5):900-6.
25. Fulkerson JA, Story M, Neumark-Sztainer D, Rydell S. Family meals: perceptions of benefits and challenges among parents of 8- to 10-year-old children. Journal of the American Dietetic Association. 2008;108(4):706-9.
26. Stang J, Loth KA. Parenting Style and Child Feeding Practices: Potential Mitigating Factors in the Etiology of Childhood Obesity. Journal of the American Dietetic Association. 2011;111(9):1301-5.
27. Johannsen DL, Johannsen NM, Specker BL. Influence of parents' eating Behaviors and child feeding practices on children's weight status. Obesity. 2006;14(3):431-9.
28. Birch LL, Fisher JO. Development of eating behaviors among children and adolescents. Pediatrics. 1998;101(3 Pt 2):539-49.
29. World Medical Association. Declaration of Helsinki 2013 [12 December 2014]. Available from: http://www.wma.net/en/30publications/10policies/b3/index.html.pdf?print-media-type&footer-right=[page]/[toPage].
30. Nunnally JC, Bernstein, I. H. Psychometric theory. 3 ed. Hill M, editor. New York.1994.
31. Daniel WWC, Chad L. Biostatistics: A Foundation for Analysis in the Health Sciences. 10 ed: Wiley Global Education; 2012.
32. Fruh SM, Fulkerson JA, Mulekar MS, Kendrick LAJ, Clanton C. The surprising benefits of the family meal. Journal for Nurse Practitioners. 2011;7(1):18-22.

5.2. Study II

Reliability of the "Pre-PAQ: Preschool-age Children's Physical Activity Questionnaire" in Portuguese Preschool Children

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Reliability of the "Pre-PAQ: Preschool-age Children's Physical Activity Questionnaire" in Portuguese Preschool Children

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ABSTRACT

Background: There´s a lack of specific tools to measure physical activity dimensions in preschool children, namely in the context of their home environment considering a socio-ecologic framework. ***Objective:*** This paper aims to translate, culturally adapt and test the psychometric properties of the Preschool-age Children's Physical Activity Questionnaire (Pre-PAQ) in Portuguese preschool children. ***Design:*** The Pre-PAQ was translated into Portuguese and back-translated into English by an expert translator. Questionnaires were filled in twice by the same participants (caregivers of preschool children), one week apart. The Pre-PAQ reliability was assessed using the intra-class correlation coefficient (ICC) for ordinal and continuous variables, and using the kappa statistics for nominal variables. ***Results:*** The reliability statistics ranged from 0.402 to 0.938, which show a fair reliability for the translated version of the Pre-PAQ tool and its psychometric properties. ***Conclusion:*** The Pre-PAQ translation led to a reliable tool to assess nature, level and duration of a child's activity behavior, and concomitantly measures the influence of parental, family and neighborhood influential factors, crucial when planning intervention policies.

Key words: preschool children; physical activity; sedentary; questionnaire

INTRODUCTION

PA is beneficial in all stages of the formative years of any given person, and active play is important in the physical, mental and social aspects of growth and development (9, 10), helping to set a pattern of participation in PA across a person's lifespan (12). For example, the development of specific motor competence in early childhood is associated to the improvement of motor proficiency beyond preschool years (14). In the preschool period and as far as obesity is concerned, physical activity (PA) seems to be a protective factor against it, whereas sedentary behaviour – television viewing, in particular – appears to be obesogenic (4). Thus, establishing and maintaining adequate levels of PA in young children is an important public health issue to be addressed in the search for long-term preventive effects (22).

It is not known at what age PA promotion should be instituted so as to be most effective, but the preschool years may represent a window of opportunity (3), as it is in these early years that behavior is more malleable rather than in later childhood (20). On the other hand, besides eating patterns, PA appears to be protective against obesity during the preschool period whereas sedentary behavior (SB), appear to be obesogenic (4).

According to PA guidelines in preschool, some studies indicate that preschool children exhibit low levels of vigorous activity and high levels of inactivity (2, 16, 22), while others recent studies suggest that most preschool children meet daily PA recommendations, in some conditions (8, 23). For better plan interventions, it is relevant to know the compliance with established guidelines for PA and evaluate several settings of children's PA, including school, home, and the neighborhoods (6, 15). The socio–ecologic model (SEM), postulated by Bronfenbrenner, provides a framework through

which potential correlates of preschool children's PA may be conceptualized in a multidimensional platform and operate across the individual, social, and physical environment domains (11, 18), making it imperative for research to examine the multiple contexts of the children's lives.

From a holistic perspective, however, less is known about activity behavior of very young children because there are limited tools for the measurement of PA and/or SB in this age group (5, 6), mainly in a multidimensional component to capture the related potentially contributing factors (15). Considering that PA is a complex construct, encompassing different dimensions and contexts (such as occupation, transportation, exercise, daily activities) and different types of activity (such as aerobic, muscle strengthening, and balance improvement), no single assessment method can measure all the domains of PA and/or SB (21). Any assessment method, whether subjective or objective, has advantages and disadvantages (5). Direct measures such as accelerometers, or observation, either objective and/or subjective, respectively, can be used but are often not feasible in large epidemiologic studies (13). Therefore, it becomes necessary to devise specific questionnaires to assess activity behavior in preschool-age children (5, 6, 16). A physical activity questionnaire (PAQ), necessarily a proxy-report tool for parents, seems to be adequate because it is attractive, has low burden (17), and because young children lack the cognitive capacity to assess or recall their activity (5). Additionally, it reports information about home environment, given that its role in shaping the PA behavior among youth is poorly understood (19).

Although PAQ's are a major requirement, the accurate and feasible measurement of PA by questionnaires remains a challenge (7). The Pre-PAQ was designed to fill this niche and it was specifically developed to measure population estimates of activity in young

children in their home environment from the perspective of a socio-ecologic framework (5). To our best knowledge, no comprehensively questionnaire of preschool-age children's PA exists or has been used in preschool Portuguese children. This paper aims to translate, culturally adapt and test the psychometric properties of the Pre-PAQ (5) in Portuguese preschool children, and then study the reliability of the new translated version. As a result, this new tool will allow PA researchers and healthcare professionals to assess the home environment in a socio-ecologic context and will provide a good basis for intervening in families, promoting an active and healthier life in the children's households.

MATERIAL AND METHODS

Participants

The Portuguese version of the Pre-PAQ was answered individually by parents, without interference of the researcher, by a convenience sample of parents of preschool children (3 to 6 years old), in June 2013.

All parents (110) from a private institution of social solidarity (non-profit organized private institution for people of all social conditions) in Faro (Algarve) were invited to take part in the study, 69 of which agreed to complete the questionnaires. Forty-eight parents filled in the questionnaire at test (Q1) and retest (Q2) administrations, one week apart, but only 46 questionnaires were filled in twice by the same caregiver. Of the 46 questionnaires, 24 (52.2%) concerned boys. All participants signed an informed consent form to participate in the study. The research protocol was approved by the Scientific Council of the Faculty of Sports of Porto University and local Health Ethical Committee

of the Algarve Regional Health Administration of Ministry of Health and further procedures complied with the Helsinki Declaration (24).

Data collection

The original Pre-PAQ was developed to estimate the level of PA in young children (3-5 years) in a socio-ecologic perspective, reporting back to the previous week, across four large domains: 1) "General information", which assesses the children demographic data; 2) "Parent physical activity & parenting habits", which assesses the parents physical activities and SB, as well as how parents stimulate to an active lifestyle; 3) "Home and neighborhood", which assesses the home characteristics and neighborhood contexts as determinant factors to PA; 4) "Children physical activity", which assesses the children's PA in general and particularly on the last weekday and two weekend days which the children spent with their family (5).

The Pre-PAQ, originally written in English, was translated into Portuguese by a health researcher carrying out the necessary semantic and cultural linguistic adjustments to obtain the adequate meaning equivalence. Permission for translation and validation was granted by the first author of the original Pre-PAQ validation study (5). The Portuguese version of the Pre-PAQ was back-translated into English by an independent expert in English language, with specialization and experience in translation from the University of Algarve (who was blinded to the original version). Subsequently, the back-translation was compared with to the original version of MOHQ to ensure equivalence between the two versions. The questionnaire was piloted in a convenience sample (n = 7) of parents from preschoolers of other preschool children to evaluate its cultural adaptation. No question was identified as being difficult to interpret and the translation of the questionnaire was considered achieved (Supplementary file).

Statistical Analysis

Descriptive statistics were computed to summarize the participants' characteristics. Mean values and frequencies were used to present socio-demographic variables and the Kolmogorov-Smirnov test was used to determine if the variables that underwent statistical inference tests were normally distributed. Statistical significance was set at 5%. Due to the nature of the data, reliability was assessed using the intra-class correlation coefficient (ICC) for ordinal and continuous variables, and using the kappa statistics for nominal variables. Following the methods from the original authors for the Pre-PAQ questionnaire, reliability was interpreted according to the criteria proposed by Altman, stating that ICC or kappa below 0.20 represent poor agreement, 0.21 to 0.40 represents fair agreement, 0.41 to 0.60 represents moderate agreement, 0.61 to 0.80 represents good agreement and 0.81 to 1.00 represents very good agreement (1). Mean differences between test and retest administrations in daily minutes of engaging in different levels of PA were interpreted with the Wicoxon's signed-rank test for paired samples. Data were analyzed with the Statistical Package for the Social Sciences (SPSS) software (Version 21 SPSS Inc., Chicago IL).

RESULTS

Sociodemographic variables

Of the 46 participants, some did not answer all of the socio-demographic questions posed to characterize the sample, resulting in questions with a total of 44 or 45 replies. The socio-demographic characteristics are summarized in Table 1.

Table 1. Socio-demographic characteristics of the participants

Relationship with child		**Participant' educational level**	
Mother	39 (86.7)	6th grade	1 (2.3)
Father	6 (13.3)	9th grade	-
Age range of parents		High school	17 (38.6)
20-29	2 (4.4)	Undergraduate degree or above	26 (59.1)
30-39	35 (77.8)		
40-49	8 (17.8)		
Marital status		**Partner's educational level**	
Married	30 (66.7)	6th grade	1 (2.4)
Living with partner	11 (24.4)	9th grade	2 (4.8)
Divorced	2 (4.4)	High school	13 (31.0)
Single	2 (4.4)	Undergraduate degree or above	26 (61.9)

Data presented as n (%).

Reliability

We computed the kappa statistic or the ICC for each individual item in the Pre-PAQ in order to analyse the translation's reliability. According to the criteria proposed by Altman (1991), none of the reliability measures we found can be considered as representing poor agreement. All statistics can be interpreted has representing, at least, a fair reliability of the test-retest procedure. Table 2 shows the range or individual value for the reliability statistics, grouped by sections of the Pre-PAQ.

Table 2. Sections of the Pre-PAQ and reliability statistics.

Section and item	Measurement scale	ICC (range)	Kappa (range)
Parent			
Physical activity behaviour	Mins.day^{-1}	0.402-0.853	
Television viewing	Mins.day^{-1}	0.511-0.728	
Computer time	Mins.day^{-1}	0.544-0.688	
Parenting behaviour	5-point Likert scale	0.543-0.744	
Family			
Car use	4-point Likert scale		0.381
Time child spent in a car	Mins.day^{-1}	0.325-0.485	
Home and Neighbourhood			
Perception of neighbourhood	One of four categories		0.410-0.705
Home small screen recreation items	Number of items	0.896-0.938	
Child			
Child's activity nature	5-point Likert scale	0.537-0.687	
Involvement in organized activities	Dichotomous (yes/no)		0.892
Use of neighbourhood facilities for activity	5-point Likert scale		0.397-0.683
Pre-PAQ levels 1-2	Mins.day^{-1}	0.510	
Pre-PAQ level 3	Mins.day^{-1}	0.408	
Pre-PAQ level 4	Mins.day^{-1}	0.432	
Pre-PAQ level 5	Mins.day^{-1}	0.615	

Sections with a lower number of items had higher reliability statistics (e.g., involvement in organized activities) and the highest reliability found was regarding the number of small screen recreational items in the household, namely laptop or desktop computers [ICC (2.1) = 0.938]. The lower reliability statistics were related to the time the child spent in a car, with time spent during a weekday showing the lowest reliability [ICC (2.1) = 0.325]. We also computed the Wilcoxon's signed-rank to assess median differences between Q1 and Q2 administrations of the questionnaire in regard to the estimation of minutes of different levels of PA during a weekday, Saturday, and Sunday.

Table 3 shows the median values for each of the days and the p-value for paired differences in test (Q1) and retest (Q2).

Table 3. Median values of test and retest and respective Wilcoxon's test p-value.

Pre-PAQ (Mins/d)	**Weekday**			**Saturday**			**Sunday**		
	Mdn (IQ)		***p***	**Mdn (IQ)**		***p***	**Mdn (IQ)**		***p***
	Q1	**Q2**		**Q1**	**Q2**		**Q1**	**Q2**	
Levels 1-2	60 (127.5)	60 (92.5)	0.3	60 (115.0)	60 (70.0)	0.09	60 (120.0)	60 (120.0)	0.34
Level 3	55 (73.5)	60 (77.5)	0.94	75 (110)	70 (105)	0.89	60 (102.5)	50 (90)	0.89
Level 4	80 (136.5)	60 (105)	0.29	110 (264)	90 (165.5)	0.30	125 (232.5)	80 (205)	0.07
Level 5	0 (40)	0 (35)	0.59	0 (35)	0 (32.5)	0.83	0 (32.5)	0 (30)	0.62

Mdn – Median; IQ – Interquartile range
Q1 – test phase; Q2 – retest phase.

We did not find significant differences between test and retest phases for any of the PA levels, on weekday, Saturday and Sunday ($p>0.05$). Furthermore, we also did not find differences in test and retest median values when considering different educational groups, relation with child, age of participant, and marital status ($p>0.05$).

Some variation in our data may have been due to the normal discrepancies caused by the time between questionnaire administrations. Items that assess data that varies with the normal development of daily life are expected to change between test and retest

answers to the questionnaire, such as time spent in a car, for example. Furthermore, some variation in PA may have occurred due to changes in weather conditions. In the retest questionnaire fulfilment, some parents report that the weather was not appropriate for outside play, while during the first questionnaire fulfilment all parents report good weather to play outside (Table 4).

Table 4. Responses to the question "What was the weather like yesterday?"

Section and item	Q1	Q2
Fine to play outdoors	46 (100)	41 (89.1)
Too wet to play outdoors	-	4 (8.7)
Too hot or humid to play outdoors	-	1 (2.2)
Too cold to play outdoors	-	-

Q1 – test phase; Q2 – retest phase. Data presented as n (%).

DISCUSSION

In the present study, we aimed at describing the adaptation and validation process of the Portuguese version of the Pre-PAQ to address the lack of available tools to assess PA in Portuguese preschool children in their home environment within a socio-ecologic framework perspective.

Our results generally indicate that the Pre-PAQ translation is considered reliable. The inexistence of statistical differences in PA estimates according to the different socio-demographic variables allows us to infer that our translation of the Pre-PAQ constitutes a tool that can be used to monitor children from different social classes and with parents from different educational backgrounds.

PAQ's are often the most feasible method when assessing PA in large-scale studies, likely because of their low cost and convenience (7). The Pre-PAQ was translated for researchers interested in understanding PA of preschool children living in Portugal or other Portuguese speaking countries (with cultural adjustments whenever pertinent),

reporting information about potential influences on the child's activity behavior, including parental, family and neighborhood factors. However, it is important to recognize the limitations of our study, regarding the small sample size, and the limited generalizability concerning socio-demographic characteristics. A further limitation of this study is that our sample of participants was composed mainly by individuals with an undergraduate degree or above, which can constitute a bias in the translation of our results for participants that are less schooled.

Concerning the Pre-PAQ, as an instrument of assessment of preschool children's PA in their home environment, it's important to highlight that this questionnaire allows only to report the PA of three days spent in the family environment, the last weekday and a weekend (Saturday and Sunday) the family spent together, not necessarily on consecutive days. Thus, this tool does not allow for the record of information on PA accomplished during actual preschool time. Furthermore, the exhaustive way the tool gathers data on different physical activities, with respective time duration, it may be uninviting to be filled in by caregivers, which could pose problems regarding the complete and correct completion of the questionnaire.

Our work was only focused on the questionnaire's reliability. Therefore and its usefulness for assessing PA of Portuguese preschool children must also include a criterion validity assessment, which we plan for future research. Despite more frequent use of objective assessment methods to measure PA, Pre-PAQ is a tool that provides a practical method for PA assessment in surveillance systems, reporting data on home environment characterization in a particular socio-ecological framework, leading to a further understanding of the PA determinants, which bear influence on active and SB, crucial when planning intervention policies.

CONCLUSIONS

The assessment of PA in children is important for examining lifestyle behaviors that can influence health and nutritional status, hence childhood overweight/ obesity risk. The measurement of PA is a challenging and complex procedure, but in regard to the assessment of preschool children PA by a proxy questionnaire, our data support the hypothesis that the Pre-PAQ is a reliable, inexpensive tool, available for further use in research. The test-retest reliability of Pre-PAQ translated version support the questionnaire's psychometric properties, thereby leading to achieving a valid Portuguese tool to assess preschool PA and SB, including concomitantly measures of parental, family and neighborhood influential factors, crucial when planning intervention policies.

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Author Contributions

TS, SV and PM gave contributions to the conception and the design of the study. TS prepared the translation of the Pre-PAQ into Portuguese. TS carried out the data collection. TS, EP and analyzed and interpreted the data. All authors were involved in drafting the manuscript and critically revised its content.

Conflicts of Interest

The authors declare no conflict of interest.

REFERENCES

1. **Altman DG.** Inter-rater agreement. In: *Practical Statistics for Medical Research*, edited by Hall/CRC C. London: Chapman & Hall/CRC, 1991.
2. **Colley RC, Garriguet D, Adamo KB, Carson V, Janssen I, Timmons BW, and Tremblay MS.** Physical activity and sedentary behavior during the early years in Canada: a cross-sectional study. *Int J Behav Nutr Phys Act* 10, 2013.
3. **De Bock F, Fischer JE, Hoffmann K, and Renz-Polster H.** A participatory parent-focused intervention promoting physical activity in preschools: design of a cluster-randomized trial. *BMC Public Health* 10, 2010.
4. **De Craemer M, De Decker E, De Bourdeaudhuij I, Vereecken C, Deforche B, Manios Y, Cardon G, and ToyBox-study G.** Correlates of energy balance-related behaviours in preschool children: a systematic review. *Obesity Reviews* 13: 13-28, 2012.
5. **Dwyer GM, Hardy LL, Peat JK, and Baur LA.** The validity and reliability of a home environment preschool-age physical activity questionnaire (Pre-PAQ). *Int J Behav Nutr Phys Act* 8, 2011.
6. **Fulton JE, Burgeson CR, Perry GR, Sherry B, Galuska DA, Alexander MP, Wechsler H, and Caspersen CJ.** Assessment of physical activity and sedentary behavior in preschool-age children: priorities for research... including commentary by Pangrazi RP and Pate R. *Pediatric Exercise Science* 13: 113-130, 2001.
7. **Helmerhorst HJF, Brage S, Warren J, Besson H, and Ekelund U.** A systematic review of reliability and objective criterion-related validity of physical activity questionnaires. *Int J Behav Nutr Phys Act* 9, 2012.
8. **Hesketh KR, McMinn AM, Ekelund U, Sharp SJ, Collings PJ, Harvey NC, Godfrey KM, Inskip HM, Cooper C, and Sluijs EMFv.** Objectively measured physical activity in four-year-old British children: a cross-sectional analysis of activity patterns segmented across the day. *Int J Behav Nutr Phys Act* 11, 2014.
9. **Hills AP, King NA, and Armstrong TP.** The Contribution of Physical Activity and Sedentary Behaviours to the Growth and Development of Children and Adolescents: Implications for Overweight and Obesity. *Sports Medicine* 37: 533-546, 2007.
10. **Hills AP, Okely AD, and Baur LA.** Addressing childhood obesity through increased physical activity. *Nat Rev Endocrinol* 6: 543-549, 2010.
11. **Hinkley T, Salmon JO, Okely AD, Crawford D, and Hesketh K.** Preschoolers' Physical Activity, Screen Time, and Compliance with Recommendations. *Medicine & Science in Sports & Exercise* 44: 458-465, 2012.
12. **Huang JS, Sallis J, and Patrick K.** The role of primary care in promoting children's physical activity. *British Journal of Sports Medicine* 43: 19-21, 2009.
13. **Li Ming W, Van der Ploeg HP, Kite J, Cashmore A, and Rissel C.** A Validation Study of Assessing Physical Activity and Sedentary Behavior in Children Aged 3 to 5 Years. *Pediatric Exercise Science* 22: 408-420, 2010.

14. **Malina RM.** PHYSICAL ACTIVITY AND HEALTH OF YOUTH. *Ovidius University Annals, Series Physical Education & Sport/Science, Movement & Health* 10: 271-277, 2010.
15. **McIver KL, Brown WH, Pfeiffer KA, Dowda M, and Pate RR.** Assessing children's physical activity in their homes: The Observational System for Recording Physical Activity in Children-Home. *Journal of Applied Behavior Analysis* 42: 1-16, 2009.
16. **Oliver M, Schofield GM, and Kolt GS.** Physical Activity in Preschoolers: Understanding Prevalence and Measurement Issues. *Sports Medicine* 37: 1045-1070, 2007.
17. **Pate RR, O'Neill JR, and Mitchell J.** Measurement of physical activity in preschool children. *Medicine and Science in Sports and Exercise* 42: 508-512, 2010.
18. **Penhollow TM and Rhoads KE.** Preventing Obesity and Promoting Fitness: An Ecological Perspective. In: *American Journal of Lifestyle Medicine*, 2014, p. 21-24.
19. **Rosenberg DE, Sallis JF, Kerr J, Maher J, Norman GJ, Durant N, Harris SK, and Brian ES.** Brief scales to assess physical activity and sedentary equipment in the home. *International Journal of Behavioral Nutrition & Physical Activity* 7: 10-20, 2010.
20. **Skouteris H, Dell'Aquila D, Baur LA, Dwyer GM, McCabe MP, Ricciardelli LA, and Fuller-Tyszkiewicz M.** Physical activity guidelines for preschoolers: a call for research to inform public health policy. *Medical Journal of Australia* 196: 174-176, 2012.
21. **Troiano RPy.** Can there be a single best measure of reported physical activity? *American Journal of Clinical Nutrition* 89: 736-737, 2009.
22. **Tucker P.** The physical activity levels of preschool-aged children: A systematic review. *Early Childhood Research Quarterly* 23: 547-558, 2008.
23. **Vale S, Silva P, Santos R, Soares-Miranda L, and Mota J.** Compliance with physical activity guidelines in preschool children. *Journal of Sports Sciences* 28: 603-608, 2010.
24. **World Medical Association.** Declaration of Helsinki, 2013.

5.3. Study III

Nutritional status, dietary intake, physical activity and socio economic status of preschool children in Southern Portugal

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Nutritional status, dietary intake, physical activity and socio economic status of preschool children in Southern Portugal

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Abstract

Objective: This paper aimed to report the nutritional status, dietary intake, physical activity and socio economic status of a preschool sample from Faro.

Methods: The study comprised 211 children, aged 3 to 6. Body mass index (BMI) was categorized using BMI z-score according to the World Health Organization growth reference, and statistical associations were performed with two BMI categories, under/normal weight and overweight/obesity. Physical activity was reported by parents and pedometers use. Dietary intake was obtained by food records. Socio-economic status was reported by parents.

Results: Prevalence of overweight/obesity was 23.7%, without differences between sexes. Vegetables, fruit and water were insufficiently consumed, whereas sugar-sweetened beverages, sweets and pastries were excessively consumed. Approximately a third and about half of children met guidelines, regarding total physical activity and moderate-vigorous physical activity, respectively. Most children, with more boys in compliance, met the steps/day recommendations, on weekdays, and with overweight/obese children having more steps on weekend days.

Conclusion: No associations were found between BMI categories and sex, dietary intake or socio-economic status. Parental reports lead to a lower physical activity compliance compared to steps obtained by pedometers. Consumption of vegetables, fruit and water, and physical activity must be reinforced.

Key words: preschool children; nutritional status; dietary intake; physical activity

Introduction

Unprecedented increases in the prevalence of child obesity in most age groups and in most regions of the world have been recorded (Lobstein 2010). Overweight and obesity are serious public health challenges (Karnik and Kanekar 2012), triggered by rapid changes in lifestyles that have occurred in the last decades, namely in dietary intake (DI), physical activity (PA) and sedentary patterns (WHO2014).

Regarding preschool children, a high prevalence of overweight and obesity has recently been observed in middle and high income countries, among both the well-off and the lower income segments of the population, in either rural and urban areas, regardless of ethnic and racial groups (Quelly and Lieberman 2011). In the USA, where obesity has been studied longer, obesity increased from 5,0% to 12,1% between 1976–1980 and 2009–2010 among preschool children aged 2 to 5 (Fryar, Carroll, and Ogden 2012; Ogden et al. 2012), but between 2009-2010 and 2011-2012 there was a significant decrease in obesity to a figure of 8,4% (Ogden et al. 2014). In Europe, a prevalence of overweight plus obesity at 4 years of age ranged from a minimum of 11.8% in Romania to a maximum of 32.3% in Spain, with the highest rates being reported in Mediterranean countries (Cattaneo et al. 2010).

In Portugal, there is no surveillance initiative to monitor the prevalence trend in preschoolers. Only a few studies on overweight and obesity prevalence in preschool children have been conducted to date, indicating a range between 23.6%, IOTF criteria (Rito 2006) and 36.1%, CDC criteria (Gomes et al. 2010), in total. A comprehensive and detailed assessment of the magnitude of obesity is an essential component of an effective response to address the problem (Rito et al. 2012). To our best knowledge, no study on nutritional status or obesity prevalence of preschool children in the Algarve region has been performed to date. Furthermore, data on diet and PA, two key factors in weight management, are even scarcer when referring to these ages. This information is vital for the outlining of effective interventions to tackle obesity from the first years of life onwards.

Contextualizing the region, the Algarve is specifically characterized by having a culinary identity marked by the Mediterranean diet of southern Portugal, and by the presence of the Atlantic Ocean, adding the practices of food consumption in meaningful social interactions (conviviality and sharing), often in a familiar

environment, widely regarded as a characteristic of a health-promoting lifestyle (Valagão 2014). This study aimed to report the nutritional status, DI, PA and SES of a preschool population from Southern Portugal, located in the Faro municipality, in the Algarve region.

Methods

Study Design

This study was carried out between October and November 2013, in all public preschools existing in the Faro Municipality (n=5), covering 11 classes, which were invited to participate through the Algarve Regional Education Authority. The participating children's parents received verbal explanation and written information about the study by the research coordinator. Prior to participating on data collection, the parents provided informed consent, according to the ethical standards defined by the Declaration of Helsinki (WMA2013). This study was approved by the Scientific Council of the Faculty of Sports of Porto University. Ethical approval was achieved from the local Health Ethical Committee of the Algarve Regional Health Administration of the Ministry of Health, and approval was also granted by the Portuguese Data Protection Authority (CNPD - Comissão Nacional de Proteção de Dados, Process Nr. 6263/2013). In addition, permission from the Ministry of Education for the implementation of school surveys was obtained through registration Nr. 0399500001. Further agreement was attained from the Algarve Regional Education Authority and the School Boards. Data collection occurred with the anthropometric assessments performed at the schools and the questionnaires filled out by parents at home. Pedometers were used in both preschool and home environments.

Participants

Participants were recruited in the five public preschools existing in the Faro municipality, located in urban, semi-urban and rural settings. The parents of all the children were contacted (n=249). Out of these, the parents of 215 children provided written informed consent (86%), of which four were excluded due to health problems (two with Gaucher disease, one with global development delay, and one due to long

illness). Therefore, the population studied comprised 211 participants, aged 5.3 (±0.5) years, of which 108 are girls (51.2%).

Data collection

Anthropometric measures

In order to obtain anthropometric data, all children were assessed under the same conditions, with the same equipment and by the same trained researchers to minimize inter-observer error, using a standardized procedure (WHO2008). Height and weight were determined wearing light clothes and no shoes. Height was measured in meters, to the nearest millimeter using a portable stadiometer (Seca® model 214), with the head in the Frankfort plane. Weight was measured in kilograms, to the nearest decigram, and body composition, expressed in fat mass percentage, were both analyzed using a digital device with tetra polar single frequency (Tanita® model BC 418). Height and weight measures were converted into BMI, expressed in kg/m^2, for each participant. BMI was standardized for age and sex, and specific prevalence of underweight, normal, overweight and obesity was determined using BMI z-score according to the World Health Organization (WHO) Growth Reference, with overweight defined as BMI z-score ≥ 1 and obesity defined as BMI z-score ≥ 2 (de Onis et al. 2007). Waist circumference was measured in centimeters, directly on the skin, midway between the lower margin of the last palpable rib and the top of the iliac crest, (WHO2011), with an accuracy of 5mm, using a flexible and non-elastic measuring tape (Seca® model 201). The average of two measurements was used for height and waist circumference, and when there was disagreement between these measures (>0.5cm for height or >0.3cm for waist), a third measurement was recorded.

Dietary intake

DI was obtained through a 3-day food record (2 weekdays and 1 weekend, when possible). Parents or caregivers were instructed to record information in the diary provided regarding all foods and beverages consumed by their child (reporting the brand name if applicable) and the respective amount (in grams, units or household measures). In order to convert foods into nutrients, the software Food Processor SQL® version (2004-2005 ESHA Research, Salem, Oregon) was used,

which is based on the Food Composition Table of the United States of America Department of Agriculture. For typically Portuguese foods or culinary dishes, new codes were created with national nutritional information. Dietary Reference Intakes (DRIs) for children aged 4 to 8 were used to analyze the adequacy for energy, macronutrients and dietary fiber intake, and the estimated energy requirement (EER) was calculated by the same DRIs (NAS2005). Regarding food intake, seven main food groups were defined: (1) total vegetables (cabbage, spinach, broccoli, lettuce, peppers, tomatoes, cucumbers, onions, carrots, etc.); (2) vegetable soup; (3) fruit (fresh fruit, including tropical fruit); (4) sweets and pastries (biscuits apart from simple ones, croissants, doughnuts, cakes, chocolates, chocolate snacks, quince jam, jam, jelly, honey, sugar, candy); (5) energy dense snack foods (crisps and other fried snacks, patties, croquettes and other savory pastry products) (6) sugar-sweetened beverages (cola, ice tea and sodas) and (7) water (including herbal infusions).

Still considering the number of days in the food records, half of the participants (53.4%) only recorded one day, 4.6% recorded two days and 42% recorded three days. In our sample, participants with different number of recording days were compared and there were no differences regarding the dietary intake, even in the participants with at least 1-day of food record stated, given that a repeated-measures ANOVA showed that DI was similar ($p>0.05$), regardless of the number of days of food records. This dietary information referred to a total of 174 participants (proportion ratio: 82.5%), 93 girls (53.4%) and 81 boys (46.6%).

Physical activity

The children's PA was subjectively measured using the *Preschool-age Children's Physical Activity Questionnaire* (Pre-PAQ) (Dwyer et al. 2011), estimating different levels of PA from a socio-ecologic perspective, in the child's home environment, corresponding to the 3-day period (a weekday, Saturday and Sunday) when the child was at home with his/her parent or caregiver, not necessarily on consecutive days. The reliability study for the Pre-PAQ translation was performed by us (unpublished data). Pre-PAQ presents PA data in a 3-day mean (min/day) with five progressive levels: (1) completely stationary, (2) stationary but moving a limb or the trunk, (3) moving slowly, (4) moving at a moderate pace, or (5) moving quickly. Levels 1 and 2 correspond to sedentary behavior (SB), level 3 corresponds to low

physical activity (LPA), level 4 corresponds to moderate physical activity (MPA), level 5 corresponds to vigorous physical activity (VPA), levels 4 and 5 correspond to moderate-vigorous physical activity (MVPA), and levels 3, 4 and 5 correspond to total physical activity (TPA). This subjective PA information was obtained through 179 questionnaires filled out by the parents of 93 girls (52.0%) and 86 boys (48.0%), although not all the domains had always been completely filled out, particularly with regard to the duration of the activities.

Daily PA was objectively measured using a pedometer (Kenz Lifecorder® model PLUS, Japan), for five or more consecutive days, which included at least one day of weekend monitoring, with a minimum of valid eight hours of daily steps records. Proceeding to an analysis of variance (ANOVA), we did not find differences between the mean number of steps in five, six or more days of record ($F=0.659$, $p=0.580$), which allowed us to use all data to further assess the participants' PA. This objective information on PA was obtained through 90 children assessed with pedometers, 44 girls (48.9%) and 46 boys (51.1%). Pedometer data were downloaded with specific software (PAAS Lifestyle Coach®), and interpreted according to the cut point of 9000 steps per day as the required compliance with recommendations for TPA and MVPA in preschool children (Vale et al. 2014). Thus, children were classified as either meeting the minimum of steps per day (category >9000: sufficiently active) or not meeting them (category ≤9000: insufficiently active).

Socio-economic status

SES data were assessed with the study questionnaire filled out by parents, about family characteristics, mother's and father's education and occupational levels, watching TV profile, and sleep characteristics. The parents' education level was defined according to the Portuguese Educational System, in three categories: basic or less (≤9 school years), secondary (10–12 school years) and college/university (>12 school years). The parents' occupation level was organized in ten categories according to the standard Portuguese method of classifying occupations (INE2011), having subsequently been re-coded into four categories (1 to 4), 4 being the highest level, beyond the status of unemployed. Thus, the SES was basically analyzed from father and mother education and occupation.

Statistical analysis

The participants' descriptive variables were presented as mean values and standard deviations, or as absolute (n) or relative frequency (%). Frequencies were computed considering the total number of valid observations in each pertaining variable.

The Kolmogorov-Smirnov test was used to assess adherence to the Normal distribution and, accordingly, parametric or non-parametric statistical procedures were used to compare groups. For comparisons between two groups, Student's t-test or Mann-Whitney test were computed, while a one-way analysis of variance (ANOVA) was used for multiple group comparisons, when applicable.

Wilcoxon's signed rank test and Friedman's test were used to compare variables that were assessed more than once, which led to using statistical procedures for paired samples. In the instances where correlation coefficients were computed, Pearson's correlation coefficient was used when all variables had Normal distribution. In all other situations, we used Spearman's correlation coefficient.

BMI z-scores were calculated using the WHO Anthro software (version 3.2.2, January 2011) and statistical associations were performed with two BMI categories, under/normal weight (NOW) and overweight/obesity (OW). The statistical procedure for analyzing the differences between participants in categorical variables was the chi-square test. Considering there were few underweight children in our study, we defined two BMI categories to perform the statistical associations, the non-overweight and the overweight (including obese) children. Differences between BMI categories and steps categories were computed with Fisher's exact test. Whenever possible, the results were interpreted after adjustment for sex and SES using an analysis of covariance (ANCOVA) and the adjusted p-value is reported. Statistical significance in all procedures was determined by two-tailed analysis considering a p-value below 0.05. Data were analyzed using IBM-SPSS® software version 21.0 (SPSS Inc., Chicago, IL, USA).

Results

The participants´ characteristics regarding sex, age and anthropometrics are presented in **Table 1**. According to the Chi-Square Goodness-of-Fit Test, the sex distribution of participants was similar (51.2% girls vs. 48.8% boys, p=0.731).

Regarding age, 69.2% of the children were 5 years of age, 24.6% were 4 years of age, 5.7% were 6 years of age, and one child (0.5%) was 3 years of age (data not shown).

Table 1. Age and anthropometric characteristics by sex.

	Total n=211	**Girls n=108**	**Boys n=103**	***p****
Age (years)	5.3 (0.5)	5.3 (0.5)	5.4 (0.5)	**0.037**
Weight (kg)	19.9 (3.5)	19.4 (3.6)	20.4 (3.4)	**0.032**
Height (cm)	111.8 (5.4)	110.7 (5.4)	112.9 (5.1)	**0.002**
BMI (kg/m^2)	15.8 (1.8)	15.8 (1.8)	15.9 (1.7)	0.396
BMI z-score	0.29 (1.1)	0.20 (1.0)	0.35 (1.1)	0.374
Waist circumference (cm)	52.4 (4.1)	51.7 (4.2)	53.2 (3.9)	**0.003**
Fat mass (%)	19.7 (3.5)	20.5 (3.4)	18.8 (3.4)	**≤0.001**

Data presented as mean (standard deviation).

**p* value for differences between sexes computed with Mann-Whitney's test.

In our study, the boys were older, and had a higher weight, height, and waist circumference ($p<0.05$), whereas the girls had a higher percentage of fat mass. However, the mean BMI z-score were similar for boys and girls ($p<0.001$).

According to the WHO growth reference, the prevalence of underweight was 2.4%, normal was 73.9%, overweight was 13.3%, obesity was 10.4%, and OW was 23.7%. BMI was also shown to be statistically similar between boys and girls ($p = 0.101$).

The description of the subjects' energy and nutrients intake is presented in **Table 2**. Mean total energy intake (TEI) was 1535 kcal (SD=303) without significant differences between sexes ($p=0.479$). Regarding the macronutrients, from TEI, 52.7% was total carbohydrates (22.6% of sugars), 28.1% was fat and 19.0% was protein, and no significant differences were found between boys and girls. Mean dietary fiber was 16.0 g, also similar between sexes. Furthermore, **Table 2** describes the subjects' food items intake, wherein no significant differences between sexes were found.

Analyzing data with only two BMI categories, corresponding to NOW and OW children, we did not find statistical differences between groups regarding energy, nutrients or food items intake, after adjustment for sex and SES.

Table 2. Nutritional and dietary intake by sex.

	Total n=174	Girls n=93	Boys n=81	*p**
Energy and nutrients				
Energy (kcal)	1534.6 (303.2)	1525.5 (335.5)	1544.9 (262.9)	0.479
Protein (g)	72.2 (15.7)	70.9 (16.3)	73.8 (14.9)	0.448
Protein (%TEI)	19.0 (3.1)	18.8 (3.3)	19.2 (2.9)	0.635
Total carbohydrates (g)	201.2 (41.6)	201.7 (45.5)	200.5 (36.9)	0.998
Total carbohydrates (%TEI)	52.7 (6.3)	53.2 (6.4)	52.2 (6.1)	0.695
Sugars (g)	86.0 (23.6)	87.5 (24.1)	84.3 (23.1)	0.233
Sugars (%TEI)	22.6 (5.0)	23.3 (4.9)	21.9 (5.0)	0.311
Total fat (g)	48.9 (15.8)	48.3 (17.1)	49.5 (14.2)	0.639
Total fat (%TEI)	28.1 (5.7)	27.8 (5.8)	28.4 (5.5)	0.587
Dietary fiber (g)	16.0 (6.1)	16.3 (6.8)	15.6 (5.3)	0.610
Food groups				
Total vegetables (g)†	57.6 (45.7)	58.5 (44.0)	56.7 (47.6)	0.233
Vegetable soup (g)	212.7 (156.5)	216.1 (162.8)	208.7 (149.9)	0.655
Fruit (g)	184.2 (107.0)	192.6 (122.3)	174.5 (85.9)	0.316
Total vegetables and fruit (g)	254.0 (127.2)	260.5 (142.0)	246.5 (108.1)	0.224
Sweets and pastries (g)	42.1 (34.8)	42.5 (37.5)	41.7 (31.7)	0.562
Energy dense snack foods(g)	3.0 (11.9)	3.6 (11.8)	2.3 (12.0)	0.302
Sugar-sweetened beverages (g)	87.6 (124.6)	67.2 (103.6)	110.9 (142.1)	0.096
Water (g)	165.7 (146.9)	164.4 (144.3)	167.3 (150.7)	0.904

Data presented as mean (standard deviation) or % (standard deviation).

**p* value for differences between sexes was adjusted for SES and total energy intake.

†Including vegetables soup.

As subjective measurement of PA, data were reported by parents, according to Pre-PAQ, in a 3-day mean (min/day), regarding different PA intensity levels. Concerning the different PA intensity levels, mean differences between sexes were not significant, except for VPA with boys reported as being more active than girls, after adjustment for SES (p=0.036). With respect to MVPA intensity we found a mean time of 86.8 min/day, being in compliance with recommendations 47.3% of girls and 53.5% of boys. When considering TPA, we found, on average, 136.6 min/day, being in compliance with recommendations 31.2% of girls and 40.7% of boys (**Table 3**).

Regarding the time of PA intensity levels by weekday, Saturday, and Sunday, significant differences were found, with weekdays having a lower mean in time of LPA (p=0.010), MPA (p=0.019) and VPA intensity levels (p<0.001), when comparing weekday with both Saturday and Sunday, but not between Saturday and Sunday.

The mean time of TPA on weekdays was 111 min/day, while the TPA mean times were 147 min/day and 154 min/day, on Saturday and Sunday, respectively.

When comparing the distribution of 3-day mean time spent in PA intensity levels between two BMI categories, we didn't find any significant difference, after adjusting for sex and SES.

Table 3. Physical activity intensity levels (3-day mean), by sex.

Physical activity levels	Total n=179	Girls n=93	Boys n=86	*p**
SB (min/day)*	86.4 (83.8)	84.7 (83.8)	88.2 (84.1)	0.467
LPA (min/day)*	50.2 (69.4)	41.2 (54.3)	59.5 (81.3)	0.061
MPA (min/day)*	69.7 (78.6)	65.0 (78.4)	74.6 (79.0)	0.311
VPA (min/day)*	16.7 (29.6)	12.3 (25.8)	21.3 (32.6)	**0.036**
MVPA (min/day)*	86.8 (96.6)	77.9 (91.6)	96.1 (101.1)	0.130
TPA (min/day)*	136.6 (145.0)	118.4 (131.6)	155.4 (155.9)	0.052
MVPA (≥ 60 min/day)**	90 (50.3)	44 (47.3)	46 (53.5)	0.330
TPA (≥ 180 min/day)**	64 (35.8)	29 (31.2)	35 (40.7)	0.120

Data presented as mean (standard deviation)*, and n (%)**.

**p* value adjusted for SES.

In order to objectively assess PA, we performed a step count with pedometers used by a sub-sample of 90 children's participants (proportion ratio: 42.7%), 51.1% boys. The mean number of hours for step recording was 11.6h (SD=1.21h), similar between girls and boys (p=0.714) and between both BMI categories (p=0,997). In **Table 4**, we can observe that the mean total steps was 11564.2 (SD=2401.9) for weekdays and weekend days combined. Nonetheless, total mean steps were higher for boys than for girls, both on weekdays (p=0.001), and in total steps/day (p=0.001). Regarding the steps categories, using a cut point placed at 9000 steps, we found a significant difference between sexes on weekdays, with more boys in compliance with the recommendations (p=0.037), although with no difference on weekend days or total days. When analyzing differences in steps through two WHO categories for BMI, corresponding to NOW and OW children, we noticed that OW children registered more steps on weekend days (p=0.044) than NOW children. Regarding the steps categories between both BMI categories, we did not find significant differences, after adjustment for sex and SES (**Table 4**).

Table 4. Steps and steps categories by sex, BMI categories, on weekdays and weekend days.

Steps by sex*		**Total n=90**	**Girls n=44**	**Boys n=46**	***p****
Total		11564.2 (2401.9)	10796.3 (2324.6)	12298.7 (2262.3)	**0.001**†
Weekdays		11782.2 (2596.8)	10909.1 (2597.4)	12617.5 (2330.6)	**0.001**†
Weekend days		10857.4 (3343.7)	10471.4 (2987.3)	11226.7 (3646.8)	0.189†
Steps categories by sex**			**Girls n=44**	**Boys n=46**	***P***‡
Total	≤ 9000 steps		9 (20.5)	4 (8.7)	0.140†
	> 9000 steps		35 (79.5)	42 (91.3)	
Weekdays	≤ 9000 steps		10 (22.7)	3 (6.5)	**0.037**†
	> 9000 steps		34 (77.3)	43 (93.5)	
Weekend days	≤ 9000 steps		17 (38.6)	15 (32.6)	0.661†
	> 9000 steps		27 (61.4)	31 (67.4)	
Steps by BMI categories*			**Non-overweight n=69**	**Overweight and obese n=21**	***p***‡
Total			11361.6 (2708.8)	12336.4 (2351.1)	0.645†
Weekdays			11622.6 (2919.5)	12464.8 (2615.8)	0.885†
Weekend days			10388.0 (3150.5)	12575.7 (3845.3)	**0.044**†
Steps categories by BMI categories**			**Non-overweight n=69**	**Overweight and obese n=21**	***P***‡
Total	≤ 9000 steps		11 (15.9)	2 (9.5)	0.849††
	> 9000 steps		58 (84.1)	19 (90.5)	
Weekdays	≤ 9000 steps		11 (15.9)	2 (9.5)	0.832††
	> 9000 steps		58 (84.1)	19 (90.5)	
Weekend days	≤ 9000 steps		27 (39.1)	5 (23.8)	0.713††
	> 9000 steps		42 (60.9)	16 (76.2)	

Data presented as mean (standard deviation)*****, and n (%)******.

† p value for differences between sexes was computed with Student's t-test.

†† p value for group differences computed with Fisher's exact test.

‡ Adjusted for sex and/or SES.

Regarding the SES, additional data not shown, suggest that the children's BMI z-score were not correlated with either mother's (r=-0.046, p=0.546) or father's (r=-0.057, p=0.478) education level. According to an analysis of variance (ANOVA), mean BMI z-score was also statistically similar, regardless of father's (F(4)=0.921, p=0.395) or mother's (F(4)=0.322, p=0.863) occupation. Additionally, when analyzing differences in BMI z-score according to different categories of school social benefits attributed to children, we did not find significant differences between groups either (p>0.05).

Discussion

This is the first study performed with preschool children in Southern Portugal, reporting the respective baseline nutritional status, DI, PA and SES. Furthermore, it

is also the first Portuguese study that presents prevalence data regarding the WHO growth reference (de Onis et al. 2007).

According to the WHO growth reference, adopted by the Portuguese Ministry of Health, since 2013, our data showed that 2.4% of preschool children were underweight, 73.9% were normal weight, 13.3% overweight and 10.4% obese. No statistical differences were found between boys and girls (p=0.101), although rates are generally higher in girls than in boys, either in Portuguese studies (Vale et al. 2011; Gomes et al. 2010) or in international studies (Cattaneo et al. 2010; Quelly and Lieberman 2011). We did not found statistical differences in age distribution in our population according to BMI categories (p=0,500) or BMI Z-score (p=0,532) like Cattaneo study (2010), although Vale (2011) has identified girls showing higher OW prevalence when they got older.

In Portugal, only a few studies on overweight and obesity prevalence in preschool children have been conducted to date. To our best knowledge, and according to available data in this age group, the prevalence of underweight ranged from a minimum of 2.6%, IOTF criteria (Vale et al. 2011), to a maximum of 5.5%, CDC criteria (Aparício et al. 2013); the prevalence of overweight ranged from a minimum of 13.6%, CDC criteria (Lourenço, Santos, and do Carmo 2014) to a maximum of 25.4%, CDC criteria (Gomes et al. 2010); the prevalence of obesity ranged from a minimum of 6.7%, IOTF criteria (Rito 2006), to a maximum of 17.4%, CDC criteria (Aparício et al. 2013). Another study presents an intermediate prevalence in preschool children, with 23.7% of overweight and 9.4% of obesity (Vale et al. 2011).

With reference to overweight and obesity in the population of our preschool children, this study shows a slightly lower prevalence than described in studies on other regions of Portugal, although with a possible lack of rigor by using different criteria. Moreover, these data are in line with previous studies comparing prevalence between regions of Portugal, highlighting the Algarve as having the lowest rate in the prevalence of child obesity (Rito et al. 2012; Rêgo et al. 2013).

As far as DI is concerned, for both girls and boys, mean TEI was 99.3% of EER, 101.9% for girls and 97.0% for boys, which is practically similar to the recommended EER. The distribution of percentage ranges for carbohydrates (52.7% in 45–65), fat (28.1% in 25–35) and protein (19.0% in 10–30) is also

acceptable, thus meeting the DRI (NAS2005) and being consistent with what would be expected in developed countries, also in line with a recent Portuguese study (Lopes et al. 2014). Nevertheless, according to the adequate intake for this age range, fiber intake was about two thirds (64.0%) the recommended amount for this age group, 25g/day (NAS2005), and sugars (22.6% of TEI) were over twice the recommended amount (10% of TEI). Concerning mean intake of food groups, we found statistically similar results between sexes, with vegetables, fruit and water being insufficiently consumed, whereas sugar-sweetened beverages, sweets and pastries were excessively consumed, whose data are very similar to the study of Lopes (2014).

According to the parents' report, no statistical significant differences between sexes were found in mean time spent in different PA intensity levels, except for VPA, with boys engaging, on average, more minutes in it than girls, in line with other studies (Vale et al. 2013; Hinkley et al. 2012). Concerning the international recommendations of at least 180 minutes of TPA accumulated daily, including 60 minutes of MVPA, (Australian Government2012; CSEP2011; UK Government2011), the guidelines were met by approximately a third of children engaged in TPA and about half of children involved in MVPA, without differences between sexes, although another recent Portuguese study had found a higher prevalence of children meeting the PA recommendations with boys in great compliance for MVPA (Vale et al. 2013). Comparing PA between weekdays and weekend days, regarding time spent in a family environment, for any intensity level, PA on weekdays was lower than on weekend days, despite significant differences between Saturday and Sunday not having been found. Regarding mean time of any PA intensity level, spent in family environment, through the two BMI categories, the parents did not report significant differences between NOW and OW children.

In PA assessed with pedometers, is well established that preschool-aged children should accumulate at least 9000 steps per day to meet the recommendation of at least 3 h of total PA per day (Vale et al. 2014), allowing us to conclude that 85.6% of our population was sufficiently active, whereas Vale (2014) met a compliance much lower (28.9%). When considering the steps categories, no differences between BMI categories were found, but on weekdays, more boys (43%) were in compliance with the steps recommendations than girls (34%), being

this sex difference consistent with Vale (2014). In addition, it should be highlighted that, on weekend days, children with more recorded steps were OW. We can thus speculate that the use of the pedometer may have probably stimulated the family to promote the practice of PA in children who, by their weight status, are usually encouraged to be more active.

Results from DI and PA related to BMI categories, must be cautiously observed. In fact, no statistical association between the two BMI categories and DI was found. However, overweight and obese children counted more steps on weekend days. Yet, the problems raised by the self-reported data collection regarding the dietary food records and the questionnaires filled out by parents, may lead to bias triggered by social desirability (Mindell, Coombs, and Stamatakis 2014). Furthermore, the reverse causality, especially observed in cross-sectional analyzes can be an important source of bias, when changing characteristics in lifestyle are not enough to impact on weight status (Hu 2008), which could explain why OW children are associated with more steps.

As to SES, no association was found between BMI categories and levels of education or occupation for both mother and father, against what is commonly described in other studies (Han, Lawlor, and Kimm 2010; Brophy et al. 2009; Dubois and Girard 2006), probably due to the limited size of our population. Furthermore, the same results were found when analyzing the different categories of school social benefits attributed to children by the Portuguese Ministry of Education.

The present study has important strengths that should be acknowledged. All children were assessed under the same conditions, with the same equipment and by two highly trained and specialized researchers in anthropometry to minimize inter-observer error. The inclusion of fat mass assessment and waist circumference enriched the anthropometric characterization of children. Additionally, evaluation through pedometers supported an objective assessment of PA. Nonetheless, our study has some weaknesses that should also be recognized. Considering that the preschool children in our study were aged 5.3 (±0.5) years the small sample of study subjects in the public preschools in the Faro Municipality restricts our having the possibility of addressing children of different ages with a proportional age distribution, given that most children were 5 years of age (69.2%), in spite of the age target range being between 3 to 6 years of age. This constraint and the small size of

the population under study, though in correspondence to the existing reality, may have limited the detection of significant differences other than those reported. Also, PA intensity levels were obtained through the parents' data report, so that under or overestimation in answers is possible. The use of Pre-PAQ as a tool of assessment of PA restricted the information to only one weekday and two weekend days spent in family environment, causing the evaluation related in preschool time be missing. Furthermore, only 42.7% (90) of children's parents authorized the use of pedometers.

Given that childhood underweight, overweight and obesity are current public health issues with several associated risk factors from childhood through to adulthood, it is crucial to further examine the situation, putting into place interventions to promote early healthy life styles, implemented by both policy-makers and health authorities.

Conclusions

The high prevalence of OW in Portuguese preschool children is of concern, mainly taking into account the tracking of childhood obesity into adult age. In our study, no association was observed between children nutritional status and parents SES. Although we observe an adequacy in energy and macronutrient intake, the dietary pattern of these preschool children's is characterized by inadequacy by excess in sugar-sweetened beverages, sweets and pastries and by default in vegetables, fruit and water. Only a third of children and about half of children met guidelines for preschoolers, regarding TPA and MVPA, respectively. Boys engaged in more minutes of VPA than girls. 85.6% of children met the steps recommendations, with more boys in compliance on weekdays. The different results obtained regarding PA, by pedometer or questionnaire, as also the increased activity reported by obese children, led to the question of reverse causality frequently observed in cross-sectional studies, namely when behavior variables are of expectancy. It is urgent to improve health professional's sensitization as also to create national health policies in order to increase healthy-behavior's early in life.

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Author Contributions

TS, PM and SV gave contributions to the conception and the design of the study. TS carried out the data collection. TS and JCR operationalized the pedometers use. TS and EzP analyzed and interpreted the data. All authors were involved in drafting the manuscript and critically revised its content.

Conflicts of Interest

The authors declare no conflict of interest.

References

Aparício, Graça, Madalena Cunha, João Duarte, Anabela Pereira, Jorge Bonito, and Carlos Albuquerque. 2013. Nutritional status in preschool children: current trends of mother's body perception and concerns. *Atencion Primaria / Sociedad Española De Medicina De Familia Y Comunitaria* 45 Suppl 2:194-200.

Australian Government: Department of Health. *Australia's Physical Activity and Sedentary Behaviour Guidelines* 2012 [cited 3 September 2014. Available from http://www.health.gov.au/internet/main/publishing.nsf/Content/health-pubhlth-strateg-phys-act-guidelines#npa05.

Brophy, Sinead, Roxanne Cooksey, Michael B. Gravenor, Rupal Mistry, Non Thomas, Ronan A. Lyons, and Rhys Williams. 2009. Risk factors for childhood obesity at age 5: analysis of the millennium cohort study. *BMC Public Health* 9:467-467.

Canadian Society for Exercise Physiology. *Canadian Physical Activity Guidelines for the early years: 0 – 4 years* 2011 [cited 3 September 2014. Available from http://www.csep.ca/english/view.asp?x=949.

Cattaneo, A., L. Monasta, E. Stamatakis, S. Lioret, K. Castetbon, F. Frenken, Y. Manios, G. Moschonis, S. Savva, A. Zaborskis, A. I. Rito, M. Nanu, J. Vignerova, M. Caroli, J. Ludvigsson, F. S. Koch, L. Serra-Majem, L. Szponar, F. van Lenthe, and J. Brug. 2010. Overweight and obesity in infants and pre-school children in the European Union: a review of existing data. *Obesity Reviews* 11 (5):389-398.

de Onis, Mercedes, Adelheid W. Onyango, Elaine Borghi, Amani Siyam, Chizuru Nishida, and Jonathan Siekmann. 2007. Development of a WHO growth reference for school-aged children and adolescents. 85 (9):660-667.

Dubois, L., and M. Girard. 2006. Early determinants of overweight at 4.5 years in a population-based longitudinal study. *International Journal of Obesity* 30 (4):610-617.

Dwyer, G. M., L. L. Hardy, J. K. Peat, and L. A. Baur. 2011. The validity and reliability of a home environment preschool-age physical activity questionnaire (Pre-PAQ). *International Journal of Behavioral Nutrition and Physical Activity* 8.

Fryar, Cheryl D., Margaret D. Carroll, and Cynthia L. Ogden. 2012. Prevalence of Obesity Among Children and Adolescents: United States, Trends 1963–1965 Through 2009–2010.

Gomes, Susana, Rosa Espanca, Ana Gato, and Cristina Miranda. 2010. Obesity in preschool age: Too Early to Be Too Heavy! *Acta Medica Portuguesa* 23 (3):371-378.

Han, Joan C., Debbie A. Lawlor, and Sue Y. S. Kimm. 2010. Childhood obesity. *The Lancet* 375 (9727):1737-1748.

Hinkley, Trina, Jo Salmon, Anthony D. Okely, Kylie Hesketh, and David Crawford. 2012. Correlates of Preschool Children's Physical Activity. *American Journal of Preventive Medicine* 43 (2):159-167.

Hu, Frank. 2008. Interpreting Epidemiologic Evidence and Causal Inference in Obesity Research. In *Obesity Epidemiology*, edited by F. Hu. New York.

Instituto Nacional de Estatística. 2011. *Classificacção Portuguesa das Profissões 2010*. Lisboa: Instituto Nacional de Estatística, IP.

Karnik, S., and A. Kanekar. 2012. Childhood obesity: a global public health crisis. *International Journal Of Preventive Medicine* 3 (1):1-7.

Lobstein, T. 2010. Prevalence and trends in childhood obesity. In *Obesity epidemiology: From aetiology to public health*, edited by D. Crawford, R. W. Jeffery, K. Ball and J. Brug. Oxford: Oxford University Press.

Lopes, Carla, Andreia Oliveira, Lisa Afonso, Teresa Moreira, Catarina Durão, Milton Severo, Sofia Vilela, Elisabete Ramos, and Henrique Barros. 2014. *Consumo alimentar e nutricional de crianças em idade pré-escolar: resultados da coorte Geração 21*. Edited by I. d. S. P. d. U. d. Porto. Porto: Instituto de Saúde Pública da Universidade do Porto.

Lourenço, Margarida, Célia Santos, and Isabel do Carmo. 2014. Nutritional status and dietary habits in preschool-age children. *Estado nutricional e hábitos alimentares em crianças de idade pré-escolar.* 4 (1):7-14.

Mindell, Jennifer S., Ngaire Coombs, and Emmanuel Stamatakis. 2014. Measuring physical activity in children and adolescents for dietary surveys: practicalities, problems and pitfalls. *The Proceedings Of The Nutrition Society* 73 (2):218-225.

National Academy of Sciences. 2005. *Dietary reference intakes for energy, carbohydrate, fiber, fat, fatty acids, cholesterol, protein, and amino acids*. Washington, D.C.: National Academies Press.

Ogden, Cynthia L., Margaret D. Carroll, Brian K. Kit, and Katherine M. Flegal. 2012. Prevalence of Obesity and Trends in Body Mass Index Among US Children and Adolescents, 1999-2010. *Jama-Journal of the American Medical Association* 307 (5):483-490.

Repeated Author. 2014. Prevalence of Childhood and Adult Obesity in the United States, 2011-2012. *JAMA: Journal of the American Medical Association* 311 (8):806-814.

Quelly, Susan, and Leslie Sue Lieberman. 2011. Global prevalence of overweight and obesity in preschoolers. *Anthropologischer Anzeiger; Bericht Über Die Biologisch-Anthropologische Literatur* 68 (4):437-456.

Rêgo, Carla, Carla Lopes, Elisabete Pinto, Margarida Nazareth, and Pedro Graça. 2013. *How babies grow in Portugal in their first three years of life: "Study of dietary and infant growth patterns - EPACI Portugal 2012"*.

Rito, Eleonora Paixão, Maria Ana Carvalho, and Carlos Ramos. 2012. *Chilhood Obesity Surveillance Initiative: COSI Portugal 2010*. Edited by I. INSA. Lisboa.

Rito, Ana. 2006. Overweight and Obesity in Preschool children of Coimbra: an urban city of Portugal. *Obesity reviews* 7 (s2):323.

United Kingdom Government: Department of Health Social Services and Public Safety. *UK Physical Activity Guidelines for Early Years* 2011 [cited 3 September 2014. Available from https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/213738/dh_128143.pdf.

Valagão, Maria Manuel. 2014. Identidade alimentar mediterrânica de Portugal e do Algarve. In *A Dieta Mediterrânica em Portugal: Cultura, Alimentação e Saúde*, edited by U. d. Algarve. Faro.

Vale, S., S. Rute, L. Soares-Miranda, C. Rego, P. Moreira, and J. Mota. 2011. Prevalence of overweight/obesity among Portuguese preschoolers. *International Journal of Obesity* 35:S166-S166.

Vale, S., S. Trost, J. J. Ruiz, C. Rêgo, P. Moreira, and J. Mota. 2013. Physical activity guidelines and preschooler's obesity status. *International Journal of Obesity* 37 (10):1352-1355.

Vale, Susana, Stewart Trost, Michael Duncan, and Jorge Mota. 2014. Step based physical activity guidelines for preschool-aged children. *Preventive Medicine* (In Press).

World Health Organization. *WHO child growth standards : training course on child growth assessment* (World Health Organization) 2008 [cited 14 September 2014. Available from http://www.who.int/childgrowth/training/module_b_measuring_growth.pdf.

Repeated Author. *Waist Circumference and Waist–Hip Ratio: Report of a WHO Expert Consultation* (World Health Organization) 2011 [cited 14 September 2014. Available from http://apps.who.int/iris/bitstream/10665/44583/1/9789241501491_eng.pdf.

Repeated Author. *Obesity and overweight* (WHO) 2014 [cited 13 July 2014. Available from http://www.who.int/mediacentre/factsheets/fs311/en/.

World Medical Association. *Declaration of Helsinki* 2013 [cited 12 December 2014. Available from http://www.wma.net/en/30publications/10policies/b3/index.html.pdf?print-media-type&footer-right=[page]/[toPage].

5.4. Study IV

Impact of a socio-ecologic intervention on dietary intake, physical activity and BMI in Portuguese preschool children: a Randomized Control Trial

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Impact of a socio-ecological intervention on body mass index, dietary intake and physical activity in Portuguese preschool children: a randomized controlled trial

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Abstract

Background: The preschool age is a critical period for obesity prevention. Interventions are needed to shape the food and physical environments in order to promote healthy eating and physical activity patterns to tackle childhood obesity.

Objective: To assess the impact of a socio-ecological intervention on dietary intake (DI), physical activity (PA) and body mass index (BMI) in Portuguese preschool children.

Design/ Subjects: A randomized controlled trial involving 211 preschool children (51.2% girls), aged 5.3 (±0.5) years, 115 allocated in the experimental group (EG) and 96 in the control group (CG).

Methods: A six month socio-ecological intervention, focused on the implementation of strategies on food provided and PA opportunities, was developed with a school-family-based framework and aimed to improve anthropometric, DI and PA. Data regarding socioeconomic status, and children's DI, PA, and BMI z-score were collected before and after the intervention, and classified according to international guidelines.

Results: Significant positive intervention effects were found for BMI z-score (p=0.04), intake of dietary fiber (p=0.041), vegetable soup (p=0.034), fruit (p=0.038), vegetables/ fruit (p=0.042) and water (p=0.034). No changes were observed on PA pattern.

Conclusions: A six month multicomponent socio-ecological intervention may positively impact preschool children's BMI, dietary fiber intake, and the consumption of fruit and vegetables, including vegetable soup, and water intake.

Key words: preschool children; dietary intake; physical activity; childhood obesity; socio-ecologic intervention

Introduction

Overweight and obesity are serious public health challenges [1], triggered by rapid changes in lifestyles that occurred in the last decades, namely in dietary, PA and sedentary patterns [2]. These factors together, establish a chronic energy imbalance, mostly positive [3; 4; 5], yet which accumulated over time may culminate in overweight [6]. Unprecedented increase have been seen in the prevalence of child obesity in most age groups and in most regions of the world [7]. Several physical disorders in multiple systems, namely cardiovascular, metabolic, pulmonary and gastrointestinal, have been reported in different studies [8; 9; 10; 11], besides the psychological and social problems that derive from it [1; 10; 12].

The treatment of obesity is a complex process [13], so prevention is not only possible but it is also the most realistic and cost effective approach for dealing with childhood obesity [11; 12; 14]. Precocious interventions must be brought together in public health efforts, with a culturally appropriate parental and caregiver education, home lifestyle changes, dietary and exercise modifications so as to reverse the current trajectory [15]. Preventive initiatives must integrate multi-sectorial, multi-disciplinary, comprehensive and sustainable approaches, involving a wide variety of complementary actions which address the individual, the community, the environment, and society as a whole [16], leading to a higher success rate.

Schools have been found to be a potentially appropriate environment for intervention [5; 17; 18], and also as an universally motivating setting for children [9]. Schools do not only influence the children's knowledge and attitudes but they also provide opportunities to experience learning along with links with the family and the broader community. Regarding early childhood interventions, there is emergent evidence demonstrating the effectiveness of obesity prevention targeting children attending early childcare settings, such as preschools [19; 20; 21; 22]. Additionally, in order to improve the DI, PA and BMI, school-based interventions should integrate behavioral and environmental approaches using a systems-level approach targeting the multilevel structure of the socioecological model as well as the possible interactions and relationships between levels [23], and simultaneously focus on DI and PA [23; 24].

The purpose of this research was to assess the impact of a six month socio-ecological intervention on BMI, DI and PA, to prevent overweight and obesity among Portuguese preschool children.

Methodology

Study Design

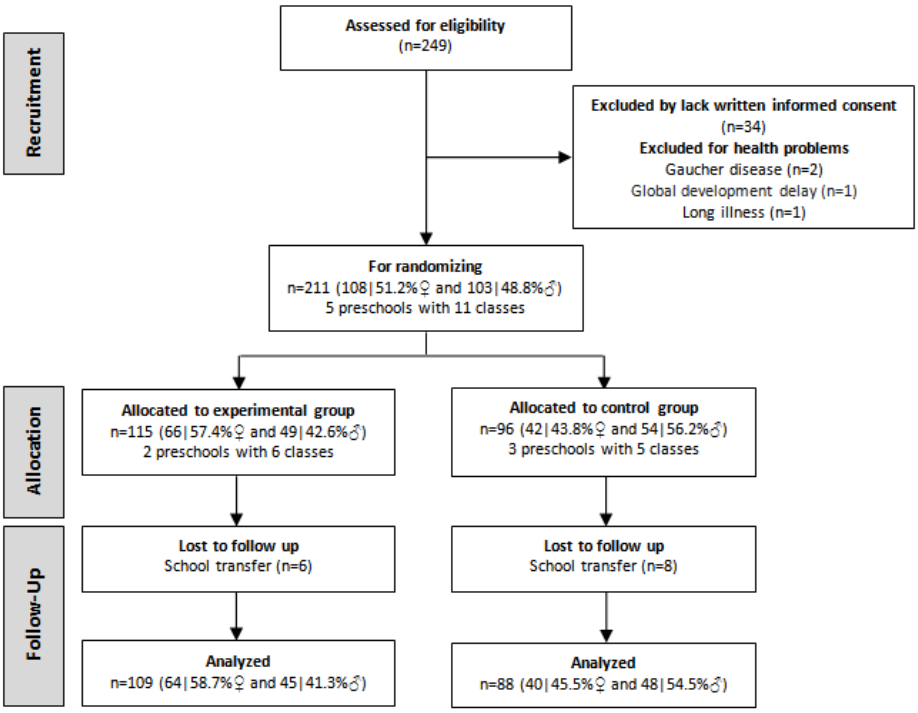
This randomized controlled trial was conducted for six months, during the school year of 2013/2014, and all public preschools existing in the Faro Municipality (n=5) were invited to participate through Algarve Regional Education Authority. Children's parents received verbal explanation and written information about the study, from the research coordinator. Prior to data collection, the parents provided informed consent, according to ethical standards defined by the Declaration of Helsinki (WMA[25]). This study was approved by the Scientific Council of the Faculty of Sports of Porto University. Ethical approval was achieved from the local Health Ethical Committee of the Algarve Regional Health Administration of the Ministry of Health, and approval was also granted by the Portuguese Data Protection Authority (CNPD - Comissão Nacional de Proteção de Dados, Process Nr. 6263/2013). In addition, permission from the Ministry of Education for the implementation of school surveys was obtained through registration Nr. 0399500001. Further agreement was obtained from the Algarve Regional Education Authority and the School Boards. Data collection occurred with anthropometric assessments performed in schools, food records and questionnaires filled out by parents at home. Pedometers were used in both preschool and home environments.

Participants

The study design is presented in **Figure 1**. Children's parents attending preschool were contacted (n=249), covering 11 classes of five preschools in Faro municipality. Parents of 215 children provided written informed consent (86%), of which four were excluded due to health problems related to a significant physical and/or intellectual disability. Out of 5 preschools (11classes with a total of 211 children, 51.2% female, aged between 3 and 6 years) in the randomization process, 2 were allocated into the EG (6 classes/ 115 children/ 54.5%), and 3 into the CG (5 classes/ 96 children/ 45.5%). For practical reasons, and to avoid the effect of contamination, preschool

classes integrated in the same school building were randomized into the same group. Anthropometric assessment after intervention was available for 93.4% of the children, 109 (94.8%) in the EG and 88 (91.7%) in the CG.

Figure 1. Flow of participants through each stage of the study design.



Overview of the intervention program

Two preschools covering 6 classes were invited and agreed to participate in the intervention program conducted between November 2013 and April 2014, involving115 children (**Figure 1**). This intervention was based on the socio-ecologic theoretical model [(26)], which has been identified as an effective approach in the promotion of healthy lifestyles [(11)], and in the prevention of childhood obesity in particular [(Penhollow & Rhoads27)]. Regarding the socio-ecologic framework, behavior of preschoolers is influenced by attitudes and behaviors of the members of their larger network, which includes parents, siblings, peer preschoolers and teachers [(28)]. Although the main target group was preschool children, the intervention also addressed parents, kindergarten teachers and preschool staff, as well as in the school environment. Kindergarten teachers and parents are the two major influence factors for preschoolers [(29)]. Parents are key to develop a home environment that fosters healthy lifestyles [(30; 31; 32)], shaping children's dietary practices [(33; 34; 35)], PA [(34; 36)], and sedentary behaviors [(36)].

Pivotal role of teachers can foster positive healthy lifestyles and provide good modeling and social learning opportunities [37]. Physical school environment comprises many opportunities for development of strategies concerning the provision of nutritious food and exposition of relevant opportunities for PA [17; 38; 39]. Given that changes in behavior are expected to be maximized when environments and policies supporting healthy choices and when individuals are motivated and educated to make those choices [40], a parent-focused, school-based childhood obesity prevention program was conceived.

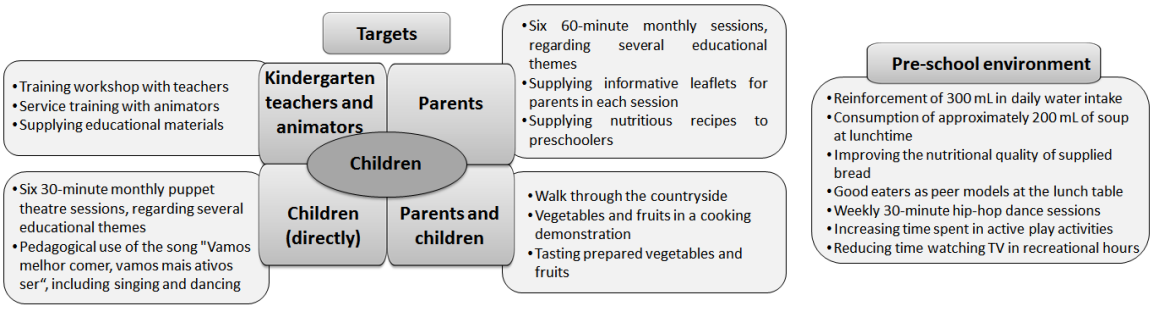
Prior to intervention, kindergarten teachers associated to EG had a six-hour workshop with contents meant to help children make healthy choices: (1) Health promotion and healthy lifestyles in childhood obesity prevention; (2) Healthy dietary and eating behavior; (3) Strategies to increase the consumption of fruit, vegetables and water; (4) Strategies to reduce the consumption of high sugar drinks and dense energy snacks; (5) Strategies for active play in and out the classroom; and (6) How to use media. Service training with preschool animators was performed, along with the supply of adequate educational materials. These resources provided the basis for activities to promote both healthy eating and PA then developed at preschools with children. Additionally, children had six 30-minute monthly puppet theatres about healthy food and PA themes, including a pedagogical song for singing and dancing.

Parents of the EG had six 60-minute monthly sessions, held after office hours, with different contents aiming to promote a healthy home environment: (1) Healthy eating; (2) PA; (3) Eating behaviors and media use; (4) Healthy snacks; (5) Reading food labels; and (6) Healthy cooking. In each session informative leaflets were provided, and healthy cooking recipes for preschoolers were delivered at the end of intervention. The healthy cooking session was held on a Saturday morning, with the children's and parent's participation and it included the tasting of prepared vegetables and fruit as well as a walk in the countryside

In a preschool environment, several strategies were put into practice: water drinking; the consumption of vegetable soup; whole grain bread intake; children good eaters seated closer of other as peer models at the lunch table; a weekly 30-minute hip-hop dance, during the break outdoors, guided by a dance teacher; the increase in the time spent in active play activities, and the reduction in the time of watching TV in recreational hours.

The intervention program occurred as planned, as presented in the overview in **Figure 2**. Children in the EG were enrolled in all activities, as had been projected. Both the school-based and the family-based components of the intervention were feasible. However, the parents' attendance of the intervention sessions was sometimes rather irregular, confirming the reports in other studies [41].

Figure 2. Intervention program diagram.



Data collection

Children were assessed both at baseline and post-intervention, but it was not always possible to collect data for all parameters. However, BMI and socio-demographic characteristics did not differ significantly between the children who followed through with the interventional study (up until post-intervention assessment) and those who only completed the first assessment.

Anthropometric measures

In order to obtain anthropometric data, all children were assessed under the same conditions, with the same equipment and by the same trained researcher to minimize inter-observer error, using a standardized procedure [42]. Height and weight were determined wearing light clothes and no shoes. Height was measured in meters, to the nearest millimeter using a portable stadiometer (Seca® model 214), with the head in the Frankfort plane. Weight was measured in kilograms, to the nearest decigram. Weight was measured in kilograms, to the nearest decigram, using a digital device (Tanita® model BC 418). Height and weight measures were converted into BMI, expressed in kg/m^2, for each participant. BMI was standardized for age and sex, and specific prevalence of underweight, normal, overweight and obesity was determined using BMI z-score according to the World Health Organization (WHO) Growth Reference, with

overweight defined as BMI z-score ≥ 1 and obesity defined as BMI z-score ≥ 2 [43], Waist circumference (WC) was measured in centimeters, directly on the skin, midway between the lower margin of the last palpable rib and the top of the iliac crest, [44], with an accuracy of 5mm, using a flexible and non-elastic measuring tape (Seca® model 201). The average of two measurements was used for height and waist circumference, and when there was disagreement between these measures (>0.5cm for height or >0.3cm for waist), a third measurement was recorded.

Dietary intake

DI was obtained through a 3-day food record (2 weekdays and 1 weekend, when possible). Parents or caregivers were instructed to record information in the diary provided, regarding all foods and beverages consumed by their child (reporting the brand name if applicable) and the respective amount (in grams, units or household measures). In order to convert foods into nutrients, the software Food Processor SQL® version (2004-2005 ESHA Research, Salem, Oregon) was used, which is based on the Food Composition Table of the United States of America Department of Agriculture. For typically Portuguese foods or culinary dishes, new codes were created with national nutritional information. Dietary Reference Intakes (DRIs) for children aged 4 to 8 years were used to analyze the energy, macronutrients and dietary fiber intake. The estimated energy requirement (EER) was calculated by the same DRIs [45]. For DI, seven main food groups were defined: (1) total vegetables (cabbage, spinach, broccoli, lettuce, peppers, tomatoes, cucumbers, onions, carrots, etc.); (2) vegetable soup; (3) fruit (fresh fruit, including tropical fruit); (4) sweets and pastries (biscuits apart from simple ones, croissants, doughnuts, cakes, chocolates, chocolate snacks, quince jam, jam, jelly, honey, sugar, candy); (5) energy dense snack foods (crisps and other fried snacks, patties, croquettes and other savory pastry products (6) sugar-sweetened beverages (cola, ice tea and sodas) and (7) water (including herbal infusions).

Physical activity

The children's PA was subjectively measured using the *Preschool-age Children's Physical Activity Questionnaire* (Pre-PAQ) [46], estimating different PA intensity levels from a socio-ecologic perspective, in the child's home environment corresponding to the 3-day period (a weekday, Saturday and Sunday) when the child

was at home with his/her parent or caregiver. The reliability study for the translated Pre-PAQ was performed by us (unpublished data). Through this tool, PA was classified in five progressive intensity levels: (1) completely stationary, (2) stationary but moving a limb or the trunk, (3) moving slowly, (4) moving at a moderate pace, or (5) moving quickly. Levels 1 and 2 correspond to sedentary behavior (SB), level 3 corresponds to low PA (LPA), level 4 corresponds to moderate PA, level 5 corresponds to vigorous PA, levels 4 and 5 correspond to moderate-vigorous PA (MVPA), and levels 3, 4 and 5 correspond to total PA (TPA).

Daily PA was objectively measured using a pedometer (KenzLifecorder® model PLUS, Japan), for five or more consecutive days, which included at least one day of weekend monitoring, with a minimum of valid eight hours of daily steps records. Proceeding to an analysis of variance (ANOVA), we did not find differences between the mean number of steps in five, six or more days of record ($F=0.659$, $p=0.580$), which allowed us to use all data to further assess the participants' PA. Pedometer data were downloaded with specific software (PAAS Lifestyle Coach®), and interpreted according to the cut point of 9000 steps per day as the required compliance with recommendations for TPA and MVPA in preschool children [47]. Thus, children were classified as either meeting the minimum of steps per day (category >9000: sufficiently active) or not meeting them (category ≤9000: insufficiently active).

Socio-demographic and lifestyle variables

SES data were assessed with the study questionnaire filled out by parents, about family characteristics, mother's and father's education and occupational levels, watching TV profile, and sleep characteristics. The parents' education level was defined according to the Portuguese Educational System, in three categories: basic or less (≤9 school years), secondary (10–12 school years) and college/university (>12 school years). The parents' occupation level was organized in ten categories according to the standard Portuguese method of classifying occupations [INE48], having subsequently been re-coded into four categories (1 to 4), 4 being the highest level, beyond the status of unemployed. Thus, the SES will be basically analyzed from father and mother education and occupation.

Statistical analyses

To describe continuous variables we computed mean values and standard deviations. Qualitative variables were described with absolute and relative frequencies.

According to the results of the Kolmogorov-Smirnov test for assessing if our data were normally distributed, we used either Student's t-tests, Mann–Whitney U, Chi-square, or Wilcoxon's signed ranks tests to compare the participants for different variables, between baseline and post-intervention moments.

The tests examining the differences between the EG and the CG were developed using Generalized Linear Models and took into account the nested nature of the data (children were nested within schools), and possible confounders such as SES, gender, age, and baseline energy intake.

Due to the loss of participants during the follow-up, we tested for significant differences in BMI and socio-demographic characteristics (SES, age and sex) between participants who completed only the baseline assessment and those who completed both assessments. No significant differences were found, which allows us to infer that the loss to follow-up did not significantly alter the sample's characteristics.

Due to poor participation of children to use pedometers, we were able to record data for five or more days, considered similar to each other by Kruskal Wallis test, which included at least one day of weekend monitoring.

Statistical significance for all tests was set at 5%. Data were analyzed with IBM-SPSS® software version 21.0 (SPSS Inc., Chicago, IL, USA).

Results

Table 1 shows the baseline characteristics of the participants. Subjects included 108 girls (51.8%) and 103 boys (48.8%), aged 5.3 (±0.5) years. On average, BMI z-score was 0.28 (±1.08) and WC was 52.4 (±4.1). No significant differences were found between the CG and the EG regarding BMI, BMI z-score or WC. Furthermore, both the mother (p=0.039) and the father (p=0.003) of the children in the CG had less schooling than those of the EG. Concerning occupation categories, the parents of the children in the CG have a lower prevalence of highly skilled professions, with differences in the mother's occupation (p=0.01) and the father's occupation (p=0.025). These differences at baseline prompted us to control these variables in all further statistical analyses.

Concerning DI, time spent in different PA intensity levels and counted steps, no significant differences were found between CG and EG at baseline.

Table 1. Characteristics at baseline in control and experimental groups.

	Total	**Control**	**Experimental**	***p****
	n=211	**n=96**	**n=115**	
Age (years)	4.8 (0.5)	5.0 (0.5)	4.7 (0.5)	**<0.001**†
Weight (Kg)	19.9 (3.5)	20.5 (3.8)	19.4 (3.2)	**0.015**†
Height (m)	1.12 (5.4)	1.13 (0.05)	1.10 (0.05)	**<0.001**†
BMI (kg/m^2)	15.8 (1.8)	15.9 (1.8)	15.8 (1.7)	0.770†
BMI z-score	0.28 (1.08)	0.33 (1.09)	0.25 (1.08)	0.638†
Waist circumference (cm)	52.4 (4.1)	52.9 (4.3)	52.0 (3.9)	0.157†
Mother's education	**n=175**	**n=69**	**n=106**	
Up to 9 years	61 (34.9)	33 (47.8)	28 (26.4)	
10 to 12 years	56 (32.0)	21 (30.4)	35 (33.0)	**0.039**‡
> 12 years	58 (33.1)	15 (21.7)	43 (40.6)	
Father's education	**n=154**	**n=58**	**n=96**	
Up to 9 years	66 (42.8)	32 (55.2)	34 (35.4)	
10 to 12 years	44 (28.6)	19 (32.8)	26 (27.1)	**0.003**‡
> 12 years	44 (28.6)	7 (12.1)	36 (37.5)	
Mother's occupation	**n=160**	**n=61**	**n=99**	
Level 1	24 (15.0)	16 (26.2)	8 (8.1)	
Level 2	62 (38.8)	28 (45.9)	34 (34.3)	
Level 3	11 (6.9)	1 (1.6)	10 (10.1)	**0.001**‡
Level 4	41 (25.6)	9 (14.8)	32 (32.3)	
Unemployed	22 (13.8)	7 (11.5)	15 (15.2)	
Father's occupation	**n=159**	**n=63**	**n=96**	
Level 1	5 (3.1)	1 (1.6)	4 (4.2)	
Level 2	86 (54.1)	43 (68.3)	43 (44.8)	
Level 3	10 (6.3)	5 (7.9)	5 (5.2)	**0.025**‡
Level 4	48 (30.2)	11 (17.5)	37 (38.5)	
Unemployed	10 (6.3)	3 (4.8)	7 (7.3)	

Data presented as mean (standard deviation) for anthropometric variables and *n* (%) for other variables.
**p* value for differences between groups computed with Mann-Whitney's test†. or χ^2 test‡
Level 1: unqualified workers; Level 2: operators of machinery and equipment, qualified workers in industry, construction, agriculture, fishery and forestry, artisans, personal service workers, safety and protective service providers, sellers and administrative staff; Level 3: mid-level technicians and professionals; Level 4: specialists in intellectual and scientific occupations, representatives of legislative branch offices and agencies, officers, directors and executive officers and armed forces members, and in another level the unemployed.

Table 2 shows the outcomes of energy and nutrients, as well as food groups, between the CG and the EG, at baseline and post-intervention moments, after adjustments for age, weight, height, SES and baseline total energy intake. Regarding energy and nutrients, we found statistical difference in dietary fiber intake, given that the EG increased their mean fiber intake by 3.9g/day (p=0.041). Concerning food

groups, the EG reports statistically significant increases in the intake of vegetable soup (p=0.034), fruit (p=0.038), vegetables/ fruit (p=0.042) and water (p=0.034). Nevertheless, both groups seem to have reduced their intake in vegetables, between baseline and post-intervention, corresponding to negative values, with the EG reporting a higher decrease in vegetables intake (p=0.029).

Regarding the reported time spent on different intensity levels of PA, only 66 participants (41 of the CG and 25 of the EG) were assessed simultaneously at baseline and post-intervention, through the questionnaires filled out by parents. Our results do not show any significant differences between the CG and the EG regarding time spent in different intensity levels of PA, during weekdays or weekend days (p>0.05). Furthermore, in both the CG and the EG, we found that boys and girls had statistically similar mean differences in time spent in any intensity level of PA, on both weekdays (p>0.05) and weekend days (p>0.05).

Table 2. Outcomes of dietary intake at post-intervention.

	Baseline		**Post-intervention**		***p***
	Control n=66	**Experimental n=108**	**Control n=34**	**Experimental n=20**	
Energy and nutrients					
Total energy intake (kcal)	1603.1 (295.4)	1492.7 (301.5)	1610.0 (313.8)	1619.6 (252.6)	0.701
Protein (g)	75.6 (17.8)	70.2 (13.9)	79.1 (11.7)	80.2 (12.3)	0.758
Protein (%TEI)	18.9 (3.0)	19.1 (3.2)	19.9 (2.4)	20.0 (2.7)	0.787
Total carbohydrates (g)	209.1 (42.5)	196.3 (40.4)	200.3 (45.0)	212.4 (45.3)	0.071
Total carbohydrates (%TEI)	52.3 (6.5)	52.9 (6.1)	49.6 (4.3)	52.2 (5.1)	0.065
Sugars (g)	88.9 (26.7)	84.2 (21.4)	87.8 (20.7)	95.3 (26.8)	0.392
Sugars (%TEI)	22.2 (5.4)	22.8 (4.7)	21.9 (3.3)	23.2 (3.7)	0.555
Total fat (g)	52.3 (13.6)	46.8 (16.7)	54.4 (17.4)	51.2 (9.7)	0.313
Total fat (%TEI)	29.1 (5.0)	27.5 (6.0)	30.2 (5.5)	28.5 (3.5)	0.332
Dietary fiber (g)	16.9 (5.8)	15.4 (6.3)	17.2 (5.7)	19.3 (4.4)	**0.041**
Dietary fiber (g/1000 kcal)	9.0 (2.3)	8.9 (2.5)	9.3 (1.8)	10.3 (1.9)	**0.040**
Food groups					
Total vegetables (g)	54.6 (47.5)	60.1 (44.2)	36.2 (56.9)	20.5 (48.3)	**0.029**
Vegetable soup (g)	279.5 (163.4)	171.9 (137.7)	194.6 (146.8)	255.5 (147.2)	**0.034**
Fruit (g)	188.5 (95.6)	181.5 (113.7)	211.6 (117.9)	288.4 (137.9)	**0.038**
Vegetables and fruit	267.8 (112.1)	245.6 (135.4)	307.7 (137.2)	406.3 (163.1)	**0.042**
Sweets and pastries (g)	41.0 (28.6)	42.8 (34.7)	39.4 (28.6)	39.7 (39.5)	0.801
Savoury snacks (g)	3.5 (11.9)	2.7 (11.9)	7.7 (16.0)	7.7 (16.9)	0.766
Sugar-sweetened beverages (g)	109.9 (137.9)	73.9 (114.3)	63.1 (88.2)	46.9 (73.8)	0.763
Water (g)	160.9 (139.9)	181.3 (157.0)	155.8 (195.3)	391.1 (254.5)	**0.034**

Data presented as mean (standard deviation).

p value was computed for the changes in CG and EG between baseline and post intervention assessments, adjusted for sex, SES, baseline total energy intake, PA, BMI and school.

PA was also assessed by pedometers, 90 participants at baseline (CG: 33; EG: 57) and for 50 participants at post-intervention (CG: 24; EG: 26). At baseline, the mean for total steps recorded was 11564 (SD=2402), and at post-intervention was 11594 (SD=2774), statistically similar to the baseline mean (p=0.844). Furthermore, at baseline, the participants that were loss to follow-up had a mean step count at baseline of 11641 (SD=2568), statistically similar (p=0.762) to those participants that were also assessed at post intervention, which was 11487 (SD=2250).

Regarding mean steps recorded at baseline and post-intervention, we did not find any significant difference between the CG and the EG (p>0.05). Similarly, when comparing the results of the CG with those of the intervened children, and referring to steps categories, we also did not find statistical differences in the total, weekdays or weekend days (**Table 3**). These results were similar when analyzing the data by sex, considering the 27 girls and the 23 boys that composed the 50 participants assessed with pedometers on both data collection moments.

Table 3. Categories of steps taken at baseline and at post-intervention.

	Baseline		**Post-intervention**		***P***
	Control n=33	**Experimental n=57**	**Control n=24**	**Experimental n=26**	
Total					
≤ 9000 steps	3 (9.1)	10 (17.5)	2 (8.3)	4 (15.4)	0.862
> 9000 steps	30 (90.9)	47 (82.5)	22 (91.7)	22 (84.6)	
Weekdays					
≤ 9000 steps	2 (6.1)	11 (19.3)	1 (4.2)	6 (23.1)	0.435
> 9000 steps	31 (93.9)	46 (80.7)	23 (95.8)	20 (76.9)	
Weekend					
≤ 9000 steps	15 (45.5)	17 (29.8)	7 (29.2)	7 (26.9)	0.097
> 9000 steps	18 (54.5)	40 (70.2)	17 (70.8)	19 (73.1)	

Data presented as n (%).

p value was computed for the changes in CG and EG between baseline and post intervention assessments, adjusted for sex, SES, baseline total energy intake, baseline number of steps, BMI and school.

Table 4 shows the outcomes of anthropometric measures reporting to the CG and the EG, at baseline and post-intervention moments, after statistical differences adjusted for age, weight, height, total energy intake and the parents' education and occupation levels. We found a statistically significant reduction in BMI z-score (p=0.04) in the EG. The intervention was responsible for a mean reduction of BMI z-score of 0.14 (SD=0.55) in the EG, whereas the CG presented an average increase of

0.02 (SD=0.4) (not shown in the table). The WC did not show significant differences after the intervention.

Table 4. Outcomes of anthropometric measures at post-intervention.

	Baseline		Post-intervention		*P*
	Control n=96	**Experimental n=115**	**Control n=88**	**Experimental n=109**	
BMI (kg/m^2)	15.9 (1.8)	15.8 (1.7)	15.8 (1.9)	15.7 (1.7)	0.964
BMI z-score	0.3 (1.1)	0.2 (1.1)	0.3 (1.0)	0.1 (1.0)	**0.04**
Waist circumference (cm)	52.9 (4.3)	52.0 (3.9)	53.6 (7.3)	53.1 (4.3)	0.955

Data presented as mean (standard deviation).

p value for differences at post intervention adjusted for sex, SES, baseline total energy intake, PA, BMI, age and school.

Considering the changes in BMI categories for the 197 participants following the intervention (**Table 5**), we were able to record that a higher proportion of obese children in the EG (n=4; 40.0%) decreased their BMI (thereby being included in the overweight category) than those in the CG (n=2; 25.0%). However, whereas two subjects in the EG increased their BMI to be included in the obese category (11.8%), none in the CG changed from overweight to obesity. Nevertheless, these changes in the incidence and prevalence of overweight and obesity are statistically similar between the CG and the EG. No change occurred from obesity to normal categories or vice versa. **Table 5** shows these results, the adjusted odds ratio for the specific category changes in the EG, and the adjusted statistical significance.

Table 5. BMI category change with effects in the overweight and obesity prevalence

Changes with intervention	**Control n=88**	**Experimental n=109**	**Adjusted odds ratio for BMI categories change in the EG* (95% CI)**	***p****
Downwards BMI category change				
Obesity to Overweight	2 (25.0)	4 (40.0)	1.07 (0.88; 2.74)	0.612
Overweight to Normal	4 (40.0)	6 (35.3)	0.69 (0.54; 1.91)	0.701
Upwards BMI category change				
Normal to Overweight	2 (3.0)	2 (2.4)	0.96 (0.92; 1.37)	0.966
Overweight to Obesity	0 (0.0)	2 (11.8)	1.18 (0.73; 1.53)	0.569

Data presented as n (%).

* Adjusted for sex, SES, baseline total energy intake, PA, BMI, age and school.

Discussion

The present study demonstrated the effectiveness of a six-month socio-ecologic intervention on DI and PA, in the context of a prevention program of overweight and obesity among a Portuguese preschool population, with regard to the mean values of

BMI z-score. This result was particularly relevant as it provides further evidence for the WHO recommendations to prevent childhood obesity, through population-based prevention strategies supporting increased PA and a healthier diet, in the context of multi-level programs achieved in early childcare settings as preschools or kindergartens[49].

In our baseline, according to WHO reference, we found a prevalence of 2.4% underweight, 73.9% normal, 13.3% overweight and 10.4% obesity [50]. Despite this prevalence being slightly lower than that described in studies with preschoolers performed in other regions of Portugal [51; 52; 53; 54; 55; 56]. Intervention programs to combat earlier child obesity must be implemented or continued, in order to minimize the prevalence of childhood obesity as much as possible, promoting the health and well-being of the children as they age [57]. Still referring to baseline, the CG and the EG were similar for all variables related to DI, time spent in different PA intensity levels and counted steps. Nonetheless, significant differences were found for age, weight and height, and the education level and occupation category for both mother and father, prompting us to control these variables in all further statistical analyses of the study.

We attempted to direct our study towards the best intervention practice according to the scientific evidence, based on the socio-ecological model [27], in a school setting [58] like preschools [20], with a parental/family home component [23] and a simultaneous focus on diet and PA [59], with relevant support for teachers and other staff [60; 61]. This study had an initial high level of participation among eligible children (84.7%). In addition, to our better knowledge, no other program devised against childhood obesity was being performed in the preschools referred in this study, which gave a higher robustness to the evaluation of the impact, without the interference of such confounders.

Regarding DI, this socio-ecological intervention showed a positive impact in the EG, in order to detect some dietary protective factors in childhood obesity, such as the intake of dietary fiber [62; 63; 64], vegetable soup, fruit, vegetables/fruit [65; 66] and water [67]. Nevertheless, both the CG and the EG reduced their intake in total vegetables after the intervention, with the EG reporting a higher decrease, probably because it was assumed that the increased intake of vegetable soup could replace the intake of portions of vegetables in other forms. On the one hand, the results obtained regarding the

aforementioned food items, are due to the fact that the action have been more incisive in these matters, in view of the prevention of childhood obesity. On the other hand the results were not even more significant because the menus have some supervision performed by nutritionists.

Concerning the time spent in different levels of PA, reported through the questionnaires filled out by parents, we didn't find any difference between baseline and post-intervention, despite of the multi-strategies implemented to increase the diary PA at the experimental preschools. Actually, the tool used to assess PA (Pre-PAQ), reported by parents, besides the risk of subjectivity, only related the child's home environment corresponding to a 3-day period (a weekday, Saturday and Sunday) when children were at home with their family. Thus, we believe that the lack of an assessment method to characterize PA at a preschool level may have been an important frailty in this study.

PA was also assessed by pedometers, but we did not find any statistical difference after the intervention, between the CG and the EG, neither in the steps categories nor even in mean steps, which may be explained by two fundamental reasons. On the one hand, the mean steps level compliance at baseline, for girls and boys, on weekdays and weekend days, meeting the cut off reference for preschool-aged children (9000 mean steps per day), recently proposed by a Portuguese study [47], allowed us to conclude that through this objective assessment our population was sufficiently active before the intervention. On the other hand, the use of the pedometer may have led to the stimulation of the practice of PA in all children [68; 69].

The outcomes of anthropometric measures related to the CG and the EG, between the baseline and the post-intervention, show that the BMI z-score had a significant decrease in the EG and a simultaneous increase in the CG, objectively demonstrating the effectiveness of this socio-ecological intervention. In addition, we would like to point out the valid use of BMI values expressed as z-scores, thereby avoiding the impact of differences in age and sex. Between the CG and the EG no differences in the incidence or prevalence in the overweight and obesity categories were found after the intervention. Therefore, results must be cautiously observed, given the small population size, the short study follow-up [70] and the specificity of this intervention, a population-based primary prevention program. However, our intervention complies the minimum duration of six months for to be considered

effective [71]. Moreover, for the remission of cases of OW it may be more effective the implementing of clinic-based programs.

The present study has important strengths that should be acknowledged. All children were assessed under the same conditions, with the same equipment and by two highly trained and specialized researchers in anthropometry to minimize inter-observer error; dietary intake was assessed using 3-day food record, method considered an excellent standard process; PA was evaluated using two methods; and the intervention was multicomponent and multilevel. Nonetheless, our study has some weaknesses that should also be recognized. Considering the small number of public preschools in the Faro municipality, the preschool children under study were mostly 5 years old, restricting the proportional age distribution, given the age of preschoolers, ranging from 3 to 6 years old of age. This constraint and the small population study size, though in correspondence to the existing reality, may have limited the detection of other significant differences than those reported. Furthermore, we were not completely rigorous in the allocation of identically equivalent subjects in the two groups after randomization, namely in both the mother's and father's education level and occupation category, mainly because we randomized by preschool and not by children, aiming to avoid cross contamination between the EG and the CG. Nevertheless, these differences were taken in account in all the statistical analyses. Additionally, PA intensity levels were obtained by questionnaires filled out by parents, so that under or overestimation bias in the answers may be possible. However, the Pre-PAQ was previously validated for Portuguese preschool children (unpublished data), so we have no reason to assume these biases would affect groups differently. The problems of self-reported data collection regarding the dietary food records and the questionnaires filled out by parents may lead to bias triggered by social desirability [72]. We must refer the problem of non-responses, arising from lack of time and/or other engagement of parents, along with the size of the questionnaires, which can further add to bias in the data. Moreover, a high number of parents who did not cooperate with the food records in the post intervention assessment, being higher in the EG.

Conclusions

The findings in this study demonstrated that a six-month socio-ecologic intervention on DI and PA among a preschool population was effective to reduce the

mean values of BMI z-score. In addition, intervened children were able to improve their dietary pattern, increasing the intake of dietary fiber, vegetable soup, fruit and water. Future preschool studies based on a socio-ecologic approach, with larger populations, for a longer period and with follow-up periods, should be carried out to improve the best practices to tackle childhood obesity, in order to minimize its prevalence as much as possible.

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Author Contributions

TS, PM and SV gave contributions to the conception and the design of the study. TS carried out the data collection. TS and JCR operationalized the use of pedometers. TS and EzP analyzed and interpreted the data. All authors were involved in drafting the manuscript and critically revised its content.

Conflicts of Interest

The authors declare no conflict of interest.

References

1. Karnik S, Kanekar A (2012) Childhood obesity: a global public health crisis. *International Journal Of Preventive Medicine* **3**, 1-7.
2. World Health Organization (2014) Obesity and overweight. http://www.who.int/mediacentre/factsheets/fs311/en/ (accessed 13 July 2014
3. De Craemer M, De Decker E, De Bourdeaudhuij I *et al.* (2012) Correlates of energy balance-related behaviours in preschool children: a systematic review. *Obesity Reviews* **13**, 13-28.
4. Kremers SPJ, de Bruijn G-J, Visscher TLS *et al.* (2006) Environmental influences on energy balance-related behaviors: a dual-process view. *The international journal of behavioral nutrition and physical activity* **3**, 9-9.
5. Moreno LA, Bel-Serrat S, Santaliestra-Pasias AM *et al.* (2013) Obesity prevention in children. *World review of nutrition and dietetics* **106**, 119-126.
6. Rennie KL, Johnson L, Jebb SA (2005) Behavioural determinants of obesity. *Best Practice & Research Clinical Endocrinology & Metabolism* **19**, 343-358.

7. Lobstein T (2010) Prevalence and trends in childhood obesity. In *Obesity epidemiology: From aetiology to public health*, pp. 3-16 [D Crawford, RW Jeffery, K Ball and J Brug, editors]. Oxford: Oxford University Press.
8. Speiser PW, Rudolf MCJ, Anhalt H *et al.* (2005) Consensus statement: Childhood obesity. *Journal of Clinical Endocrinology & Metabolism* **90**, 1871-1887.
9. Han JC, Lawlor DA, Kimm SYS (2010) Childhood obesity. *The Lancet* **375**, 1737-1748.
10. Daniels SR (2009) Complications of obesity in children and adolescents. *International Journal of Obesity* **33**, S60-S65.
11. Lobstein T, Baur L, Uauy R (2004) Obesity in children and young people: a crisis in public health. *Obesity Reviews: An Official Journal Of The International Association For The Study Of Obesity* **5 Suppl 1**, 4-104.
12. Ebbeling CB, Pawlak DB, Ludwig DS (2002) Childhood obesity: public-health crisis, common sense cure. *Lancet* **360**, 473-482.
13. Branca F, Nikogosia H, Lobstein T (2007) *The challenge of obesity in the WHO European Region and the strategies for response.* Copenhagen: World Health Organization.
14. Livingstone MB (2001) Childhood obesity in Europe: a growing concern. *Public Health Nutrition* **4**, 109-116.
15. Quelly S, Lieberman LS (2011) Global prevalence of overweight and obesity in preschoolers. *Anthropologischer Anzeiger; Bericht Über Die Biologisch-Anthropologische Literatur* **68**, 437-456.
16. Lobstein T, Brinsden H (2014) Symposium report: the prevention of obesity and NCDs: challenges and opportunities for governments. *Obesity reviews : an official journal of the International Association for the Study of Obesity* **15**, 630-639.
17. Story M, Nanney MS, Schwartz MB (2009) Schools and Obesity Prevention: Creating School Environments and Policies to Promote Healthy Eating and Physical Activity. *Milbank Quarterly* **87**, 71-100.
18. Dahlgren G, Whitehead M (2007) *European strategies for tackling social inequities in health: Levelling up Part 2.* Copenhagen: WHO.
19. Hesketh KD, Campbell KJ (2010) Interventions to Prevent Obesity in 0-5 Year Olds: An Updated Systematic Review of the Literature. *Obesity* **18**, S27-S35.
20. Wofford LG (2008) Systematic review of childhood obesity prevention. *Journal of Pediatric Nursing* **23**, 5-19.
21. de Onis M, Blossner M, Borghi E (2010) Global prevalence and trends of overweight and obesity among preschool children. *American Journal of Clinical Nutrition* **92**, 1257-1264.
22. Gupta N, Goel K, Shah P *et al.* (2012) Childhood obesity in developing countries: epidemiology, determinants, and prevention. *Endocrine Reviews* **33**, 48-70.
23. Hoelscher DM, Kirk S, Ritchie L *et al.* (2013) Position of the Academy of Nutrition and Dietetics: Interventions for the Prevention and Treatment of Pediatric Overweight and Obesity. *Journal of the Academy of Nutrition and Dietetics* **113**, 1375-1394.
24. Pratt CA, Boyington J, Esposito L *et al.* (2013) Childhood Obesity Prevention and Treatment Research (COPTR): Interventions addressing multiple influences in childhood and adolescent obesity. *Contemporary Clinical Trials* **36**, 406-413.
25. World Medical Association (2013) Declaration of Helsinki. http://www.wma.net/en/30publications/10policies/b3/index.html.pdf?print-media-type&footer-right=[page]/[toPage] (accessed 12 December 2014

26. Bronfenbrenner U (1994) Ecological Models of Human Development. In *International Encyclopedia of Education*, 2nd ed., vol. 3. NY: Freeman.
27. Penhollow T, Rhoads K (2014) Preventing Obesity and Promoting Fitness: An Ecological Perspective. *American Journal of Lifestyle Medicine* **8**, 21-24.
28. De Bock F, Fischer JE, Hoffmann K *et al.* (2010) A participatory parent-focused intervention promoting physical activity in preschools: design of a cluster-randomized trial. *BMC Public Health* **10**.
29. Niederer I, Kriemler S, Zahner L *et al.* (2009) Influence of a lifestyle intervention in preschool children on physiological and psychological parameters (Ballabeina): study design of a cluster randomized controlled trial. *BMC Public Health* **9**.
30. Hawkins SS, Cole TJ, Law C *et al.* (2009) An ecological systems approach to examining risk factors for early childhood overweight: findings from the UK Millennium Cohort Study. *Journal of Epidemiology and Community Health* **63**, 147-155.
31. Ritchie LD, Welk G, Styne D *et al.* (2005) Family environment and pediatric overweight: What is a parent to do? *Journal of the American Dietetic Association* **105**, S70-S79.
32. Brotman LM, Dawson-McClure S, Huang K-Y *et al.* (2012) Early Childhood Family Intervention and Long-term Obesity Prevention Among High-risk Minority Youth. *Pediatrics* **129**, E621-E628.
33. Pearson N, Biddle SJH, Gorely T (2009) Family correlates of fruit and vegetable consumption in children and adolescents: a systematic review. *Public Health Nutrition* **12**, 267-283.
34. Gruber KJ, Haldeman LA (2009) Using the Family to Combat Childhood and Adult Obesity. *Preventing Chronic Disease* **6**.
35. Mitchell GL, Farrow C, Haycraft E *et al.* (2013) Parental influences on children's eating behaviour and characteristics of successful parent-focussed interventions. *Appetite* **60**, 85-94.
36. O'Dwyer MV, Fairclough SJ, Knowles Z *et al.* (2012) Effect of a family focused active play intervention on sedentary time and physical activity in preschool children. *The International Journal Of Behavioral Nutrition And Physical Activity* **9**, 117-117.
37. Manore MM, Brown K, Houtkooper L *et al.* (2014) Energy Balance at a Crossroads: Translating the Science into Action. *Journal of the Academy of Nutrition and Dietetics* **114**, 1113-1119.
38. Story M, Kaphingst KM, French S (2006) The role of schools in obesity prevention. *Future of Children* **16**, 109-142.
39. Harrison F, Jones AP (2012) A framework for understanding school based physical environmental influences on childhood obesity. *Health & Place* **18**, 639-648.
40. Sallis JF, Owen N, Fisher EB (2008) Ecological Models Of Health Behavior. In *Health Behavior and Health Education: Theory, Research and Practice*, 4th ed., pp. 465-485 [K Glanz, BK Rimer and K Viswanath, editors]. San Francisco: Jossey-Bass.
41. Fitzgibbon ML, Stolley MR, Schiffer L *et al.* (2013) Family-based hip-hop to health: Outcome results. *Obesity (19307381)* **21**, 274-283.
42. World Health Organization (2008) WHO child growth standards : training course on child growth assessment. http://www.who.int/childgrowth/training/module_b_measuring_growth.pdf (accessed 14 September 2014

43. de Onis M, Onyango AW, Borghi E *et al.* (2007) Development of a WHO growth reference for school-aged children and adolescents. **85**, 660-667.
44. World Health Organization (2011) Waist Circumference and Waist–Hip Ratio: Report of a WHO Expert Consultation. *World Health Organization*. http://apps.who.int/iris/bitstream/10665/44583/1/9789241501491_eng.pdf (accessed 14 September 2014
45. National Academy of Sciences (2005) *Dietary reference intakes for energy, carbohydrate, fiber, fat, fatty acids, cholesterol, protein, and amino acids.* Washington, D.C.: National Academies Press.
46. Dwyer GM, Hardy LL, Peat JK *et al.* (2011) The validity and reliability of a home environment preschool-age physical activity questionnaire (Pre-PAQ). *Int J Behav Nutr Phys Act* **8**.
47. Vale S, Trost S, Duncan M *et al.* (2014) Step based physical activity guidelines for preschool-aged children. *Preventive Medicine*.
48. Instituto Nacional de Estatística (2011) *Classificacção Portuguesa das Profissões 2010.* Lisboa: Instituto Nacional de Estatística, IP.
49. World Health Organization (2012) *Population-based approaches to childhood obesity prevention.* Geneva: World Health Organization.
50. Sancho T, Cruz S, Pinto E *et al.* (2014) Prevalence of obesity among preschool children using three definition criteria. *Revista Portuguesa de Cirurgia*, 48.
51. Aparício G, Cunha M, Duarte J *et al.* (2013) Nutritional status in preschool children: current trends of mother's body perception and concerns. *Atencion Primaria / Sociedad Española De Medicina De Familia Y Comunitaria* **45 Suppl 2**, 194-200.
52. Gomes S, Espanca R, Gato A *et al.* (2010) Obesity in preschool age: Too Early to Be Too Heavy! *Acta Medica Port* **23**, 371-378.
53. Lourenço M, Santos C, do Carmo I (2014) Nutritional status and dietary habits in preschool-age children. *Estado nutricional e hábitos alimentares em crianças de idade pré-escolar* **4**, 7-14.
54. Rito A (2006) Overweight and Obesity in Preschool children of Coimbra: an urban city of Portugal. *Obesity reviews* **7**, 323.
55. Vale S, Rute S, Soares-Miranda L *et al.* (2011) Prevalence of overweight/obesity among Portuguese preschoolers. *International Journal of Obesity* **35**, S166-S166.
56. Duarte ME (2011) Estilos de vida familiar e peso excessivo na criança em idade pré-escolar. Lisboa.
57. Olds T, Maher C, Zumin S *et al.* (2011) Evidence that the prevalence of childhood overweight is plateauing: data from nine countries. *International Journal of Pediatric Obesity* **6**, 342-360.
58. World Health Organization (2009) *Interventions on diet and physical activity: what works: summary report.* Geneva: World Health Organization.
59. De Bourdeaudhuij I, Van Cauwenberghe E, Spittaels H *et al.* (2011) School-based interventions promoting both physical activity and healthy eating in Europe: a systematic review within the HOPE project. *Obesity Reviews* **12**, 205-216.
60. Waters E, de Silva-Sanigorski A, Hall BJ *et al.* (2011) Interventions for preventing obesity in children. *Cochrane Database of Systematic Reviews*.
61. Rosário R, Oliveira B, Araújo A *et al.* (2012) The impact of an intervention taught by trained teachers on childhood overweight. *International Journal Of Environmental Research And Public Health* **9**, 1355-1367.

62. Brauchla M, Juan W, Story J *et al.* (2012) Sources of Dietary Fiber and the Association of Fiber Intake with Childhood Obesity Risk (in 2-18 Year Olds) and Diabetes Risk of Adolescents 12-18 Year Olds: NHANES 2003-2006. *Journal of nutrition and metabolism* **2012**.
63. Kimm SY (1995) The role of dietary fiber in the development and treatment of childhood obesity. *Pediatrics* **96**, 1010-1014.
64. Williams CL (2006) Dietary fiber in childhood. *Journal of Pediatrics* **149**, S121-S130.
65. Gentile DA, Welk G, Eisenmann JC *et al.* (2009) Evaluation of a multiple ecological level child obesity prevention program: Switch what you Do, View, and Chew. *BMC Medicine* **7**, 49-49.
66. World Health Organization (2003) Diet, nutrition and the prevention of chronic diseases - Introduction. In *Diet, Nutrition and the Prevention of Chronic Diseases*, vol. 916, pp. 1-149. Geneva: World Health Organization.
67. Muckelbauer R, Libuda L, Clausen K *et al.* (2009) A Simple Dietary Intervention in the School Setting Decreased Incidence of Overweight in Children. *Obesity Facts* **2**, 282-285.
68. Lubans DR, Morgan PJ, Tudor-Locke C (2009) A systematic review of studies using pedometers to promote physical activity among youth. *Preventive Medicine* **48**, 307-315.
69. Tudor-Locke C, Craig CL, Beets MW *et al.* (2011) How many steps/day are enough? for children and adolescents. *The International Journal Of Behavioral Nutrition And Physical Activity* **8**, 78-78.
70. Gonzalez-Suarez C, Worley A, Grimmer-Somers K *et al.* (2009) School-based interventions on childhood obesity: a meta-analysis. *American Journal Of Preventive Medicine* **37**, 418-427.
71. Doak C, Heitmann BL, Summerbell C *et al.* (2009) Prevention of childhood obesity – what type of evidence should we consider relevant? *Obesity Reviews* **10**, 350-356.
72. Mindell JS, Coombs N, Stamatakis E (2014) Measuring physical activity in children and adolescents for dietary surveys: practicalities, problems and pitfalls. *The Proceedings Of The Nutrition Society* **73**, 218-225.

5.5. Study V

Eating behavior and body mass index in Portuguese preschool children: results from a socio-ecological intervention

Eating behavior and body mass index in Portuguese preschool children: results from a socio-ecological intervention

Background: Weight status is the result of multiple factors, in which eating behaviors also play an important role, namely the individual responsiveness and the environment to which individuals are exposed.

Objective: This study aimed to analyze the association between eating behaviors and BMI, as well as to report the results from a socio-ecological intervention with Portuguese preschool children.

Methods: This randomized control trial had the participation of 211 preschool children, aged 5.3 (±0.5) years, 108 girls (51.2%), allocated in an experimental group (EG) and a control group (CG). A six month socio-ecological intervention in a school-family based framework was developed. Anthropometric, eating behavior and socioeconomic status (SES) assessments were performed before and after the intervention. BMI was categorized using the World Health Organization (WHO) growth reference and statistical associations were performed with two BMI categories, non-overweight (NOW) and overweight/obesity (OW). Eating behavior was assessed with the Child Eating Behavior Questionnaire (CEBQ) and Meals in Our Household Questionnaire (MOHQ), filled out by parents. SES was assessed regarding mother's and father's education and occupational levels.

Results: At baseline, BMI categories were associated to the following behaviors: "buying food with a previously prepared list", "enjoyment of food", "satiety responsiveness" and "slowness in eating". The six month intervention was effective in increasing the frequencies of children that, at meals, eat the same food as everyone else.

Conclusion: Buying foods with a previously prepared list controls the individual responsiveness to food and improve the environment of meals that can be effective in addressing childhood obesity.

Key words: preschool children; BMI; eating behavior; food list

Introduction

Rapid changes in diets and lifestyles that have occurred with industrialization, urbanization, economic development and market globalization (WHO, 2003), have resulted in an obesogenic environment (Doak et al., 2006; Kremers et al., 2006; Wells, 2012). The increased prevalence of childhood obesity is a result of the lack of physical activity and the availability of high-fat and high-energy-density foods which the paediatric population faces daily (Obregón et al., 2014). Childhood overweight and obesity are thus serious public health challenges (Karnik & Kanekar, 2012).

Commonly childhood obesity is basically attributed to the energy imbalance from factors related to dietary intake and physical activity. However, energy intake and energy expenditure are consequences of specific behaviors (e.g. choosing foods, eating foods, watching TV, playing sports) that are themselves influenced by a wide range of internal and external determinants (Wardle, 2007). On the one hand, eating behaviors are consequences of the interplay of biological, psychological, and social factors. On the other hand, food intake is regulated by a complex interplay of physiological, environmental, and cognitive factors (Heshmat, 2011). Additionally, there is a wide variation in body weight, suggesting the presence of different patterns of response to the obesogenic environment (Obregón et al., 2014). Although it is known that a high heritability of appetitive traits are related to weight (Carnell et al., 2008), there are several determinants related to food intake, including food characteristics, emotional state, modern food environment, individual traits in both appetite and control of energy intake (Wardle, 2007).

A number of appetitive traits related to obesity risk in children have been identified (Croker et al., 2011). Several studies have reported relationships for food responsiveness, (positive relationship with obesity) satiety responsiveness and slowness in eating (negative relationship with obesity) (Croker et al., 2011; Sleddens et al., 2008; Spence et al., 2011; Viana & Sinde, 2008; Webber et al., 2009). These behaviors can be measured with the *Children's Eating Behaviour Questionnaire* (CEBQ) (Wardle et al., 2001), which includes eight subscales that measure either food approach (promote food consumption) or food avoid (avoid food consumption) type eating behaviors, for which it is expected to be a positive or negative relationship with weight status, respectively.

Within the framework of eating behavior, it is noted that the family mealtime environment is also an important issue. There is increasing evidence that the frequency of shared family mealtimes is associated with many positive dietary outcomes for children and youth (Anderson et al., 2012; Cason, 2006; Fiese et al., 2012; Quick et al., 2011). In addition to the nutritional benefits, shared family mealtimes have been associated with an inverse relationship for the risk of pediatric overweight or obesity (Berge et al., 2013; Burnier et al., 2011; Eisenberg et al., 2004; Fiese et al., 2012; Fiese & Schwartz, 2008; Hammons & Fiese, 2011; Martin-Biggers et al., 2014; Moens et al., 2007; Neumark-Sztainer et al., 2010; Rockett, 2007; Taveras et al., 2005).

Different child-feeding parental practices may also affect family meals, from coercing children to eating specific foods by promising rewards, or withholding favorite food as punishment, thereby shaping the availability and accessibility to specific food, either healthy or unhealthy food items (Johannsen et al., 2006; Stang & Loth, 2011). The restriction and the pressure-to-eat food-related parenting practices can disrupt the children's regulation of energy intake (Birch & Fisher, 1998), meaning a negative impact on the children's dietary intake, leading to the risk of overweight and obesity (Loth et al., 2013).

The structure of family meals is characterized by the preparation of meals and how they are usually consumed (who with, where and what the environment is). Additionally, it is known that some of the characteristics of family meals also have related to weight. The Meals in Our Household Questionnaire (MOHQ) (Anderson et al., 2012) includes six domains which measures comprehensively family meal structure and environment, the children's mealtime behavior and its impact on the family, parental concerns about the children's diet, and the use of food as a reward.

Schools have been found to be a potential environments for intervention (Dahlgren & Whitehead, 2007; Moreno et al., 2013; Story et al., 2009), and also as a universally motivating setting for children (Han et al., 2010). Regarding early childhood interventions, there is emerging evidence demonstrating the effectiveness of obesity prevention by targeting children attending early childcare settings, such as preschools (de Onis et al., 2010; Gupta et al., 2012; Hesketh & Campbell, 2010; Wofford, 2008). In addition, school-based interventions should integrate behavioral and environmental approaches using

a systems-level approach targeting the multilevel structure of the socioecological model as well as the possible interactions and relationships between levels (Hoelscher et al., 2013). The purpose of this research was to assess the impact of a six month socio-ecological intervention on eating behaviors and BMI in Portuguese preschool children.

Methodology

Study Design

This randomized control trial was conducted during the school year of 2013/2014 for a period of six months. All public preschools existing in the Faro Municipality (n=5) were invited to participate through the Algarve Regional Education Authority. The participating children's parents received verbal explanation and written information about the study by the research coordinator. Prior to data collection, the parents provided an informed consent, according to the ethical standards defined by the Declaration of Helsinki (WMA, 2013), and children provided verbal consent. This study was approved by the Scientific Council of the Faculty of Sports of Porto University. Ethical approval was achieved from the local Health Ethical Committee of the Algarve Regional Health Administration of the Ministry of Health, and approval was also granted by the Portuguese Data Protection Authority (CNPD - Comissão Nacional de Proteção de Dados, Process Nr. 6263/2013). In addition, permission from the Ministry of Education for the implementation of school surveys was obtained through registration Nr. 0399500001. Further agreement was obtained from the Algarve Regional Education Authority and the School Boards. Data collection occurred with the anthropometric assessments performed at the schools and the questionnaires filled out by parents at home. Pedometers were used in both preschool and home environments.

Participants

Parents of all children (n=249) attending the five preschools (a total of 11 classes) in the Faro municipality were contacted. Only the parents of 215 children provided a written informed consent (86%), of which four were excluded due to health problems related to physical and/or intellectual disability.

The final study sample consisted of a total of 211 children (51.2% female, aged between 3 and 6 years) from the 5 preschools in the Faro municipality. All children participating in the study were randomized into the following groups: (i) 115 children (54.5%) from 2 preschools (6 classes) were allocated into the EG, and (ii) 96 children (45.5%) from 3 preschools (5 classes) were allocated into the CG group. For practical reasons, and to avoid the effect of contamination, preschool classes that were integrated in the same school building were randomized into the same group. Follow up anthropometric assessment data was only collected from 93.4% of the children, 109 (94.8%) from the EG and 88 (91.7%) from the CG.

Overview of the intervention program

Children (n=115) from the two preschools that were allocated into the EG, participated in the intervention program that was conducted between November 2013 and April 2014. This intervention was based on the socio-ecologic theoretical model (Bronfenbrenner, 1994), which has been identified as an effective approach in the promotion of healthy lifestyles (Lobstein et al., 2004), and in the prevention of childhood obesity (Penhollow & Rhoads, 2014). The socio-ecologic framework model further explains that the behavior of preschoolers is influenced by the attitudes and behaviors of the members of their larger network, which includes parents, siblings, peer preschoolers and teachers (De Bock et al., 2010).

Although the main target group was preschool children, the intervention was also addressed to parents, kindergarten teachers and preschool staff, as well as in the preschool environment. Kindergarten teachers and parents are the two major influence factors for preschoolers (Niederer et al., 2009). Parents are essential in developing a home environment that fosters healthy lifestyles (Brotman et al., 2012; Hawkins et al., 2009; Ritchie et al., 2005). Teachers have an important role of fostering positive healthy lifestyles and providing good modeling and social learning opportunities (Manore et al., 2014). The physical school environment offers many opportunities for the development of strategies concerning healthy behaviors (Harrison & Jones, 2012; Story et al., 2006; Story et al., 2009). Given that a change in behavior is expected to be maximized both when environments and policies support healthy choices and when individuals

are motivated and educated to make those choices (Sallis et al., 2008), a parent-focused, school-based childhood obesity prevention program was devised.

Prior to the beginning of the intervention, kindergarten teachers of children belonging in the EG, participated in a six-hour workshop, that aimed in promoting strategies to help children make healthy food choices, where healthy eating behaviors were approached. All preschool animators participated in work training and specific educational materials were handed out. These educational materials provided information on activities that could be implemented to promote healthy lifestyle behaviors in children at preschools. Additionally, children participated in six 30-minute, puppet theatres about healthy lifestyle behaviors, which included a pedagogical song for singing and dancing.

Parents of children from the EG, participated in six, 60-minute, monthly sessions, with different contents aiming to promote a healthy home environment and healthy eating behaviors. For each session, an informative leaflets was provided. In a preschool environment, several strategies were put into practice, addressing eating behaviors.

The implementation of the intervention program occurred as planned. Children from the EG participated in all of the activities as planned. Both the school-based and the family-based components of the intervention were feasible. However, parents attendance at the interventional sessions were irregular, which is also confirmed in other studies (Fitzgibbon et al., 2013).

Data collection

Children were assessed both at baseline and post-intervention, but it was not always possible to collect data for all parameters. However, BMI and socio-demographic characteristics did not differ significantly between the children who followed through with the interventional study (up until post-intervention assessment) and those who only completed the first assessment.

Anthropometric measures

All the children were assessed under the same conditions, with the same equipment and by the same trained researcher in order to minimize inter-observer error, using a standardized procedure (WHO, 2008). Height and

weight were determined wearing light clothes, no shoes and no socks. Height was measured in meters, to the nearest millimeter using a portable stadiometer (Seca® model 214), with the head in the Frankfort plane. Weight was measured in kilograms, to the nearest decigram, using a digital device (Tanita® model BC 418). Height and weight measures were converted into BMI, expressed in kg/m^2, for each participant. BMI was standardized for age and sex, and specific prevalence of underweight, normal, overweight and obesity was determined using BMI z-score according to the World Health Organization (WHO) Growth Reference (de Onis et al., 2007), with overweight and obesity being defined as a BMI z-score ≥1 and ≥2, respectively.

Eating behavior

Eating behavior of children was measured using the *Children's Eating Behaviour Questionnaire* (CEBQ) (Wardle et al., 2001) translated and validated into Portuguese language (Viana & Sinde, 2008), and by the *Meals in Our Household Questionnaire* (MOHQ) (Anderson et al., 2012) also translated and validated into Portuguese language (Sancho et al., 2014). The CEBQ is a multi-dimensional, parent-reported questionnaire measuring children's eating behaviors related to obesity risk. This questionnaire consists of 35 items comprising eight scales of eating style: enjoyment of food (EF), food responsiveness (FR), emotional overeating (EOE), desire to drink (DD), satiety responsiveness (SR), slowness in eating (SE), emotional under-eating (EUE), and food fussiness (FF). The CEBQ subscales are categorized in "food approach" (EF, FR, EOE, DD) and "food avoidant" subscales (SR, SE, EUE, FF). The MOHQ is a parent-report questionnaire which comprehensively measures family meal structure and environment with a special emphasis to the children's mealtime eating behavior. This questionnaire measures six domains, but in our study we used only two of them: "structure of family meals" and "use of food as reward". In order to better understand eating behavior including food purchasing procedures, in the context of meal preparation, we introduced into the "structure of family meals" domain, two additional questions: "Buying of food is done with a previously prepared list" and "In buying food, I read the nutrition labelling".

Socio-demographic and lifestyle variables

SES data was collected, which included family characteristics, mother's and father's education and occupational levels, watching TV profile, and sleeping characteristics. Parent's education level was defined according to the Portuguese Educational System, which includes three categories: basic or less (≤9 school years), secondary (10–12 school years) and college/university (>12 school years). The parents occupation level was organized in ten categories according to the standard Portuguese method of classifying occupations (INE, 2011), having subsequently been re-coded into four categories (1 to 4), 4 being the highest level, beyond the status of unemployed. Additionally, socioeconomic status was also evaluated through the school assigned echelons for social intervention by the Ministry of Education: A (greater intervention), B (less intervention), and without social intervention.

Statistical analyses

To describe continuous variables we computed mean values and standard deviations, or median values and interquartile range. Qualitative variables were described with absolute and relative frequencies. Following the results of the Kolmogorov-Smirnov test for assessing normality, we used Mann–Whitney's U, Chi-square, or Wilcoxon's signed ranks tests to compare the participants in baseline assessment and at post-intervention.

The differences between the EG and the CG were also analyzed using a Generalized Linear Model and took into account the nested nature of the data (children were nested within schools), and possible confounders such as SES, gender, age, and baseline energy intake.

Due to the loss of participants during the follow-up, we tested for significant differences in BMI and socio-demographic characteristics (SES, age and sex) between participants who completed only the baseline assessment and those who completed both assessments. No significant differences were found, which allows us to infer that the loss of follow-up did not significantly alter the characteristics of the sample.

BMI z-scores were calculated using the WHO Anthro software (version 3.2.2, January 2011) and statistical associations were performed with two BMI

categories, under/normal weight (NOW) and overweight/obesity (OW), considering that there were only a few underweight children in our study.

Statistical significance for all tests was set at 5%. Data were analyzed with IBM-SPSS® software version 21.0 (SPSS Inc., Chicago, IL, USA).

Results

In **Table 1** we can observe the baseline characteristics of the participants. Subjects included 108 girls (51.8%) and 103 boys (48.8%), aged 5.3 (±0.5) years. The average BMI was 15.8 kg/m^2 (±1.8) and BMI z-score was 0.28 (±1.08). According to the WHO growth reference, 2.4% of the children were classified as underweight, 13.3% as overweight and 10.4% as obese. No significant differences were found between the CG and the EG regarding BMI or BMI z-score. However, significant differences were found between the control and the experimental groups at baseline ($p<0.05$) in age, weight and height, indicating higher mean values in these variables for the participants in the CG. Furthermore, both the mother ($p=0.039$) and the father ($p=0.003$) of the children in the CG had less schooling than those of the EG. Concerning occupation categories, the parents of the children in the CG have a lower prevalence of highly skilled professions, with differences in the mother's occupation ($p=0.01$) and the father's occupation ($p=0.025$). These differences at baseline prompted us to control these variables in all further statistical analyses.

Table 2 shows the median scores of the CEBQ sub-scale related to the two BMI categories, NOW and OW children, presented in the "food approach" sub-scales and "food avoid" sub-scales, as well as the interquartile range at baseline and post-intervention assessments, reporting the behavior change after the socio-ecologic intervention. Regarding the relationship between eating behaviors of CEBQ sub-scales and BMI category at baseline, we found statistical association in respect to enjoyment of food ($p=0.001$) related to "food approach" in OW children, satiety responsiveness ($p=0.045$) and slowness in eating ($p=0.004$) related to "food avoid" in NOW children. After the intervention, with adjustments for age, sex and SES, the results for CG and EG, presented through the interquartile range at baseline and post-intervention assessments, allowed us to conclude that there is no statistical difference for eating behaviors in the CEBQ sub-scales ($p>0.05$).

Table 1. Characteristics at baseline in control and experimental groups.

	Total	Control	Experimental	*p**
Anthropometry	**n=211**	**n=96**	**n=115**	
Age (years)	4.8 (0.5)	5.0 (0.5)	4.7 (0.5)	**<0.001**†
Weight (Kg)	19.9 (3.5)	20.5 (3.8)	19.4 (3.2)	**0.015**†
Height (cm)	111.8 (5.4)	1.13 (0.05)	1.10 (0.05)	**<0.001**†
BMI (Kg/m^2)	15.8 (1.8)	15.9 (1.8)	15.8 (1.7)	0.770†
BMI z-score	0.28 (1.08)	0.33 (1.09)	0.25 (1.08)	0.638†
Mother's education	**n=175**	**n=69**	**n=106**	
Up to 9 years	61 (34.9)	33 (47.8)	28 (26.4)	
10 to 12 years	56 (32.0)	21 (30.4)	35 (33.0)	**0.039**††
> 12 years	58 (33.1)	15 (21.7)	43 (40.6)	
Father's education	**n=154**	**n=58**	**n=96**	
Up to 9 years	66 (42.8)	32 (55.2)	34 (35.4)	
10 to 12 years	44 (28.6)	19 (32.8)	26 (27.1)	**0.003**††
> 12 years	44 (28.6)	7 (12.1)	36 (37.5)	
Mother's occupation	**n=160**	**n=61**	**n=99**	
Level 1	24 (15.0)	16 (26.2)	8 (8.1)	
Level 2	62 (38.8)	28 (45.9)	34 (34.3)	
Level 3	11 (6.9)	1 (1.6)	10 (10.1)	**0.001**††
Level 4	41 (25.6)	9 (14.8)	32 (32.3)	
Unemployed	22 (13.8)	7 (11.5)	15 (15.2)	
Father's occupation	**n=159**	**n=63**	**n=96**	
Level 1	5 (3.1)	1 (1.6)	4 (4.2)	
Level 2	86 (54.1)	43 (68.3)	43 (44.8)	
Level 3	10 (6.3)	5 (7.9)	5 (5.2)	**0.025**††
Level 4	48 (30.2)	11 (17.5)	37 (38.5)	
Unemployed	10 (6.3)	3 (4.8)	7 (7.3)	

Data presented as mean (standard deviation) for anthropometric variables and *n* (%) for other variables.

**p* value for differences between groups computed with Mann-Whitney's test†. or χ^2 test††

The domain "structure of family meals" from MOHQ, as well as "procedures in buying food", were assessed by a group of sentences (**Table 3**) that participants had to classify in a numeric scale where 0 represented "never", 1 represented "rarely", 2 represented "sometimes", 3 represented "often", and 4 represented "very often". Where applicable, scoring for the sentences was inverted in order to present the data in a way that allowed a better comparison of scoring for each sentence. Thus, higher median scores indicate a better behavior.

Table 2. CEBQ subscale by BMI category(I) and CEBQ median scores and median scores at post-intervention (II).

CEBQ sub-scales		Association of eating behaviors by BMI categories before intervention (I)			Behavior change after intervention (II)				
					Baseline		Post-intervention		
		Non-overweight n=128	Overweight n=47	p*	CG n=71	EG n=104	CG n=43	EG n=25	p**
"**Food approach" sub-scales**	Enjoyment of Food	2.75 (1.0)	3.25 (1.0)	**0.001**	3.0 (1.0)	2.75 (1.0)	1.8 (1.0)	1.8 (1.0)	0.652
	Food Responsiveness	1.6 (0.8)	2.0 (1.3)	0.102	1.8 (1.0)	1.8 (1.0)	1.8 (1.0)	1.8 (1.0)	0.653
	Emotional Overeating	1.8 (0.8)	2.0 (1.2)	0.260	1.8 (1.0)	1.8 (0.8)	1.8 (1.2)	1.6 (1.2)	0.113
	Desire to Drink	1.67 (1.33)	2.0 (1.0)	0.236	2.17 (1.33)	1.67 (1.0)	2.0 (1.33)	1.33 (1.0)	0.324
"Food avoidant" sub-scales	Satiety Responsiveness	3.0 (0.6)	2.8 (0.6)	**0.045**	2.9 (0.8)	2.8 (0.6)	2.8 (1.0)	3.0 (0.2)	0.719
	Slowness in Eating	2.75 (0.75)	2.5 (0.5)	**0.004**	2.75 (1.0)	2.75 (0.75)	2.75 (0.75)	2.75 (0.75)	0.680
	Emotional Undereating	2.67 (1.0)	2.3 (0.67)	0.081	2.33 (1.0)	2.67 (1.0)	2.33 (1.0)	2.67 (0.83)	0.433
	Food Fussiness	2.83 (0.33)	2.83 (0.33)	0.924	2.83 (0.33)	2.83 (0.33)	2.67 (0.5)	2.83 (0.33)	0.881

CG – Control group; EG – Experimental group.

Data presented as median (interquartile range)

* p value for group differences computed with Mann-Whitney's test

** p value adjusted for age, sex and socio-economic status.

Table 3. Structure of family meals and procedures in buying food by BMI categories (I) and median scores at post-intervention (II).

	Behaviors of structure of family meals and procedures in buying food by BMI categories (I)			Change in behaviors of structure of family meals and procedures in buying food after intervention (II)						
				Baseline			Post-intervention			
	Non-overweight n=128	Overweight and obese n=47	P*	CG n=71	EG n=104	p	CG n=43	EG n=25	P*	P**
My child eats with myself or other family members	4.0 (1.0)	4.0 (1.0)	0.790	4.0 (1.0)	4.0 (1.0)	0.952	4.0 (1.0)	4.0 (0.0)	0.279	0.714
The television is on in the same room when my child is eating meals	2.0 (2.0)	1.0 (2.0)	0.059	1.0 (3.0)	2.0 (2.0)	0.072	1.0 (1.0)	2.0 (2.0)	0.372	0.647
Our family eats an evening meal at a regular time	4.0 (1.0)	4.0 (1.0)	0.873	4.0 (1.0)	4.0 (1.0)	0.074	3.0 (1.0)	4.0 (1.0)	**0.016**	0.381
Meals in our household are rushed	3.0 (1.0)	3.0 (2.0)	0.894	3.0 (1.0)	3.0 (1.0)	0.770	3.0 (2.0)	3.0 (2.0)	0.775	0.128
We eat meals in the kitchen or dining room	4.0 (0.0)	4.0 (0.0)	0.743	4.0 (0.0)	4.0 (0.0)	0.246	4.0 (1.0)	4.0 (0.0)	0.133	0.417
We eat meals in the car	4.0 (0.0)	4.0 (0.0)	0.582	4.0 (0.0)	4.0 (0.0)	0.762	4.0 (0.0)	4.0 (0.0)	0.966	0.511
At meals, my child eats the same food as everyone else	4.0 (0.0)	4.0 (1.0)	0.672	4.0 (0.0)	4.0 (1.0)	0.199	4.0 (1.0)	4.0 (0.0)	0.222	**0.017**
Someone in our household cooks meals	4.0 (4.0)	3.5 (4.0)	0.416	4.0 (4.0)	4.0 (4.0)	0.861	3.0 (4.0)	4.0 (3.0)	0.168	0.623
We buy food with a previously prepared list	3.0 (2.0)	2.0 (1.0)	**0.001**	3.0 (2.0)	3.0 (2.0)	0.026	3.0 (2.5)	3.5 (2.0)	0.236	0.280
When buying food, I read the information in the labels	2.0 (1.0)	2.0 (1.0)	0.956	2.0 (1.0)	2.0 (1.0)	0.806	2.0 (1.0)	2.0 (1.0)	0.923	0.697

CG – Control group; EG – Experimental group.

Data presented as median (interquartile range).

* p-value for group differences computed with Mann-Whitney's test.

** p value adjusted for age, sex and socio-economic status.

Table 3 shows results reporting the behavior change after the socio-ecologic intervention, regarding the eight items of the “structure of family meals” domain along with two items from “procedures in buying food” related to the two BMI categories, NOW and OW children, as well as the interquartile range at baseline and post-intervention assessments. Regarding the relationship between “structure of family meals” items and BMI category at baseline, we did not find statistical differences between BMI categories. However, in respect to buying food with a previously prepared list (“We buy food with a previously prepared list”) we found a statistical association (p=0.001) with NOW children. After the intervention, all sentences where similarly scored by participants at baseline and at post-intervention, except the one regarding the regular time for evening meals (“Our family eats an evening meal at a regular time”). At post intervention, the EG ranked a higher median score (Mdn=4.0) than the CG (Mdn=3.0), indicating a higher frequency of regular evening meals (p=0.016). Nevertheless, when analyzing the differences in median scores for each group considering both the baseline and the post-intervention assessment, the behavior change was not considered statistically significant (p=0.381). The only change in behavior of the structure of family meals we recorded as statistically significant was the one related with the frequency of the child eating the same food as everyone else (“At meals, my child eats the same food as everyone else”). In this sentence, we found a statistically significant evolution in behavior (p=0.017) even if median scores remained similar and the only apparent change is in the dispersion of the distribution of variables, as can be perceived by the interquartile range at both assessments.

The behaviors related to using food as a reward were scored in the same numbered scale ranging from 0 (“never”) to 4 (“very often”) and studied through five items: (1) “I give my child food to keep him/her quiet when shopping or travelling”; (2) “I give my child food to reward him/her for good behavior”; (3) “I with hold a food my child likes as a consequence for bad behavior”; (4) “I give my child a special food to celebrate as achievement”; and (5) “I give my child food to persuade him/her to do something him/her to do something he/she does not really want to do”. Nevertheless, we did not find any statistical difference

regarding BMI categories. In the same way, there were no significant differences between baseline and post-intervention assessments. Additionally, no statistically significant behavior change in this variable was observed ($p>0.05$).

In this intervention study, BMI z-score was reduced in the EG ($p=0.04$) and increased in the CG. However, no changes were achieved regarding BMI categories.

Discussion

The present study shows results regarding the relationship between existing eating behaviors at baseline and BMI categories, as well as, the results of a six-month socio-ecologic intervention on healthy eating behavior, in the context of a prevention program for overweight and obesity among a Portuguese preschool population, that aimed to improve eating behaviors.

In the eating behaviors that were studied, only a statistically significant change was found related to the “structure of family meals”, on the circumstance of at meals, children eat the same food as everyone else. Actually, although just one, it consists in an important premise to address childhood obesity within the family context, because eating the same food is part of the spectrum of ordering of eating, which is crucial to improve the interventions targeted at addressing childhood obesity prevention (Kime, 2009).

Concerning the associations that were identified between eating behaviors from the CEBQ sub-scales and BMI categories, we found significant results that are in line with other studies. Eating behaviors such as “enjoyment of food” was positively connected with obesity and “satiety responsiveness” and “slowness in eating” were both negatively connected with obesity (Sleddens et al., 2008; Spence et al., 2011; Viana & Sinde, 2008; Webber et al., 2009), with Croker et al. (2011) also pointing to the same “food avoidant” sub-scales (Croker et al., 2011).

Regarding the relationship between procedures in buying food related to BMI categories, we found a significant association. Buying food with a previously prepared list was inversely related to being obese or overweight. In

fact, several published papers have mentioned that a food list is an important strategy in the prevention or treatment of obesity (Beneke & Davis, 1985; Cunningham et al., 2006; Elmslie et al., 2012). However, to our best knowledge, no study has ever revealed a relationship between food shopping with a previously prepared list and weight status, which is something innovative in our study.

Regarding baseline results, the CG and the EG were significantly different for age, weight and height, and the education level and occupation category for both mother and father, prompting us to control these variables in all further statistical analyses of the study.

We attempted to direct our study towards the best evidence-based intervention practice, based on the socio-ecological model (Penhollow & Rhoads, 2014), in a school setting (WHO, 2009) such as preschools (Wofford, 2008), with a parental/family home component (Hoelscher et al., 2013), and with relevant support for teachers and other staff members (Rosário et al., 2012; Waters et al., 2011). In addition, and to our better knowledge, no other program devised on eating behaviors against childhood obesity has been performed in the preschools of this study.

Between the CG and the EG there were no differences observed in the incidence or prevalence of overweight and obesity categories after the intervention.

The present study has important strengths that should be acknowledged. All children were assessed under the same conditions, with the same equipment and by two highly trained and specialized researchers in anthropometry to minimize inter-observer error. Nonetheless, our study has some weaknesses that should also be recognized. The small population study size, though in correspondence to the existing reality in public preschools of Faro, may have limited the detection of other significant differences than those reported. Furthermore, we were not completely rigorous in allocating identical subjects into two groups after randomization, namely in both the mother's and father's education level and occupation category, as well as the children's age, weight and height, mainly because we randomized by preschool, and not by

children, aiming to avoid cross contamination between the EG and the CG. Nevertheless, these differences were taken into account in all of the statistical analyses. Self-reported data collection, such as the questionnaires that were filled out by parents, may lead to bias triggered by social desirability (Mindell et al., 2014). Finally, we must refer to the problem of non-responses, arising from lack of time and/or other engagement of parents, along with the size of the questionnaires, which can further add bias to the data collected.

Conclusions

The findings in this study demonstrated that a six-month socio-ecologic intervention on eating behavior among a preschool population was effective in increasing the frequency of children that, at meals, eat the same food as everyone else. In addition, at baseline, we found associations between BMI categories and “enjoyment of food”, “satiety responsiveness” and “slowness in eating”, as well as “to buy food with a previously prepared list”. Future preschool studies should be based on a socio-ecological approach, with larger populations, for a longer period and with periodically follow-up assessments.

References

Anderson, S. E., Must, A., Curtin, C., & Bandini, L. G. (2012). Meals in Our Household: Reliability and Initial Validation of a Questionnaire to Assess Child Mealtime Behaviors and Family Mealtime Environments. *Journal of the Academy of Nutrition and Dietetics, 112*(2), 276-284.

Beneke, W. M., & Davis, C. H. (1985). Relationship of hunger, use of a shopping list and obesity to food purchases. *International Journal Of Obesity, 9*(6), 391-399.

Berge, J. M., Jin, S. W., Hannan, P., & Neumark-Sztainer, D. (2013). Structural and Interpersonal Characteristics of Family Meals: Associations with Adolescent Body Mass Index and Dietary Patterns. *Journal of the Academy of Nutrition and Dietetics, 113*(6), 816-822.

Birch, L. L., & Fisher, J. O. (1998). Development of eating behaviors among children and adolescents. *Pediatrics, 101*(3 Pt 2), 539-549.

Bronfenbrenner, U. (1994). Ecological Models of Human Development. In *International Encyclopedia of Education* (2nd ed., Vol. 3). NY: Freeman.

Brotman, L. M., Dawson-McClure, S., Huang, K.-Y., Theise, R., Kamboukos, D., Wang, J., Petkova, E., & Ogedegbe, G. (2012). Early Childhood Family Intervention and Long-term Obesity Prevention Among High-risk Minority Youth. *Pediatrics, 129*(3), E621-E628.

Burnier, D., Dubois, L., & Girard, M. (2011). Arguments at Mealtime and Child Energy Intake. *Journal of Nutrition Education and Behavior, 43*(6), 473-481.

Carnell, S., Haworth, C. M. A., Plomin, R., & Wardle, J. (2008). Genetic influence on appetite in children. *International Journal of Obesity, 32*(10), 1468-1473.

Cason, K. L. (2006). Family mealtimes: More than just eating together. *Journal of the American Dietetic Association, 106*(4), 532-533.

Croker, H., Cooke, L., & Wardle, J. (2011). Appetitive behaviours of children attending obesity treatment. *Appetite, 57*(2), 525-529.

Cunningham, C., Johnson, S., Cowell, B., Soroudi, N., Segal-Isaacson, C. J., Davis, N. J., Isasi, C. R., & Wylie-Rosett, J. (2006). Menu Plans in a Diabetes Self-management Weight Loss Program. *Journal of Nutrition Education and Behavior, 38*(4), 264-266.

Dahlgren, G., & Whitehead, M. (2007). *European strategies for tackling social inequities in health: Levelling up Part 2*. Copenhagen: WHO.

De Bock, F., Fischer, J. E., Hoffmann, K., & Renz-Polster, H. (2010). A participatory parent-focused intervention promoting physical activity in preschools: design of a cluster-randomized trial. *BMC Public Health, 10*.

de Onis, M., Blossner, M., & Borghi, E. (2010). Global prevalence and trends of overweight and obesity among preschool children. *American Journal of Clinical Nutrition, 92*(5), 1257-1264.

de Onis, M., Onyango, A. W., Borghi, E., Siyam, A., Nishida, C., & Siekmann, J. (2007). Development of a WHO growth reference for school-aged children and adolescents. *85*(9), 660-667.

Doak, C. M., Visscher, T. L., Renders, C. M., & Seidell, J. C. (2006). The prevention of overweight and obesity in children and adolescents: a review of interventions and programmes. *Obesity Reviews: An Official Journal Of The International Association For The Study Of Obesity, 7*(1), 111-136.

Eisenberg, M. E., Olson, R. E., Neumark-Sztainer, D., Story, M., & Bearinger, L. H. (2004). Correlations between family meals and psychosocial well-being among adolescents. *Archives of Pediatrics & Adolescent Medicine, 158*(8), 792-796.

Elmslie, J. L., Sellman, J. D., Schroder, R. N., & Carter, F. A. (2012). The NEEDNT Food List: non-essential, energy-dense, nutritionally-deficient foods. *The New Zealand Medical Journal, 125*(1350), 84-92.

Fiese, B. H., Hammons, A., & Grigsby-Toussaint, D. (2012). Family mealtimes: a contextual approach to understanding childhood obesity. *Economics And Human Biology, 10*(4), 365-374.

Fiese, B. H., & Schwartz, M. (2008). Reclaiming the Family Table: Mealtimes and Child Health and Wellbeing: Social Policy Report. *Society for Research in Child Development, 22*(4), 3-19.

Fitzgibbon, M. L., Stolley, M. R., Schiffer, L., Kong, A., Braunschweig, C. L., Gomez-Perez, S. L., Odoms-Young, A., Van Horn, L., Christoffel, K. K., & Dyer, A. R. (2013). Family-based hip-hop to health: Outcome results. *Obesity (19307381), 21*(2), 274-283.

Gupta, N., Goel, K., Shah, P., & Misra, A. (2012). Childhood obesity in developing countries: epidemiology, determinants, and prevention. *Endocrine Reviews, 33*(1), 48-70.

Hammons, A. J., & Fiese, B. H. (2011). Is Frequency of Shared Family Meals Related to the Nutritional Health of Children and Adolescents? *Pediatrics, 127*(6), E1565-E1574.

Han, J. C., Lawlor, D. A., & Kimm, S. Y. S. (2010). Childhood obesity. *The Lancet, 375*(9727), 1737-1748.

Harrison, F., & Jones, A. P. (2012). A framework for understanding school based physical environmental influences on childhood obesity. *Health & Place, 18*(3), 639-648.

Hawkins, S. S., Cole, T. J., Law, C., & Millennium Cohort Study Child, H. (2009). An ecological systems approach to examining risk factors for early childhood overweight: findings from the UK Millennium Cohort Study. *Journal of Epidemiology and Community Health, 63*(2), 147-155.

Heshmat, S. (2011). *Eating Behavior and Obesity*. New York: Springer Pub. Co.

Hesketh, K. D., & Campbell, K. J. (2010). Interventions to Prevent Obesity in 0-5 Year Olds: An Updated Systematic Review of the Literature. *Obesity, 18*, S27-S35.

Hoelscher, D. M., Kirk, S., Ritchie, L., Cunningham-Sabo, L., & Acad Positions, C. (2013). Position of the Academy of Nutrition and Dietetics: Interventions for the Prevention and Treatment of Pediatric Overweight and Obesity. *Journal of the Academy of Nutrition and Dietetics, 113*(10), 1375-1394.

Instituto Nacional de Estatística. (2011). *Classificacção Portuguesa das Profissões 2010*. Lisboa: Instituto Nacional de Estatística, IP.

Johannsen, D. L., Johannsen, N. M., & Specker, B. L. (2006). Influence of parents' eating Behaviors and child feeding practices on children's weight status. *Obesity, 14*(3), 431-439.

Karnik, S., & Kanekar, A. (2012). Childhood obesity: a global public health crisis. *International Journal Of Preventive Medicine, 3*(1), 1-7.

Kime, N. (2009). How children eat may contribute to rising levels of obesity: children's eating behaviours: an intergenerational study of family influences. *International Journal of Health Promotion & Education, 47*(1), 4-11.

Kremers, S. P. J., de Bruijn, G.-J., Visscher, T. L. S., van Mechelen, W., de Vries, N. K., & Brug, J. (2006). Environmental influences on energy balance-related behaviors: a dual-process view. *The international journal of behavioral nutrition and physical activity, 3*, 9-9.

Lobstein, T., Baur, L., & Uauy, R. (2004). Obesity in children and young people: a crisis in public health. *Obesity Reviews: An Official Journal Of The International Association For The Study Of Obesity, 5 Suppl 1*, 4-104.

Loth, K. A., MacLehose, R. F., Fulkerson, J. A., Crow, S., & Neumark-Sztainer, D. (2013). Eat this, not that! Parental demographic correlates of food-related parenting practices. *Appetite, 60*(1), 140-147.

Manore, M. M., Brown, K., Houtkooper, L., Jakicic, J. M., Peters, J. C., Edge, M. S., Steiber, A., Going, S., Gable, L. G., & Krautheim, A. M. (2014). Energy Balance at a Crossroads: Translating the Science into Action. *Journal of the Academy of Nutrition and Dietetics, 114*(7), 1113-1119.

Martin-Biggers, J., Spaccarotella, K., Berhaupt-Glickstein, A., Hongu, N., Worobey, J., & Byrd-Bredbenner, C. (2014). Come and get it! A discussion of family mealtime literature and factors affecting obesity risk. *Advances in Nutrition, 5*(3), 235-247.

Moens, E., Braet, C., & Soetens, B. (2007). Observation of family functioning at mealtime: A comparison between families of children with and without overweight. *Journal of Pediatric Psychology, 32*(1), 52-63.

Moreno, L. A., Bel-Serrat, S., Santaliestra-Pasias, A. M., & Rodriguez, G. (2013). Obesity prevention in children. *World review of nutrition and dietetics, 106*, 119-126.

Neumark-Sztainer, D., Larson, N. I., Fulkerson, J. A., Eisenberg, M. E., & Story, M. (2010). Family meals and adolescents: what have we learned from Project EAT (Eating Among Teens)? *Public Health Nutrition, 13*(7), 1113-1121.

Niederer, I., Kriemler, S., Zahner, L., Buergi, F., Ebenegger, V., Hartmann, T., Meyer, U., Schindler, C., Nydegger, A., Marques-Vidal, P., & Puder, J. J. (2009). Influence of a lifestyle intervention in preschool children on physiological and psychological parameters (Ballabeina): study design of a cluster randomized controlled trial. *BMC Public Health, 9*.

Obregón, A. M., Pettinelli, P. P., & Santos, J. L. (2014). Childhood obesity and eating behaviour. *Journal Of Pediatric Endocrinology & Metabolism: JPEM*.

Penhollow, T., & Rhoads, K. (2014). Preventing Obesity and Promoting Fitness: An Ecological Perspective. *American Journal of Lifestyle Medicine, 8*(1), 21-24.

Quick, B. L., Fiese, B. H., Anderson, B., Koester, B. D., & Marlin, D. W. (2011). A Formative Evaluation of Shared Family Mealtime for Parents of Toddlers and Young Children. *Health Communication, 26*(7), 656-666.

Ritchie, L. D., Welk, G., Styne, D., Gerstein, D. E., & Crawford, P. B. (2005). Family environment and pediatric overweight: What is a parent to do? *Journal of the American Dietetic Association, 105*(5), S70-S79.

Rockett, H. R. H. (2007). Family dinner: More than just a meal. *Journal of the American Dietetic Association, 107*(9), 1498-1501.

Rosário, R., Oliveira, B., Araújo, A., Lopes, O., Padrão, P., Moreira, A., Teixeira, V., Barros, R., Pereira, B., & Moreira, P. (2012). The impact of an intervention taught by trained teachers on childhood overweight. *International Journal Of Environmental Research And Public Health, 9*(4), 1355-1367.

Sallis, J. F., Owen, N., & Fisher, E. B. (2008). Ecological Models Of Health Behavior. In K. Glanz, B. K. Rimer & K. Viswanath (Eds.), *Health Behavior and Health Education: Theory, Research and Practice* (4th ed., pp. 465-485). San Francisco: Jossey-Bass.

Sancho, T., Pinto, E., Moreira, R., Mota, J., Vale, S., & Moreira, P. (2014). Reliability of the "Meals in Our Household Questionnaire" in Portuguese Preschool Children [Electronic version]. *Nutrícias, 23*, 10-13 from http://www.apn.org.pt/xFiles/scContentDeployer_pt/docs/Doc2288.pdf.

Sleddens, E. F. C., Kremers, S. P. J., & Thijs, C. (2008). The Children's Eating Behaviour Questionnaire: Factorial validity and association with body mass index in Dutch children aged 6–7. *The International Journal of Behavioral Nutrition and Physical Activity, 5*.

Spence, J. C., Carson, V., Casey, L., & Boule, N. (2011). Examining behavioural susceptibility to obesity among Canadian pre-school children: The role of eating behaviours. *International Journal of Pediatric Obesity, 6*(2Part2), e501-e507.

Stang, J., & Loth, K. A. (2011). Parenting Style and Child Feeding Practices: Potential Mitigating Factors in the Etiology of Childhood Obesity. *Journal of the American Dietetic Association, 111*(9), 1301-1305.

Story, M., Kaphingst, K. M., & French, S. (2006). The role of schools in obesity prevention. *Future of Children, 16*(1), 109-142.

Story, M., Nanney, M. S., & Schwartz, M. B. (2009). Schools and Obesity Prevention: Creating School Environments and Policies to Promote Healthy Eating and Physical Activity. *Milbank Quarterly, 87*(1), 71-100.

Taveras, E. M., Rifas-Shiman, S., Berkey, C. S., Rockett, H. R. H., Field, A. E., Frazir, A. L., Colditz, G. A., & Gillman, M. W. (2005). Family dinner and adolescent overweight. *Obesity Research, 13*(5), 900-906.

Viana, V., & Sinde, S. (2008). O comportamento alimentar em crianças: Estudo de validação de um questionário numa amostra portuguesa (CEBQ). *Análise Psicológica, 26*(1), 111-120.

Wardle, J. (2007). Eating behaviour and obesity. *Obesity Reviews, 8*, 73-75.

Wardle, J., Guthrie, C. A., Sanderson, S., & Rapoport, L. (2001). Development of the Children's Eating Behaviour Questionnaire. *Journal of Child Psychology & Psychiatry & Allied Disciplines, 42*(7), 963.

Waters, E., de Silva-Sanigorski, A., Hall, B. J., Brown, T., Campbell, K. J., Gao, Y., Armstrong, R., Prosser, L., & Summerbell, C. D. (2011). Interventions for preventing obesity in children. *Cochrane Database of Systematic Reviews*(12).

Webber, L., Hill, C., Saxton, J., Van Jaarsveld, C. H. M., & Wardle, J. (2009). Eating behaviour and weight in children. *International Journal of Obesity, 33*(1), 21-28.

Wells, J. C. K. (2012). Obesity as malnutrition: The role of capitalism in the obesity global epidemic. *American Journal of Human Biology*, *24*(3), 261-276.

Wofford, L. G. (2008). Systematic Review of Childhood Obesity Prevention. *Journal of Pediatric Nursing, 23*(1), 5-19.

World Health Organization. (2003). Diet, nutrition and the prevention of chronic diseases - Introduction. In *Diet, Nutrition and the Prevention of Chronic Diseases* (Vol. 916, pp. 1-149). Geneva: World Health Organization.

World Health Organization. (2008). WHO child growth standards : training course on child growth assessment. World Health Organization. Retrieved 14 September 2014, from http://www.who.int/childgrowth/training/module_b_measuring_growth.pdf

World Health Organization. (2009). *Interventions on diet and physical activity: what works: summary report.* Geneva: World Health Organization.

World Medical Association. (2013). Declaration of Helsinki. Retrieved 12 December 2014, from http://www.wma.net/en/30publications/10policies/b3/index.html.pdf?print-media-type&footer-right=[page]/[toPage]

6. Global discussion and conclusions

Following the presentation of the studies that emerged from this research work, we hereby address the discussion and presentation of the main findings, the strengths and limitations identified, as well as the recommendations for future research.

Being a nutritionist reporting to the Algarve Regional Health Administration, we have been responsible for the program to combat childhood obesity in this region since 2007. On the one hand, given that childhood obesity increases the risk of obesity in adulthood (Waters et al., 2011; Whitaker et al., 1997), with the risk of earlier onset of obesity-related chronic disease (Lawlor & Chaturvedi, 2006; Lobstein, 2010), fighting childhood obesity is a priority for the Portuguese Ministry of Health. On the other hand, there is limited success registered in available treatment programs, so it is likely that prevention may provide the most effective method of containing this epidemic (Ells et al., 2005). Actually, most of the intervention programs to prevent childhood obesity in Portugal have been performed in a school context, given the protocol between the Ministry of Education and the Ministry of Health for the promotion of health education in schools (DGS, 2006b). However, it is our conviction that most of these intervention programs have been developed especially in mandatory school age levels; therefore, preschools have not been a priority target, even though they are a favorite setting within the education system. Thus, it was with great commitment, enthusiasm and also professional interest that we initiated this research in the pursuit of the best practices to tackle childhood obesity at an earlier age group, although aware of the complexity and multi-etiology of this problem.

Concerning our professional experience in community nutrition for health promotion, we implemented an intervention program in the prevention of childhood obesity, inspired by a socio-ecological framework, using the resources available in the community itself. The intervention was developed on multiple levels, with actions targeting children, parents, kindergarten teachers,

animators and other staff at preschools. Additionally, in the preschool environment, dietary changes were implemented in the quality and diversity of the lunch and snacks provided, as well as the definition of more active leisure opportunities and less sedentary activities. In the operationalizing of the intervention, training was given to kindergarten teachers and staff, thematic sessions with parents were conducted, puppet theatres and hip-hop dance sessions were performed with children, country walks were held with family, and vegetables/ fruit cooking shows were achieved.

In this framework, related to the process of the intervention program, there are some strengths that we would like to emphasize, according to the scientific evidence we gathered. Our intervention is based on the socio-ecological model, in a school setting, addressing young pupils like those at preschools, with a parental/family home component, with a simultaneous focus on diet and PA, with training support for teachers and other staff. Additionally, in the school environment we implemented the improved availability of healthy foods and increased opportunities for active recreation. Furthermore, this study had a high level of participation among children for eligibility (84.7%).

In this randomized controlled trial we performed the characterization of the participating children regarding their nutritional status, DI, eating behavior, PA and SES, at baseline and post-intervention, having around half (54.5%) integrated the experimental group.

At baseline, the nutritional status was studied using three definition criteria (IOTF, WHO and CDC), which allowed us to compare our data with prior studies, where the prevalence of underweight, overweight and obesity, categorized by sex, is summarized in **Table 12** (Sancho, Cruz, et al., 2014).

According to the WHO's growth reference, our data showed that 2.4% of preschool children were underweight, 13.3% overweight and 10.4% obese. Nevertheless, the results of the comparative analysis showed that the absolute prevalence of underweight, overweight and obesity varies according to the BMI reference criteria used. Using the WHO growth reference, the prevalence of obesity (10.4%) was nearly twice as high as that using the IOTF criteria (4.7%). For underweight prevalence, using the WHO reference (2.4%), we noted it was

five times lesser than when calculated using the IOTF reference (11.8%), or twice higher when considered by CDC reference (4.7%) (**Figure 7**). Although this variation might be confusing, the option to present data using different criteria to evaluate the children's nutritional status provides more opportunities to compare and interpret prevalence between studies, while a common definition of childhood obesity is not adopted (Rolland-Cachera, 2011). Additionally, no statistical differences were found between boys and girls for any of the criteria we used; however, rates are generally higher in girls than in boys, either in Portuguese studies (Gomes et al., 2010; Vale et al., 2011) or in international studies (Cattaneo et al., 2010; Quelly & Lieberman, 2011).

Table 12. BMI categories by sex using IOTF, WHO and CDC criteria.

IOTF											
	Underweight		**Normal**		**Overweight (Ow)**		**Obesity (Ob)**		**Ow + Ob**		**p***
	%	**95% CI**	**%**	**95% CI**	**%**	**95% CI**	**%**	**95% CI**	**%**	**95% CI**	
Boys	13.6	6.8-20.3	69.9	60.9-78.9	12.6	6.1-19.1	3.9	0.09-7.7	16.5	9.2-23.8	
Girls	10.2	4.4-16.0	75.0	67.4-84.0	9.3	3.7-14.8	5.6	1.2-10.0	14.8	8.0-21.6	0.668
Total	**11.8**	7.5-16.2	**72.5**	66.8-78.9	**10.9**	6.7-15.2	**4.7**	1.9-7.7	**15.6**	10.8-20.7	
WHO											
	Underweight		**Normal**		**Overweight (Ow)**		**Obesity (Ob)**		**Ow + Ob**		**p***
	%	95% CI	%	95% CI	%	95% CI	%	95% CI	%	95% CI	
Boys	3.9	0.09-7.7	67.0	57.8-76.2	17.4	10.0-24.9	11.7	5.4-18.0	29.1	20.2-38.1	
Girls	0.9	0.1-2.7	80.6	73.0-88.1	9.3	3.7-14.8	9.2	3.7-14.8	18.5	11.1-26.0	0.101
Total	**2.4**	0.3-4.4	**73.9**	68.0-79.9	**13.3**	8.7-17.9	**10.4**	6.3-14.6	**23.7**	17.9-29.5	
CDC											
	Underweight		**Normal**		**Overweight (Ow)**		**Obesity (Ob)**		**Ow + Ob**		**p***
	%	95% CI	%	95% CI	%	95% CI	%	95% CI	%	95% CI	
Boys	4.9	0.6-9.1	66.0	56.7-75.3	16.5	9.2-23.8	12.6	6.1-19.1	29.1	20.2-38.0	
Girls	4.6	0.6-8.7	75.9	67.7-84.1	8.3	3.0-13.6	11.1	5.1-17.1	19.4	11.9-27.0	0.297
Total	**4.7**	1.9-7.6	**71.1**	64.9-77.3	**12.3**	7.9-16.8	**11.8**	7.5-16.2	**24.2**	18.4-30.0	

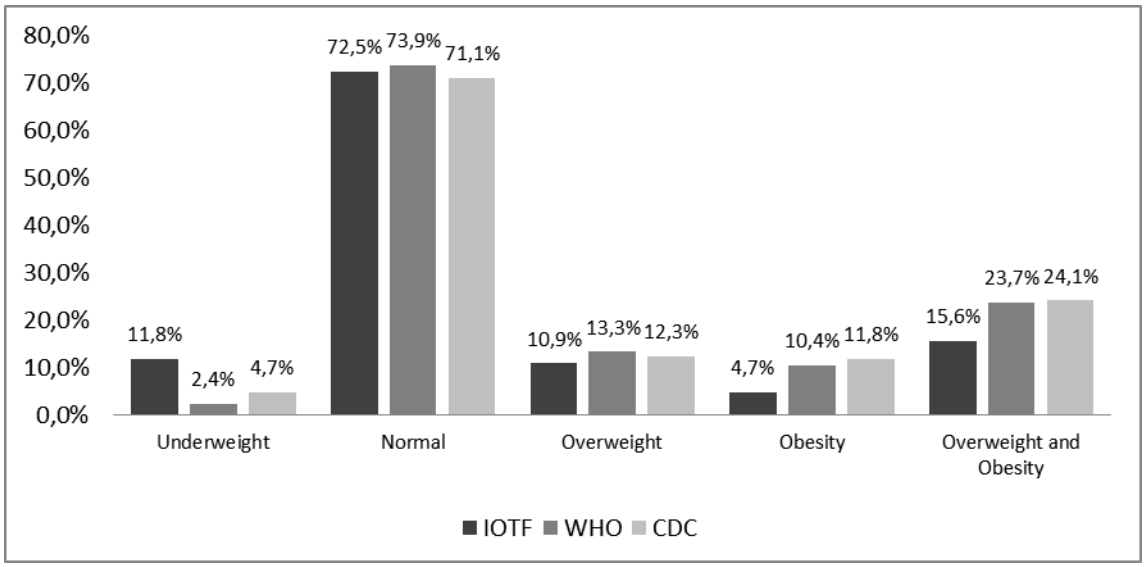
*p value for differences between boys and girls computed with χ^2 test. 95% CI, 95% confidence interval.

IOTF, International Obesity Task Force; WHO, World Health Organization; CDC, Center for Diseases Control and Prevention.

In Portugal, according to accessible data using IOTF, WHO and CDC criteria, we might conclude that our study presents, the lowest prevalence for CDC criteria (4.7%), and the highest prevalence for IOTF criteria (11.8%), when considering underweight. Concerning overweight and obesity among our preschool children population, this study shows a lower prevalence than that described in studies of other regions of Portugal (**Table 2**). Moreover, these

data are in line with previous studies comparing prevalence between regions of Portugal, the Algarve having the lowest rate in the prevalence of childhood obesity (Rêgo et al., 2013; Rito et al., 2012). Nonetheless, our purpose was to intervene trying to reduce the discrepancy between the BMI values found and the desirable ones, given that rates of overweight and obesity are still unacceptably high, with significant consequences for the health and well-being of these children as they age (Olds et al., 2011).

Figure 7. Nutritional status defined by IOTF, WHO, and CDC criteria.



Regarding DI, we analyzed the energy and nutrients intake, as well as some food groups, namely those who have a described association with the risk of obesity, like vegetables, fruit, vegetable soup, sweets and pastries, energy dense foods, sugar-sweetened beverages and water. Globally, energy and macronutrients intake have been considered acceptable right at baseline. Concerning mean intake of food groups, we found statistically similar results between sexes, with vegetables, fruits and water being consumed insufficiently, while sugar-sweetened beverages, sweets and pastries were excessively consumed, whose data are very similar to a recent Portuguese study (Lopes et al., 2014). Hence, our nutritional intervention was carefully structured given these data.

PA was self-reported by the children's parents and simultaneously evaluated objectively by pedometers. Mean time PA reported by parents was characterized in progressive intensity levels of PA: SB, LPA, MPA, VPA and MVPA. The steps counted by pedometers were categorized into two groups, according to the cut point of the compliance with recommendations for TPA and MVPA in preschool children. Given the data collected at baseline, not all children were sufficiently active, neither considering the time spent in PA (TPA and MVPA) nor the steps, which led us to organize the intervention towards promoting regular PA, and concomitantly reducing SB.

Eating behavior was self-reported by the children's parents by filled out the CEBQ and tow domains of MOHQ. Additionally, we have also studied also two features of buying food, in the context of prior preparation of meals. Actually, we found at baseline some associations between these behaviors and weight status. In the context of our intervention, eating behaviors and food buying procedures were approached with our targets.

SES was self-reported by the children's parents, being assessed through the parents' educational and occupation levels, besides the school echelons assigned for the social intervention by the Ministry of Education. Nevertheless, no association was found with variables such as nutritional status, DI or PA variables.

Regarding the research process, there are some strengths that should be highlighted. Firstly, in Portugal, to our best knowledge, there is no published randomized controlled trial performed in a preschool setting with a multi-component intervention regarding the combat of childhood obesity. Secondly, although small, the study population corresponds to the existing reality in the Faro municipality. Thirdly, we used methodological caution in performing the anthropometric assessment of all children under the same conditions, with the same equipment and by two highly trained and specialized researchers in anthropometry to minimize inter-observer error, at baseline and at post-intervention. Finally, the presentation of the BMI data, using z-scores, avoided the independent effects of age and gender.

Still referring to our research process, some limitations should be recognized. First of all, we refer to the short supply of public preschools in the Faro municipality, meaning that the preschool children in our study were mostly 5 years old, restricting an advisable proportional age distribution, given the usual age of preschoolers, ranging between 3 to 6 years of age. This age constraint and the small population study size, though corresponding to the existing reality, may have limited the detection of other significant differences than those reported. Second, our study population is from only one geographical area, which makes it difficult to generalize our findings. Third, the identical allocation of children in two groups after randomization was not completely rigorous, namely considering both the mother's and father's education level and occupation category, as well as the children's age, weight and height, mainly because we randomized by preschool and not by children, aiming to avoid cross contamination between groups. Nevertheless, these differences were taken into account in all the statistical analyses we performed and presented. Fourth, PA intensity levels were obtained by questionnaires (Pre-PAQ) filled out by parents, therefore under or overestimation bias in the answers could be possible. However, the Pre-PAQ was previously validated for Portuguese preschool children (data in publishing process, being one of the studies of this thesis), so we haven't got any reason to assume these biases would affect groups differently. Fifth, the use of Pre-PAQ as a tool of assessment of PA restricted the information to only one weekday and two weekend days spent in the family environment, thus causing the evaluation related to preschool time to be missing. Sixth, only 42.7% (90) of children's parents authorized the use of pedometers. Seventh, the problems of self-reported data collection related to dietary food records and questionnaires filled out by parents may lead to bias triggered by social desirability (Mindell et al., 2014). Eighth, we must refer to the problem of non-responses, arising from lack of time and/or other engagement of parents, as well as from the length of the questionnaires, which can contribute to bias in the data. Ninth, as described in another recent family-based study, the components of the intervention proved feasible, but the attendance of the parent intervention sessions was rather low

(Fitzgibbon et al., 2013). Finally, in order to evaluate the efficacy of this intervention over time, it would be advisable to conduct the follow-up of the children, six months after the end of the intervention.

At the end of the intervention, we assessed the opinion of the kindergarten teachers, which was as follows: (1) The training workshop previously performed with kindergarten teachers was very important, and they reported having acquired skills on the improvement of the children's eating habits, on how to increase the time children engaged in PA, and how to reduce the children's sedentary behavior; (2) The puppet theater was very important to facilitate the adherence of children to a healthier diet and to a more active lifestyle, as well as facilitate the reduction of sedentary activities; (3) The changes in the preschool environment, in the food supply and in more active recreation time were very important; (4) The song "*Vamos melhor comer, vamos mais ativos ser*" was important to facilitate the children's adherence to a healthier behavior; (5) The sessions and activities with the children's families were also very important to facilitate adherence to healthier behavior; (6) The overall intervention framework was adequate for the sessions with the children (considering number, duration, methodology, timing, content and interaction) and with the parents; (7) The sessions of hip-hop dance allowed the artistic performance of children in other schools; (8) The song, despite having good musical quality, had rather extensive lyrics for the younger children to memorize.

We next analyze the achievement of the objectives defined for this research.

Study I

Assessment tools of mealtimes in a family environment are limited and there is none which comprehensively measured the Portuguese children's mealtime structure, environment, behavior and its effects on the household. This study aimed to translate, culturally adapt and test the psychometric properties of the MOHQ in Portuguese preschool children. The questionnaire's translation led to the definition of a satisfactory reliable tool to assess the

parents' perception of the Portuguese preschoolers' mealtime behavior and environment, which can be quite useful for healthcare interventions aimed to facilitate discussion with parents about their children's mealtime behavior, and to promote healthier household meals.

Study II

There´s a lack of specific tools to measure PA dimensions in preschool children, namely in the context of their home environment considering a socio-ecologic framework. This study aimed to translate, culturally adapt and test the psychometric properties of the Pre-PAQ in Portuguese preschool children. The questionnaire's translation led to a reliable tool to assess the nature, level and duration of the child's activity behavior, and concomitantly measure the influence of parental, family and neighborhood factors. Pre-PAQ is a tool that provides a practical method for PA assessment, leading to a further understanding of the PA determinants, which bear influence on active and sedentary behaviors, crucial when planning intervention policies.

Study III

Consensually, the nutritional status depends on several determinants, in particular DI, PA and SES. The preliminary study of these determinants is essential in the planning of any intervention, when its objective is to improve the nutritional status of a population.

Related to the preschool sample studied, this study reported (1) similar prevalence of underweight, overweight and obesity between sexes; (2) vegetables, fruit and water were insufficiently consumed, whereas sugar-sweetened beverages, sweets and pastries were excessively consumed; (3) approximately a third of the children and about half of the children met the recommended guidelines, regarding total PA and moderate-vigorous PA, respectively; (4) most children met the steps/day recommendations, with more boys in compliance, on weekdays, and with overweight/obese children having more steps on weekend days; (5) no associations were found between BMI

categories and DI or SES; (6) and parental reports lead to a lower PA compliance compared to steps obtained by pedometers.

These study results were fundamental to design the intervention of this research.

Study IV

This randomized control trial developed with the implementation of a socio-ecological intervention on DI, PA and BMI, on the preschool children population, had several positive impacts. Although we have not obtained significant differences in PA, after the intervention, we achieved: (1) a significant reduction in BMI z-score in the EG, compared with the respective increase in the CG; (2) and positive changes in the intake of dietary fiber, vegetable soup, fruit, vegetables/ fruit and water.

Our intervention based on the school-family interaction provided further scientific support to tackle childhood obesity, in order to minimize its prevalence as much as possible.

Study V

This randomized control trial aimed to analyze the association between the eating behavior traits and the weight status, before and after a socio-ecological intervention. Firstly, at baseline, we found with overweight/obesity positive associations between “enjoyment of food”, “satiety responsiveness” and “slowness in eating”, as well as an inverse association with “buying of food with a previously prepared list”. However, after the intervention, the only behavior change we recorded as statistically significant was related to the frequency of the child eating the same food as everyone else (“At meals, my child eats the same food as everyone else”).

Globally and in view of the statements above, we consider that most of our aims were achieved. The translated questionnaires resulted in two instruments with acceptable reliability to be used by researchers in Portuguese pre-schools. The intervention program has proved effective in reducing the BMI

z-scores in the EG and in the achievement of important dietary changes that have impact on tackling child obesity. The intervention program hasn't proved to be very effective on changes in eating behavior, but this may have been due to the nature of these variables, which may need a longer intervention period. The intervention program didn't prove effective in changes either in PA or in SB, despite our determination to try to accomplish an appropriate intervention program in this area. Probably due to our profession, we do not hold the skills for it to be efficient enough. However, our intervention program showed effectiveness in combating childhood obesity in preschool, the prime purpose of our research.

Concerning our socio-ecologic intervention, developed in a multi-component framework, future studies should strive to refine these results through the use of controlled fragmented interventions (DI analyzed apart from PA), in order to better understand the effectiveness of the isolated contribution of each type of intervention. Other methodological approaches with parents should be reinvented and studied, in order to improve intervention with families.

Early childhood provides a circumscribed and important opportunity within which to establish lifestyle behaviors that will promote health and minimize the risk of development of obesity (Campbell et al., 2008). However, from our point of view, because earlier interventions lead to a higher success rate, it is also essential that interventions take place with pregnant women, or even in a context of pre-pregnancy, to prevent obesity as early as possible.

Priority actions must include policies allocating much greater funding for prevention programs, cross-cutting policies into both health and non-health sectors (trade, agriculture, food industry, transport, urban planning, sport and development), at a national, regional and local level. They can, in turn, greatly increase the influence and sustainability of the interventions to be developed.

The prevention of childhood obesity is highlighted for WHO as a high priority, because overweight and obese children are likely to remain obese into adulthood and more likely to develop no communicable diseases, as well as their related diseases (WHO, 2014b), having the WHO's Director-General, in May 2014 established a high-level Commission on Ending Childhood Obesity

(WHO, 2014c). In Portugal, this subject is even more worrying given the current conditions of economic crisis, with unemployment and food insecurity (OECD, 2014), which increase the risk of childhood malnutrition with the double burden of underweight and obesity.

7. References

Addy, C. L., Trilk, J. L., Dowda, M., Won, B., & Pate, R. R. (2014). Assessing Preschool Children's Physical Activity: How Many Days of Accelerometry Measurement. *Pediatric Exercise Science, 26*(1), 103-109.

Agostoni, C., Braegger, C., Decsi, T., Kolacek, S., Koletzko, B., Mihatsch, W., Moreno, L. A., Puntis, J., Shamir, R., Szajewska, H., Turck, D., van Goudoever, J., & Nutr, E. C. (2011). Role of Dietary Factors and Food Habits in the Development of Childhood Obesity: A Commentary by the ESPGHAN Committee on Nutrition. *Journal of Pediatric Gastroenterology and Nutrition, 52*(6), 662-669.

Ahlsson, F., Gustafsson, J., Tuvemo, T., & Lundgren, M. (2007). Females born large for gestational age have a doubled risk of giving birth to large for gestational age infants. *Acta Paediatrica (Oslo, Norway: 1992), 96*(3), 358-362.

Alkon, A., Crowley, A. A., Neelon, S. E. B., Hill, S., Pan, Y., Nguyen, V., Rose, R., Savage, E., Forestieri, N., Shipman, L., & Kotch, J. B. (2014). Nutrition and physical activity randomized control trial in child care centers improves knowledge, policies, and children's body mass index. *BMC Public Health, 14*, 215-215.

Anderson, S. E., Must, A., Curtin, C., & Bandini, L. G. (2012). Meals in Our Household: Reliability and Initial Validation of a Questionnaire to Assess Child Mealtime Behaviors and Family Mealtime Environments. *Journal of the Academy of Nutrition and Dietetics, 112*(2), 276-284.

Anderson, S. E., & Whitaker, R. C. (2010). Household Routines and Obesity in US Preschool-Aged Children. *Pediatrics, 125*(3), 420-428.

Androutsos, O., Katsarou, C., Payr, A., Birnbaum, J., Geyer, C., Wildgruber, A., Kreichauf, S., Lateva, M., De Decker, E., De Craemer, M., Socha, P., Moreno, L., Iotova, V., Koletzko, B. V., Manios, Y., & ToyBox-study, g. (2014). Designing and implementing teachers' training sessions in a kindergarten-based, family-involved intervention to prevent obesity in early childhood. The ToyBox-study. *Obesity Reviews, 15*, 48-52.

Antonogeorgos, G., Panagiotakos, D. B., Papadimitriou, A., Priftis, K. N., Anthracopoulos, M., & Nicolaidou, P. (2012). Breakfast consumption and meal frequency interaction with childhood obesity. *Pediatric Obesity, 7*(1), 65-72.

Antunes, A., & Moreira, P. (2011). Prevalence of Overweight and Obesity in Portuguese Children and Adolescents. *Acta Medica Portuguesa, 24*(2), 279-284.

Aparício, G., Cunha, M., Duarte, J., Pereira, A., Bonito, J., & Albuquerque, C. (2013). Nutritional status in preschool children: current trends of mother's body perception and concerns. *Atencion Primaria / Sociedad Española De Medicina De Familia Y Comunitaria, 45 Suppl 2*, 194-200.

Aranceta Bartrina, J. (2013). Public health and the prevention of obesity: failure or success? *Nutricion hospitalaria, 28 Suppl 5*, 128-137.

Australian Government: Department of Health. (2012). Australia's Physical Activity and Sedentary Behaviour Guidelines. Retrieved 3 September 2014, from http://www.health.gov.au/internet/main/publishing.nsf/Content/health-pubhlth-strateg-phys-act-guidelines#npa05

Baker, J. L., Farpour-Lambert, N. J., Nowicka, P., Pietrobelli, A., & Weiss, R. (2010). Evaluation of the Overweight/Obese Child - Practical Tips for the Primary Health Care Provider: Recommendations from the Childhood Obesity Task Force of the European Association for the Study of Obesity. *Obesity Facts, 3*(2), 131-137.

Berge, J. M., Jin, S. W., Hannan, P., & Neumark-Sztainer, D. (2013). Structural and Interpersonal Characteristics of Family Meals: Associations with Adolescent Body Mass Index and Dietary Patterns. *Journal of the Academy of Nutrition and Dietetics, 113*(6), 816-822.

Boonpleng, W., Park, C. G., Gallo, A. M., Corte, C., McCreary, L., & Bergren, M. D. (2013). Ecological Influences of Early Childhood Obesity: A Multilevel Analysis. *Western Journal of Nursing Research, 35*(6), 742-759.

Bost, K. K., Wiley, A. R., Fiese, B., Hammons, A., & McBride, B. (2014). Associations between adult attachment style, emotion regulation, and preschool children's food consumption. *Journal Of Developmental And Behavioral Pediatrics: JDBP, 35*(1), 50-61.

Braithwaite, I., Stewart, A. W., Hancox, R. J., Beasley, R., Murphy, R., & Mitchell, E. A. (2013). The Worldwide Association between Television Viewing and Obesity in Children and Adolescents: Cross Sectional Study. *PLoS ONE, 8*(9), 1-8.

Branca, F., Nikogosia, H., & Lobstein, T. (2007). *The challenge of obesity in the WHO European Region and the strategies for response*. Copenhagen: World Health Organization.

Brauchla, M., Juan, W., Story, J., & Kranz, S. (2012). Sources of Dietary Fiber and the Association of Fiber Intake with Childhood Obesity Risk (in 2-18 Year Olds) and Diabetes Risk of Adolescents 12-18 Year Olds: NHANES 2003-2006. *Journal of nutrition and metabolism, 2012*.

Bray, G. A. (2004). Medical consequences of obesity. *The Journal Of Clinical Endocrinology And Metabolism, 89*(6), 2583-2589.

Bronfenbrenner, U. (1986). Ecology of the family as a context for human development: Research perspectives. *Developmental Psychology, 22*(6), 723-742.

Bronfenbrenner, U. (1994). Ecological Models of Human Development. In *International Encyclopedia of Education* (2nd ed., Vol. 3). NY: Freeman.

Brotman, L. M., Dawson-McClure, S., Huang, K.-Y., Theise, R., Kamboukos, D., Wang, J., Petkova, E., & Ogedegbe, G. (2012). Early Childhood Family Intervention and Long-term Obesity Prevention Among High-risk Minority Youth. *Pediatrics, 129*(3), E621-E628.

Bryant, M. J., Lucove, J. C., Evenson, K. R., & Marshall, S. (2007). Measurement of television viewing in children and adolescents: a systematic review. *Obesity Reviews: An Official Journal Of The International Association For The Study Of Obesity, 8*(3), 197-209.

Buyken, A. E., Cheng, G., Guenther, A. L. B., Liese, A. D., Remer, T., & Karaolis-Danckert, N. (2008). Relation of dietary glycemic index, glycemic load, added sugar intake, or fiber intake to the development of body composition between ages 2 and 7 y. *American Journal of Clinical Nutrition, 88*(3), 755-762.

Campbell, K., Hesketh, K., Crawford, D., Salmon, J., Ball, K., & McCallum, Z. (2008). The Infant Feeding Activity and Nutrition Trial (INFANT) an early intervention

to prevent childhood obesity: Cluster-randomised controlled trial. *Bmc Public Health, 8*.

Campbell, K. J., & Hesketh, K. D. (2007). Strategies which aim to positively impact on weight, physical activity, diet and sedentary behaviours in children from zero to five years. A systematic review of the literature. *Obesity Reviews: An Official Journal Of The International Association For The Study Of Obesity, 8*(4), 327-338.

Campbell, K. J., Lioret, S., McNaughton, S. A., Crawford, D. A., Salmon, J., Ball, K., McCallum, Z., Gerner, B. E., Spence, A. C., Cameron, A. J., Hnatiuk, J. A., Ukoumunne, O. C., Gold, L., Abbott, G., & Hesketh, K. D. (2013). A Parent-Focused Intervention to Reduce Infant Obesity Risk Behaviors: A Randomized Trial. *Pediatrics, 131*(4), 652-660.

Canadian Society for Exercise Physiology. (2011). Canadian Physical Activity Guidelines for the early years: 0 – 4 years. Retrieved 3 September 2014, from http://www.csep.ca/english/view.asp?x=949

Cappuccio, F. P., Taggart, F. M., Kandala, N. B., Currie, A., Peile, E., Stranges, S., & Miller, M. A. (2008). Meta-analysis of short sleep duration and obesity in children and adults. *Sleep, 31*(5), 619-626.

Cardon, G., & De Bourdeaudhuij, I. (2007). Comparison of Pedometer and Accelerometer Measures of Physical Activity in Preschool Children. *Pediatric Exercise Science, 19*(2), 205-214.

Cardon, G. M., & De Bourdeaudhuij, I. M. M. (2008). Are preschool children active enough? Objectively measured physical activity levels. *Research Quarterly for Exercise and Sport, 79*(3), 326-332.

Cason, K. L. (2006). Family mealtimes: More than just eating together. *Journal of the American Dietetic Association, 106*(4), 532-533.

Cassell, J. A. (1995). Social anthropology and nutrition: A different look at obesity in America. *Journal of the American Dietetic Association, 95*(4), 424.

Cattaneo, A., Monasta, L., Stamatakis, E., Lioret, S., Castetbon, K., Frenken, F., Manios, Y., Moschonis, G., Savva, S., Zaborskis, A., Rito, A. I., Nanu, M., Vignerova, J., Caroli, M., Ludvigsson, J., Koch, F. S., Serra-Majem, L., Szponar, L., van Lenthe, F., & Brug, J. (2010). Overweight and obesity in infants and pre-school children in the European Union: a review of existing data. *Obesity Reviews, 11*(5), 389-398.

Centers for Disease Control and Prevention. (2012). Overweight and obesity. *Centers for Disease Control and Prevention* Centers for Disease Control and Prevention. Retrieved 5 August 2014, 2014, from http://www.cdc.gov/obesity/childhood/basics.html

Chari, R., Warsh, J., Ketterer, T., Hossain, J., & Sharif, I. (2014). Association between health literacy and child and adolescent obesity. *Patient Education & Counseling, 94*(1), 61-66.

Cliff, D. P., & Janssen, X. (2011). Levels of Habitual Physical Activity in Early Childhood. *Centre of Excellence for Early Childhood Development* Encyclopedia on early childhood development. Retrieved 2 September 2014, from http://www.child-encyclopedia.com/pages/PDF/Cliff-JanssenANGxp1.pdf

Cole, T. J., Bellizzi, M. C., Flegal, K. M., & Dietz, W. H. (2000). Establishing a standard definition for child overweight and obesity worldwide: international survey. *British Medical Journal, 320*(7244), 1240-1243.

Cole, T. J., Flegal, K. M., Nicholls, D., & Jackson, A. A. (2007). Body mass index cut offs to define thinness in children and adolescents: international survey. *British Medical Journal, 335*(7612), 194-197.

Croker, H., Sweetman, C., & Cooke, L. (2009). Mothers' views on portion sizes for children. *Journal of Human Nutrition and Dietetics, 22*(5), 437-443.

Currie, C., & al. (2012). *Social determinants of health and well-being among young people : Health Behaviour in School-Aged Children (HBSC) study : international report from the 2009/2010 survey*. Copenhagen: World Health Organization.

Dahlgren, G., & Whitehead, M. (2007). *European strategies for tackling social inequities in health: Levelling up Part 2*. Copenhagen: WHO.

Daniels, S. R. (2009). Complications of obesity in children and adolescents. *International Journal of Obesity, 33*, S60-S65.

De Bock, F., Fischer, J. E., Hoffmann, K., & Renz-Polster, H. (2010). A participatory parent-focused intervention promoting physical activity in preschools: design of a cluster-randomized trial. *BMC Public Health, 10*.

De Bourdeaudhuij, I., Van Cauwenberghe, E., Spittaels, H., Oppert, J. M., Rostami, C., Brug, J., Van Lenthe, F., Lobstein, T., & Maes, L. (2011). School-based interventions promoting both physical activity and healthy eating in Europe: a systematic review within the HOPE project. *Obesity Reviews, 12*(3), 205-216.

De Craemer, M., De Decker, E., De Bourdeaudhuij, I., Vereecken, C., Deforche, B., Manios, Y., Cardon, G., & ToyBox-study, G. (2012). Correlates of energy balance-related behaviours in preschool children: a systematic review. *Obesity Reviews, 13*, 13-28.

De Moira, A. P., Power, C., & Li, L. (2010). Changing Influences on Childhood Obesity: A Study of 2 Generations of the 1958 British Birth Cohort. *American Journal of Epidemiology, 171*(12), 1289-1298.

de Onis, M., Blossner, M., & Borghi, E. (2010). Global prevalence and trends of overweight and obesity among preschool children. *American Journal of Clinical Nutrition, 92*(5), 1257-1264.

de Onis, M., Garza, C., Onyango, A. W., & Borghi, E. (2007). Comparison of the WHO Child Growth Standards and the CDC 2000 growth charts. *Journal of Nutrition, 137*(1), 144-148.

de Onis, M., Onyango, A. W., Borghi, E., Siyam, A., Nishida, C., & Siekmann, J. (2007). Development of a WHO growth reference for school-aged children and adolescents. *85*(9), 660-667.

de Silva-Sanigorski, A. M., Bell, A. C., Kremer, P., Park, J., Demajo, L., Smith, M., Sharp, S., Nichols, M., Carpenter, L., Boak, R., & Swinburn, B. (2012). Process and impact evaluation of the Romp & Chomp obesity prevention intervention in early childhood settings: lessons learned from implementation in preschools and long day care settings. *Childhood Obesity (Print), 8*(3), 205-215.

Dehghan, M., Akhtar-Danesh, N., & Merchant, A. T. (2005). Childhood obesity, prevalence and prevention. *Nutrition Journal, 4*, 24-24.

Dennison, B. A., Erb, T. A., & Jenkins, P. L. (2002). Television Viewing and Television in Bedroom Associated With Overweight Risk Among Low-Income Preschool Children. *Pediatrics, 109*(6), 1028.

Dev, D. A., McBride, B. A., Fiese, B. H., Jones, B. L., & Cho, H. (2013). Risk factors for overweight/obesity in preschool children: an ecological approach. *Childhood Obesity (Print), 9*(5), 399-408.

DGS. (2013). Programa Nacional de Saúde Infantil e Juvenil. Direcção-Geral da Saúde. Retrieved 22 agosto 2014, from http://www.dgs.pt/directrizes-da-dgs/normas-e-circulares-normativas/norma-n-0102013-de-31052013-jpg.aspx&rct=j&frm=1&q=&esrc=s&sa=U&ei=kFf3U__gO4XoaI3xgNAP&ved=0CBMQFjAA&usg=AFQjCNHOiBRTBf9W7TMscP3OYfk3PJFmxQ

Dietz, W. H. (1998). Health consequences of obesity in youth: Childhood predictors of adult disease. *Pediatrics, 101*(3), 518-525.

Dietz, W. H., & Bellizzi, M. C. (1999). Introduction: the use of body mass index to assess obesity in children. *The American Journal Of Clinical Nutrition, 70*(1), 123S-125S.

Dietz, W. H., Jr., & Gortmaker, S. L. (1985). Do we fatten our children at the television set? Obesity and television viewing in children and adolescents. *Pediatrics, 75*(5), 807-812.

Direcção-Geral da Saúde. (2006a). Consultas de Vigilância de Saúde Infantil e Juvenil - Actualização das curvas de crescimento *Circular Normativa Nº: 05/DSMIA - 21/02/06* Direcção-Geral da Saúde. Retrieved 22 August 2014, from http://www.dgs.pt/upload/membro.id/ficheiros/i007811.pdf

Direcção-Geral da Saúde. (2006b). Programa Nacional de Saúde Escolar. Retrieved 8 December 2014, from http://www.dgs.pt/paginas-de-sistema/saude-de-a-a-z/saude-escolar/paginas-de-sistema/saude-de-a-a-z/saude-escolar/programa-nacional-de-saude-escolar.aspx

do Carmo, I., dos Santos, O., Camolas, J., Vieira, J., Carreira, M., Medina, L., Reis, L., & Galvão-Teles, A. (2006). Prevalence of obesity in Portugal. *Obesity Reviews, 7*(3), 233-237.

do Carmo, I., dos Santos, O., Camolas, J., Vieira, J., Carreira, M., Medina, L., Reis, L., Myatt, J., & Galvao-Teles, A. (2008). Overweight and obesity in Portugal: national prevalence in 2003-2005. *Obesity Reviews, 9*(1), 11-19.

Doak, C., Heitmann, B. L., Summerbell, C., & Lissner, L. (2009). Prevention of childhood obesity – what type of evidence should we consider relevant? *Obesity Reviews, 10*(3), 350-356.

Doak, C. M., Visscher, T. L., Renders, C. M., & Seidell, J. C. (2006). The prevention of overweight and obesity in children and adolescents: a review of interventions and programmes. *Obesity Reviews: An Official Journal Of The International Association For The Study Of Obesity, 7*(1), 111-136.

Dorosty, A. R., Emmett, P. M., Cowin, I. S., Reilly, J. J., & Team, A. S. (2000). Factors associated with early adiposity rebound. *Pediatrics, 105*(5), 1115-1118.

Duarte, M. E. (2011). *Estilos de vida familiar e peso excessivo na criança em idade pré-escolar*. Lisboa: Doctorate Thesis presented to Universidade de Lisboa.

Dubois, L., Farmer, A., Girard, M., & Peterson, K. (2007). Regular sugar-sweetened beverage consumption between meals increases risk of overweight among preschool-aged children. *Journal of the American Dietetic Association, 107*(6), 924-934.

Dubois, L., Farmer, A., Girard, M., & Peterson, K. (2008). Social factors and television use during meals and snacks is associated with higher BMI among pre-school children. *Public Health Nutrition, 11*(12), 1267-1279.

Dubois, L., Farmer, A., Girard, M., & Porcherie, M. (2006). Family food insufficiency is related to overweight among preschoolers'. *Social Science & Medicine, 63*(6), 1503-1516.

Dwyer, G. M., Hardy, L. L., Peat, J. K., & Baur, L. A. (2011). The validity and reliability of a home environment preschool-age physical activity questionnaire (Pre-PAQ). *International Journal of Behavioral Nutrition and Physical Activity, 8*.

Ebbeling, C. B., Pawlak, D. B., & Ludwig, D. S. (2002). Childhood obesity: public-health crisis, common sense cure. *Lancet, 360*(9331), 473-482.

Economos, C. D., & Tovar, A. (2012). Promoting health at the community level: thinking globally, acting locally. *Childhood obesity (Print), 8*(1), 19-22.

Eliakim, A., Nemet, D., Balakirski, Y., & Epstein, Y. (2007). The effects of nutritional-physical activity school-based intervention on fatness and fitness in preschool children. *Journal Of Pediatric Endocrinology & Metabolism: JPEM, 20*(6), 711-718.

Ells, L. J., Campbell, K., Lidstone, J., Kelly, S., Lang, R., & Summerbell, C. (2005). Prevention of childhood obesity. *Best Practice & Research Clinical Endocrinology & Metabolism, 19*(3), 441-454.

Faith, M. S., Scanlon, K. S., Birch, L. L., Francis, L. A., & Sherry, B. (2004). Parent-child feeding strategies and their relationships to child eating and weight status. *Obesity Research, 12*(11), 1711-1722.

Food Agriculture Organization. (2013). The State of Food Insecurity in the World 2013. The multiple dimensions of food security. FAO. Retrieved 27 July 2014, from http://www.fao.org/docrep/018/i3434e/i3434e.pdf

Fiese, B. H., Hammons, A., & Grigsby-Toussaint, D. (2012). Family mealtimes: a contextual approach to understanding childhood obesity. *Economics And Human Biology, 10*(4), 365-374.

Fiese, B. H., & Schwartz, M. (2008). Reclaiming the Family Table: Mealtimes and Child Health and Wellbeing: Social Policy Report. *Society for Research in Child Development, 22*(4), 3-19.

Fisher, A., McDonald, L., van Jaarsveld, C. H. M., Llewellyn, C., Fildes, A., Schrempft, S., & Wardle, J. (2014). Sleep and energy intake in early childhood. *International Journal Of Obesity (2005), 38*(7), 926-929.

Fitzgibbon, M. L., Stolley, M. R., Schiffer, L., Kong, A., Braunschweig, C. L., Gomez-Perez, S. L., Odoms-Young, A., Van Horn, L., Christoffel, K. K., & Dyer, A. R. (2013). Family-based hip-hop to health: Outcome results. *Obesity (19307381), 21*(2), 274-283.

Fitzgibbon, M. L., Stolley, M. R., Schiffer, L., Van Horn, L., KauferChristoffel, K., & Dyer, A. (2005). Two-year follow-up results for Hip-Hop to Health Jr.: a randomized controlled trial for overweight prevention in preschool minority children. *The Journal Of Pediatrics, 146*(5), 618-625.

Forshee, R. A., Anderson, P. A., & Storey, M. L. (2008). Sugar-sweetened beverages and body mass index in children and adolescents: a meta-analysis. *American Journal of Clinical Nutrition, 87*(6), 1662-1671.

Franko, D. L., Striegel-Moore, R. H., Thompson, D., Affenito, S. G., Schreiber, G. B., Daniels, S. R., & Crawford, P. B. (2008). The relationship between meal frequency and body mass index in black and white adolescent girls: more is less. *International Journal of Obesity, 32*(1), 23-29.

Fruh, S. M., Fulkerson, J. A., Mulekar, M. S., Kendrick, L. A. J., & Clanton, C. (2011). The surprising benefits of the family meal. *Journal for Nurse Practitioners, 7*(1), 18-22.

Fryar, C. D., Carroll, M. D., & Ogden, C. L. (2012). Prevalence of Obesity Among Children and Adolescents: United States, Trends 1963–1965 Through 2009–2010.

Fulkerson, J. A., Larson, N., Horning, M., & Neumark-Sztainer, D. (2014). A review of associations between family or shared meal frequency and dietary and weight status outcomes across the lifespan. *Journal of Nutrition Education and Behavior, 46*(1), 2-19.

Fulkerson, J. A., Neumark-Sztainer, D., Hannan, P. J., & Story, M. (2008). Family Meal Frequency and Weight Status Among Adolescents: Cross- sectional and 5-year Longitudinal Associations. *Obesity, 16*(11), 2529-2534.

Gabel, L., Proudfoot, N. A., Obeid, J., Macdonald, M. J., Bray, S. R., Cairney, J., & Timmons, B. W. (2013). Step Count Targets Corresponding to New Physical Activity Guidelines for the Early Years. *Medicine & Science in Sports & Exercise, 45*(2), 314-318.

Gable, S., Chang, Y., & Krull, J. L. (2007). Television watching and frequency of family meals are predictive of overweight onset and persistence in a national sample of school-aged children. *Journal of the American Dietetic Association, 107*(1), 53-61.

Garcia, R. P., & dos Santos, F. M. M. (2009). La obesidad o la impronta del planeta en el ser humano. / Obesity or the mark of the planet for human beings. *Cultura, Ciencia y Deporte, 4*(10), 55-60.

Garvis, S. (2012). "You Are My Sunshine My Only Sunshine": Current Music Activities in Kindergarten Classrooms in Queensland, Australia. *Australian Journal of Music Education*(1), 14-21.

Gentile, D. A., Welk, G., Eisenmann, J. C., Reimer, R. A., Walsh, D. A., Russell, D. W., Callahan, R., Walsh, M., Strickland, S., & Fritz, K. (2009). Evaluation of a multiple ecological level child obesity prevention program: Switch what you Do, View, and Chew. *BMC Medicine, 7*, 49-49.

Godfrey, K., Rhodes, P., & Hunt, C. (2013). The relationship between family mealtime interactions and eating disorder in childhood and adolescence: A systematic review. *Australian and New Zealand Journal of Family Therapy, 34*(1), 54-74.

Gomes, S., Espanca, R., Gato, A., & Miranda, C. (2010). Obesity in preschool age: Too Early to Be Too Heavy! *Acta Medica Portuguesa, 23*(3), 371-378.

Gonzalez-Suarez, C., Worley, A., Grimmer-Somers, K., & Dones, V. (2009). School-based interventions on childhood obesity: a meta-analysis. *American Journal Of Preventive Medicine, 37*(5), 418-427.

Goran, M. I. (2001). Metabolic precursors and effects of obesity in children: a decade of progress, 1990-1999. *American Journal of Clinical Nutrition, 73*(2), 158-171.

Gortmaker, S. L., Swinburn, B. A., Levy, D., Carter, R., Mabry, P. L., Finegood, D. T., Huang, T., Marsh, T., & Moodie, M. L. (2012). Changing the Future of Obesity: Science, Policy, and Action EDITORIAL COMMENT. *Obstetrical & Gynecological Survey, 67*(1), 6-8.

Grimes, C. A., Riddell, L. J., Campbell, K. J., & Nowson, C. A. (2013). Dietary Salt Intake, Sugar-Sweetened Beverage Consumption, and Obesity Risk. *Pediatrics, 131*(1), 14-21.

Gruber, K. J., & Haldeman, L. A. (2009). Using the Family to Combat Childhood and Adult Obesity. *Preventing Chronic Disease, 6*(3).

Guo, S. S., Wu, W., Chumlea, W. C., & Roche, A. F. (2002). Predicting overweight and obesity in adulthood from body mass index values in childhood and adolescence. *American Journal of Clinical Nutrition, 76*(3), 653-658.

Gupta, N., Goel, K., Shah, P., & Misra, A. (2012). Childhood obesity in developing countries: epidemiology, determinants, and prevention. *Endocrine Reviews, 33*(1), 48-70.

Haines, J., McDonald, J., O'Brien, A., Sherry, B., Bottino, C. J., Schmidt, M. E., & Taveras, E. M. (2013). Healthy Habits, Happy Homes Randomized Trial to Improve Household Routines for Obesity Prevention Among Preschool-Aged Children. *Jama Pediatrics, 167*(11), 1072-1079.

Hammons, A. J., & Fiese, B. H. (2011). Is Frequency of Shared Family Meals Related to the Nutritional Health of Children and Adolescents? *Pediatrics, 127*(6), E1565-E1574.

Han, J. C., Lawlor, D. A., & Kimm, S. Y. S. (2010). Childhood obesity. *The Lancet, 375*(9727), 1737-1748.

Hardy, L. L., King, L., Kelly, B., Farrell, L., & Howlett, S. (2010). Munch and Move: evaluation of a preschool healthy eating and movement skill program. *International Journal of Behavioral Nutrition & Physical Activity, 7*, 80-90.

Harrison, F., & Jones, A. P. (2012). A framework for understanding school based physical environmental influences on childhood obesity. *Health & Place, 18*(3), 639-648.

Haslam, D., & Rigby, N. (2010). A long look at obesity. *Lancet, 376*(9735), 85-86.

Hawkins, S. S., Cole, T. J., Law, C., & Millennium Cohort Study Child, H. (2009). An ecological systems approach to examining risk factors for early childhood overweight: findings from the UK Millennium Cohort Study. *Journal of Epidemiology and Community Health, 63*(2), 147-155.

Heim, S., Stang, J., & Ireland, M. (2009). A Garden Pilot Project Enhances Fruit and Vegetable Consumption among Children. *Journal of the American Dietetic Association, 109*(7), 1220-1226.

Herman, A., Nelson, B. B., Teutsch, C., & Chung, P. J. (2012). "Eat Healthy, Stay Active!": a coordinated intervention to improve nutrition and physical activity among Head Start parents, staff, and children. *American Journal Of Health Promotion: AJHP, 27*(1), e27-e36.

Hesketh, K. D., & Campbell, K. J. (2010). Interventions to Prevent Obesity in 0-5 Year Olds: An Updated Systematic Review of the Literature. *Obesity, 18*, S27-S35.

Hills, A. P., Andersen, L. B., & Byrne, N. M. (2011). Physical activity and obesity in children. *British Journal of Sports Medicine, 45*(11), 866-870.

Hills, A. P., King, N. A., & Armstrong, T. P. (2007). The Contribution of Physical Activity and Sedentary Behaviours to the Growth and Development of Children and Adolescents: Implications for Overweight and Obesity. *Sports Medicine, 37*(6), 533-546.

Hills, A. P., Okely, A. D., & Baur, L. A. (2010). Addressing childhood obesity through increased physical activity. *Nat Rev Endocrinol, 6*(10), 543-549.

Hinkley, T., Crawford, D., Salmon, J., Okely, A. D., & Hesketh, K. (2008). Preschool children and physical activity - A review of correlates. *American Journal of Preventive Medicine, 34*(5), 435-441.

Hinkley, T., Salmon, J., Okely, A. D., Hesketh, K., & Crawford, D. (2012). Correlates of Preschool Children's Physical Activity. *American Journal of Preventive Medicine, 43*(2), 159-167.

Hinkley, T., Salmon, J. O., Okely, A. D., Crawford, D., & Hesketh, K. (2012). Preschoolers' Physical Activity, Screen Time, and Compliance with Recommendations. *Medicine & Science in Sports & Exercise, 44*(3), 458-465.

Hoelscher, D. M., Kirk, S., Ritchie, L., Cunningham-Sabo, L., & Acad Positions, C. (2013). Position of the Academy of Nutrition and Dietetics: Interventions for the Prevention and Treatment of Pediatric Overweight and Obesity. *Journal of the Academy of Nutrition and Dietetics, 113*(10), 1375-1394.

Huang, J. S., Sallis, J., & Patrick, K. (2009). The role of primary care in promoting children's physical activity. *British Journal of Sports Medicine, 43*(1), 19-21.

Instituto Nacional de Estatística. (2011). *Classificacção Portuguesa das Profissões 2010*. Lisboa: Instituto Nacional de Estatística, IP.

Johannsen, D. L., Johannsen, N. M., & Specker, B. L. (2006). Influence of parents' eating Behaviors and child feeding practices on children's weight status. *Obesity, 14*(3), 431-439.

Jones, A., Bentham, G., Foster, C., Hillsdon, M., & Panter, J. (2007). *Future Choices – Obesogenic Environments – Evidence Review*: UK Government's Foresight Programme.

Jones, B. L., & Fiese, B. H. (2014). Parent routines, child routines, and family demographics associated with obesity in parents and preschool-aged children. *Frontiers In Psychology, 5*, 374-374.

Jones, R. A., Riethmuller, A., Hesketh, K., Trezise, J., Batterham, M., & Okely, A. D. (2011). Promoting Fundamental Movement Skill Development and Physical Activity in Early Childhood Settings: A Cluster Randomized Controlled Trial. *Pediatric Exercise Science, 23*(4), 600-615.

Jouret, B., Ahluwalia, N., Dupuy, M., Cristini, C., Negre-Pages, L., Grandjean, H., & Tauber, M. (2009). Prevention of overweight in preschool children: results of kindergarten-based interventions. *International Journal of Obesity, 33*(10), 1075-1083.

Kain, J., Leyton, B., Concha, F., Weisstaub, G., Lobos, L., Bustos, N., & Vio, F. (2012). [Evaluation of an obesity prevention intervention which included nutrition education and physical activity applied in public schools of Santiago, Chile]. *Archivos Latinoamericanos De Nutrición, 62*(1), 60-67.

Kanekar, A., & Sharma, M. (2008). Meta-analysis of school-based childhood obesity interventions in the U.K. and U.S. *International Quarterly Of Community Health Education, 29*(3), 241-256.

Karnik, S., & Kanekar, A. (2012). Childhood obesity: a global public health crisis. *International Journal Of Preventive Medicine, 3*(1), 1-7.

Katz, D. L., O'Connell, M., Njike, V. Y., Yeh, M. C., & Nawaz, H. (2008). Strategies for the prevention and control of obesity in the school setting: systematic review and meta-analysis. *International Journal of Obesity, 32*(12), 1780-1789.

Kimm, S. Y. (1995). The role of dietary fiber in the development and treatment of childhood obesity. *Pediatrics, 96*(5 Pt 2), 1010-1014.

Koplan, J. P., Liverman, C. T., Kraak, V. I., & Comm Prevention Obesity Children, Y. (2005). Preventing childhood obesity: Health in the balance: Executive summary. *Journal of the American Dietetic Association, 105*(1), 131-138.

Kremers, S. P. J., de Bruijn, G.-J., Visscher, T. L. S., van Mechelen, W., de Vries, N. K., & Brug, J. (2006). Environmental influences on energy balance-related behaviors: a dual-process view. *The international journal of behavioral nutrition and physical activity, 3*, 9-9.

Kudlová, E., & Schneidrová, D. (2012). Dietary patterns and their changes in early childhood. *Central European Journal Of Public Health, 20*(2), 126-134.

Kumanyika, S. K., Obarzanek, E., Stettler, N., Bell, R., Field, A. E., Fortmann, S. P., Franklin, B. A., Gillman, M. W., Lewis, C. E., Poston, W. C., 2nd, Stevens, J., & Hong, Y. (2008). Population-based prevention of obesity: the need for comprehensive promotion of healthful eating, physical activity, and energy balance: a scientific statement from American Heart Association Council on Epidemiology and Prevention, Interdisciplinary Committee for Prevention (formerly the expert panel on population and prevention science). *Circulation, 118*(4), 428-464.

Langellotto, G. A., & Gupta, A. (2012). Gardening Increases Vegetable Consumption in School-aged Children: A Meta-analytical Synthesis. *Horttechnology, 22*(4), 430-445.

Larson, N., Ward, D., Neelon, S. B., & Story, M. (2011). Preventing Obesity Among Preschool Children: How Can Child-care Settings Promote Healthy Eating and Physical Activity? Robert Wood Johnson Foundation. Retrieved 7 julho 2013, from http://www.healthyeatingresearch.org/images/RS_ChildCare_For_posting_on_web_FINAL_10-27-11.pdf

Lawlor, D. A., & Chaturvedi, N. (2006). Treatment and prevention of obesity - are there critical periods for intervention? *International Journal of Epidemiology, 35*(1), 3-9.

Ledikwe, J. H., Ello-Martin, J. A., & Rolls, B. J. (2005). Portion sizes and the obesity epidemic. *Journal of Nutrition, 135*(4), 905-909.

Leung, M. M., Agaronov, A., Grytsenko, K., & Yeh, M.-C. (2012). Intervening to Reduce Sedentary Behaviors and Childhood Obesity among School-Age Youth: A Systematic Review of Randomized Trials. *Journal of obesity, 2012*.

Levine, J. A. (2011). Poverty and Obesity in the U.S. *Diabetes, 60*(11), 2667-2668.

Lindsay, A. C., Sussner, K. M., Kim, J., & Gortmaker, S. (2006). The role of parents in preventing childhood obesity. *Future of Children, 16*(1), 169-186.

Lioret, S., Volatier, J. L., Lafay, L., Touvier, M., & Maire, B. (2009). Is food portion size a risk factor of childhood overweight? *European Journal Of Clinical Nutrition, 63*(3), 382-391.

Lissner, L., Lanfer, A., Gwozdz, W., Olafsdottir, S., Eiben, G., Moreno, L. A., Santaliestra-Pasías, A. M., Kovács, E., Barba, G., Loit, H.-M., Kourides, Y., Pala, V., Pohlabeln, H., De Henauw, S., Buchecker, K., Ahrens, W., & Reisch, L. (2012). Television habits in relation to overweight, diet and taste preferences in European children: the IDEFICS study. *European Journal Of Epidemiology, 27*(9), 705-715.

Livingstone, M. B. (2001). Childhood obesity in Europe: a growing concern. *Public Health Nutrition, 4*(1A), 109-116.

Lobstein, T. (2010). Prevalence and trends in childhood obesity. In D. Crawford, R. W. Jeffery, K. Ball & J. Brug (Eds.), *Obesity epidemiology: From aetiology to public health* (pp. 3-16). Oxford: Oxford University Press.

Lobstein, T., Baur, L., & Uauy, R. (2004). Obesity in children and young people: a crisis in public health. *Obesity Reviews: An Official Journal Of The International Association For The Study Of Obesity, 5 Suppl 1*, 4-104.

Lobstein, T., & Brinsden, H. (2014). Symposium report: the prevention of obesity and NCDs: challenges and opportunities for governments. *Obesity reviews : an official journal of the International Association for the Study of Obesity, 15*(8), 630-639.

Lopes, C., Oliveira, A., Afonso, L., Moreira, T., Durão, C., Severo, M., Vilela, S., Ramos, E., & Barros, H. (2014). *Consumo alimentar e nutricional de crianças em idade pré-escolar: resultados da coorte Geração 21*. Porto: Instituto de Saúde Pública da Universidade do Porto.

Loring, B., & Robertson, A. (2014). *Obesity and inequities: Guidance for addressing inequities in overweight and obesity*. Copenhagen: World Health Organization.

Loth, K. A., MacLehose, R. F., Fulkerson, J. A., Crow, S., & Neumark-Sztainer, D. (2013). Eat this, not that! Parental demographic correlates of food-related parenting practices. *Appetite, 60*(1), 140-147.

Lourenço, M., Santos, C., & do Carmo, I. (2014). Nutritional status and dietary habits in preschool-age children. *Estado nutricional e hábitos alimentares em crianças de idade pré-escolar., 4*(1), 7-14.

Maffeis, C., Talamini, G., & Tatò, L. (1998). Influence of diet, physical activity and parents' obesity on children's adiposity: a four-year longitudinal study. *International Journal Of Obesity And Related Metabolic Disorders: Journal Of The International Association For The Study Of Obesity, 22*(8), 758-764.

Malik, V. S., Schulze, M. B., & Hu, F. B. (2006). Intake of sugar-sweetened beverages and weight gain: a systematic review. *American Journal of Clinical Nutrition, 84*(2), 274-288.

Malina, R. M. (2010). PHYSICAL ACTIVITY AND HEALTH OF YOUTH. *Ovidius University Annals, Series Physical Education & Sport/Science, Movement & Health, 10*(2), 271-277.

Manios, Y., Kondaki, K., Kourlaba, G., Grammatikaki, E., Birbilis, M., & Ioannou, E. (2009). Television viewing and food habits in toddlers and preschoolers in Greece: the GENESIS study. *European Journal Of Pediatrics, 168*(7), 801-808.

Manore, M. M., Brown, K., Houtkooper, L., Jakicic, J. M., Peters, J. C., Edge, M. S., Steiber, A., Going, S., Gable, L. G., & Krautheim, A. M. (2014). Energy Balance at a Crossroads: Translating the Science into Action. *Journal of the Academy of Nutrition and Dietetics, 114*(7), 1113-1119.

Martin-Biggers, J., Spaccarotella, K., Berhaupt-Glickstein, A., Hongu, N., Worobey, J., & Byrd-Bredbenner, C. (2014). Come and get it! A discussion of family mealtime literature and factors affecting obesity risk. *Advances in Nutrition, 5*(3), 235-247.

Mindell, J. S., Coombs, N., & Stamatakis, E. (2014). Measuring physical activity in children and adolescents for dietary surveys: practicalities, problems and pitfalls. *The Proceedings Of The Nutrition Society, 73*(2), 218-225.

Mitchell, G. L., Farrow, C., Haycraft, E., & Meyer, C. (2013). Parental influences on children's eating behaviour and characteristics of successful parent-focussed interventions. *Appetite, 60*, 85-94.

Mo-suwan, L., Pongprapai, S., Junjana, C., & Puetpaiboon, A. (1998). Effects of a controlled trial of a school-based exercise program on the obesity indexes of preschool children. *American Journal of Clinical Nutrition, 68*(5), 1006-1011.

Monteiro, C. A., Conde, W. L., Lu, B., & Popkin, B. M. (2004). Obesity and inequities in health in the developing world. *International Journal Of Obesity And Related Metabolic Disorders: Journal Of The International Association For The Study Of Obesity, 28*(9), 1181-1186.

Moreira, P. (2007). Overweight and obesity in Portuguese children and adolescents. *Journal of Public Health, 15*(3), 155-161.

Morenga, L. T., Mallard, S., & Mann, J. (2013). Dietary sugars and body weight: systematic review and meta-analyses of randomised controlled trials and cohort studies. *British Medical Journal, 346*.

Moreno, L. A., Bel-Serrat, S., Santaliestra-Pasias, A. M., & Rodriguez, G. (2013). Obesity prevention in children. *World review of nutrition and dietetics, 106*, 119-126.

Mota, J., Fidalgo, F., Silva, R., Ribeiro, J. C., Santos, R., Carvalho, J., & Santos, M. P. (2008). Relationships between physical activity, obesity and meal frequency in adolescents. *Annals of Human Biology, 35*(1), 1-10.

Mota, J., Ribeiro, J., Santos, M. P., & Gomes, H. (2006). Obesity, physical activity, computer use, and TV viewing in Portuguese adolescents. *Pediatric Exercise Science, 18*(1), 113-121.

Muckelbauer, R., Libuda, L., Clausen, K., Toschke, A. M., Reinehr, T., & Kersting, M. (2009). Promotion and Provision of Drinking Water in Schools for Overweight Prevention: Randomized, Controlled Cluster Trial. *Pediatrics, 123*(4), E661-E667.

Natale, R. A., Lopez-Mitnik, G., Uhlhorn, S. B., Asfour, L., & Messiah, S. E. (2014). Effect of a Child Care Center-Based Obesity Prevention Program on Body Mass Index and Nutrition Practices Among Preschool-Aged Children. *Health Promotion Practice, 15*(5), 695-705.

National Academy of Sciences. (2005). *Dietary reference intakes for energy, carbohydrate, fiber, fat, fatty acids, cholesterol, protein, and amino acids*. Washington, D.C.: National Academies Press.

National Association for Sport and Physical Education of United States of America. (2010). Active Start - Physical Activity Guidelines for Children Birth to Five Years. Retrieved 3 September 2014, from http://journal.naeyc.org/btj/200605/NASPEGuidelinesBTJ.pdf

Neel, J. V. (1962). DIABETES MELLITUS - A THRIFTY GENOTYPE RENDERED DETRIMENTAL BY PROGRESS. *American Journal of Human Genetics, 14*(4), 353-&.

Nemet, D., Geva, D., Pantanowitz, M., Igbaria, N., Meckel, Y., & Eliakim, A. (2013). Long term effects of a health promotion intervention in low socioeconomic Arab- Israeli kindergartens. *Bmc Pediatrics, 13*.

Niederer, I., Burgi, F., Ebenegger, V., Marques-Vidal, P., Schindler, C., Nydegger, A., Kriemler, S., & Puder, J. J. (2013). Effects of a lifestyle intervention on adiposity and fitness in overweight or low fit preschoolers (Ballabeina). *Obesity (Silver Spring, Md.), 21*(3), E287-293.

Niederer, I., Bürgi, F., Ebenegger, V., Marques-Vidal, P., Schindler, C., Nydegger, A., Kriemler, S., & Puder, J. J. (2013). Effects of a lifestyle intervention on

adiposity and fitness in overweight or low fit preschoolers (Ballabeina). *Obesity (Silver Spring, Md.), 21*(3), E287-E293.

Niederer, I., Kriemler, S., Zahner, L., Buergi, F., Ebenegger, V., Hartmann, T., Meyer, U., Schindler, C., Nydegger, A., Marques-Vidal, P., & Puder, J. J. (2009). Influence of a lifestyle intervention in preschool children on physiological and psychological parameters (Ballabeina): study design of a cluster randomized controlled trial. *BMC Public Health, 9*.

Nunnally, J. C., Bernstein, I. H. (1994). *Psychometric theory* (3 ed.). New York.

O'Connell, M. L., Henderson, K. E., Luedicke, J., & Schwartz, M. B. (2012). Repeated Exposure in Natural Setting: A Preschool Intervention to Increase Vegetable Consumption. *Journal of the Academy of Nutrition and Dietetics, 112*(2), 230-234.

O'Dwyer, M. V., Fairclough, S. J., Knowles, Z., & Stratton, G. (2012). Effect of a family focused active play intervention on sedentary time and physical activity in preschool children. *The International Journal Of Behavioral Nutrition And Physical Activity, 9*, 117-117.

Ogata, B. N., & Hayes, D. (2014). Position of the Academy of Nutrition and Dietetics: Nutrition Guidance for Healthy Children Ages 2 to 11 Years. *Journal of the Academy of Nutrition & Dietetics, 114*(8), 1257-1276.

Ogden, C. L., Carroll, M. D., Kit, B. K., & Flegal, K. M. (2012). Prevalence of Obesity and Trends in Body Mass Index Among US Children and Adolescents, 1999-2010. *Jama-Journal of the American Medical Association, 307*(5), 483-490.

Ogden, C. L., Carroll, M. D., Kit, B. K., & Flegal, K. M. (2014). Prevalence of Childhood and Adult Obesity in the United States, 2011-2012. *JAMA: Journal of the American Medical Association, 311*(8), 806-814.

Olds, T., Maher, C., Zumin, S., Péneau, S., Lioret, S., Castetbon, K., Bellisle, de Wilde, J., Hohepa, M., Maddison, R., Lissner, L., Sjöberg, A., Zimmermann, M., Aeberli, I., Ogden, C., Flegal, K., & Summerbell, C. (2011). Evidence that the prevalence of childhood overweight is plateauing: data from nine countries. *International Journal of Pediatric Obesity, 6*(5/6), 342-360.

Organisation for Economic Co-Operation and Development. (2014). Obesity Update. OECD. Retrieved 28 July 2014, 2014, from http://www.oecd.org/els/health-systems/Obesity-Update-2014.pdf

Pabayo, R., Spence, J. C., Cutumisu, N., Casey, L., & Storey, K. (2012). Sociodemographic, behavioural and environmental correlates of sweetened beverage consumption among pre-school children. *Public Health Nutrition, 15*(8), 1338-1346.

Padez, C., Fernandes, T., Mourao, I., Moreira, P., & Rosado, V. (2004). Prevalence of overweight and obesity in 7-9-year-old Portuguese children: Trends in body mass index from 1970-2002. *American Journal of Human Biology, 16*(6), 670-678.

Padez, C., Mourao, I., Moreira, P., & Rosado, V. (2009). Long Sleep Duration and Childhood Overweight/Obesity and Body Fat. *American Journal of Human Biology, 21*(3), 371-376.

Pagels, P., Boldemann, C., & Raustorp, A. (2011). Comparison of pedometer and accelerometer measures of physical activity during preschool time on 3- to 5-year-old children. *Acta Paediatrica, 100*(1), 116-120.

Papas, M. A., Alberg, A. J., Ewing, R., Helzlsouer, K. J., Gary, T. L., & Klassen, A. C. (2007). The built environment and obesity. *Epidemiologic Reviews, 29*, 129-143.

Parmer, S. M., Salisbury-Glennon, J., Shannon, D., & Struempler, B. (2009). School Gardens: An Experiential Learning Approach for a Nutrition Education Program to Increase Fruit and Vegetable Knowledge, Preference, and Consumption among Second-Grade Students. *Journal of Nutrition Education and Behavior, 41*(3), 212-217.

Parsons, T. J., Powers, C., Logan, S., & Summerbell, C. D. (1999). Childhood predictors of adult obesity: a systematic review. *International Journal of Obesity & Related Metabolic Disorders, 23*, S1-S107.

Pate, R. R., O'Neill, J. R., Liese, A. D., Janz, K. F., Granberg, E. M., Colabianchi, N., Harsha, D. W., Condrasky, M. M., O'Neil, P. M., Lau, E. Y., & Taverno Ross, S. E. (2013). Factors associated with development of excessive fatness in children and adolescents: a review of prospective studies. *Obesity Reviews, 14*(8), 645-658.

Pearson, N., Biddle, S. J. H., & Gorely, T. (2009a). Family correlates of breakfast consumption among children and adolescents. A systematic review. *Appetite, 52*(1), 1-7.

Pearson, N., Biddle, S. J. H., & Gorely, T. (2009b). Family correlates of fruit and vegetable consumption in children and adolescents: a systematic review. *Public Health Nutrition, 12*(2), 267-283.

Penhollow, T., & Rhoads, K. (2014). Preventing Obesity and Promoting Fitness: An Ecological Perspective. *American Journal of Lifestyle Medicine, 8*(1), 21-24.

Penhollow, T. M., & Rhoads, K. E. (2014, Jan 12, 2014). Preventing Obesity and Promoting Fitness: An Ecological Perspective. *American Journal of Lifestyle Medicine*. Retrieved 23 February, 2014, from http://ajl.sagepub.com/content/8/1/21

Pereira, J., & Mateus, C. (2003). Custos indirectos associados à obesidade

em Portugal. *Revista Portuguesa de Saúde Pública*.

Pinto, E., Toro, B., & Vicéns, L. (2014). Nutrition and Physical Activity Interventions for Childhood Obesity: Lessons Learned. *Ecology Of Food And Nutrition, 53*(5), 503-513.

Pratt, C. A., Boyington, J., Esposito, L., Pemberton, V. L., Bonds, D., Kelley, M., Yang, S., Murray, D., & Stevens, J. (2013). Childhood Obesity Prevention and Treatment Research (COPTR): Interventions addressing multiple influences in childhood and adolescent obesity. *Contemporary Clinical Trials, 36*(2), 406-413.

Pratt, C. A., Stevens, J., & Daniels, S. (2008). Childhood obesity prevention and treatment: recommendations for future research. *American Journal of Preventive Medicine, 35*(3), 249-252.

Prentice, A. M., & Jebb, S. A. (2003). Fast foods, energy density and obesity: a possible mechanistic link. *Obesity reviews : an official journal of the International Association for the Study of Obesity, 4*(4), 187-194.

Proctor, M. H., Moore, L. L., Gao, D., Cupples, L. A., Bradlee, M. L., Hood, M. Y., & Ellison, R. C. (2003). Television viewing and change in body fat from preschool to early adolescence: The Framingham Children's Study. *International Journal of Obesity, 27*(7), 827-833.

Quelly, S., & Lieberman, L. S. (2011). Global prevalence of overweight and obesity in preschoolers. *Anthropologischer Anzeiger; Bericht Über Die Biologisch-Anthropologische Literatur, 68*(4), 437-456.

Rampersaud, G. C., Pereira, M. A., Girard, B. L., Adams, J., & Metzl, J. D. (2005). Breakfast habits, nutritional status, body weight, and academic performance in children and adolescents. *Journal of the American Dietetic Association, 105*(5), 743-762.

Rêgo, C., Lopes, C., Pinto, E., Nazareth, M., & Graça, P. (2013). How babies grow in Portugal in their first three years of life: "Study of dietary and infant growth patterns - EPACI Portugal 2012".

Reilly, J. J. (2010). Low Levels of Objectively Measured Physical Activity in Preschoolers in Child Care. *Medicine and Science in Sports and Exercise, 42*(3), 502-507.

Reilly, J. J., Kelly, L., Montgomery, C., Williamson, A., Fisher, A., McColl, J. H., Lo Conte, R., Paton, J. Y., & Grant, S. (2006). Physical activity to prevent obesity in young children: cluster randomised controlled trial. *British Medical Journal, 333*(7577), 1041-1043.

Rennie, K. L., Johnson, L., & Jebb, S. A. (2005). Behavioural determinants of obesity. *Best Practice & Research Clinical Endocrinology & Metabolism, 19*(3), 343-358.

Ritchie, L. D., Welk, G., Styne, D., Gerstein, D. E., & Crawford, P. B. (2005). Family environment and pediatric overweight: What is a parent to do? *Journal of the American Dietetic Association, 105*(5), S70-S79.

Rito, A., Paixão, E., Carvalho, M. A., & Ramos, C. (2012). *Chilhood Obesity Surveillance Initiative: COSI Portugal 2010*. Lisboa.

Rito, A. (2006). Overweight and Obesity in Preschool children of Coimbra: an urban city of Portugal. *Obesity reviews, 7*(s2), 323.

Rito, A., Wijnhoven, T. M., Rutter, H., Carvalho, M. A., Paixão, E., Ramos, C., Claudio, D., Espanca, R., Sancho, T., Cerqueira, Z., Carvalho, R., Faria, C., Feliciano, E., & Breda, J. (2012). Prevalence of obesity among Portuguese children (6-8 years old) using three definition criteria: COSI Portugal, 2008. *Pediatric Obesity, 7*(6), 413-422.

Robinson-O'Brien, R., Story, M., & Heim, S. (2009). Impact of Garden-Based Youth Nutrition Intervention Programs: A Review. *Journal of the American Dietetic Association, 109*(2), 273-280.

Rockett, H. (2007). Family dinner: More than just a meal. *Journal of the American Dietetic Association, 107*(9), 1498-1501.

Rolland-Cachera, M. F. (2011). Childhood obesity: current definitions and recommendations for their use. *International Journal of Pediatric Obesity, 6*(5/6), 325-331.

Rolland-Cachera, M. F., Deheeger, M., Maillot, M., & Bellisle, F. (2006). Early adiposity rebound: causes and consequences for obesity in children and adults. *International Journal of Obesity, 30*, S11-S17.

Rosário, R., Oliveira, B., Araújo, A., Lopes, O., Padrão, P., Moreira, A., Teixeira, V., Barros, R., Pereira, B., & Moreira, P. (2012). The impact of an intervention taught by trained teachers on childhood overweight. *International Journal Of Environmental Research And Public Health, 9*(4), 1355-1367.

Rosenberg, D. E., Sallis, J. F., Kerr, J., Maher, J., Norman, G. J., Durant, N., Harris, S. K., & Brian, E. S. (2010). Brief scales to assess physical activity and sedentary equipment in the home. *International Journal of Behavioral Nutrition & Physical Activity, 7*, 10-20.

Rowlinson, M. (2011). *Obesity Stigma in Young Children*. Academic Unit of Psychiatry and Behavioural Sciences School of Medicine: Doutoramento Thesis presented to University of Leeds.

Sallis, J. F., & Glanz, K. (2009). Physical activity and food environments: solutions to the obesity epidemic. *The Milbank Quarterly, 87*(1), 123-154.

Sallis, J. F., Owen, N., & Fisher, E. B. (2008). Ecological Models Of Health Behavior. In K. Glanz, B. K. Rimer & K. Viswanath (Eds.), *Health Behavior and Health Education: Theory, Research and Practice* (4th ed., pp. 465-485). San Francisco: Jossey-Bass.

Sallis, J. F., Prochaska, J. J., & Taylor, W. C. (2000). A review of correlates of physical activity of children and adolescents. *Medicine and Science in Sports and Exercise, 32*(5), 963-975.

Salsberry, P. J., & Reagan, P. B. (2005). Dynamics of early childhood overweight. *Pediatrics, 116*(6), 1329-1338.

Sancho, T., Cruz, S., Pinto, E., Mota, J., Vale, S., & Moreira, P. (2014). Prevalence of obesity among preschool children using three definition criteria. *Revista Portuguesa de Cirurgia*(Suplemento Outubro 2014), 48.

Sancho, T., Pinto, E., Moreira, R., Mota, J., Vale, S., & Moreira, P. (2014). Reliability of the "Meals in Our Household Questionnaire" in Portuguese Preschool Children [Electronic version]. *Nutrícias, 23*, 10-13 from http://www.apn.org.pt/xFiles/scContentDeployer_pt/docs/Doc2288.pdf.

Santos, O. (2010). O papel da literacia em Saúde: capacitando a pessoa com excesso de peso para o controlo e redução da carga ponderal. *Endocrinologia, Diabetes & Obesidade, 4*(3), 127-134.

Sardinha, L. B., Santos, R., Vale, S., Silva, A. M., Ferreira, J. P., Raimundo, A. M., Moreira, H., Baptista, F., & Mota, J. (2011). Prevalence of overweight and obesity among Portuguese youth: A study in a representative sample of 10-18-year-old children and adolescents. *International Journal of Pediatric Obesity, 6*(2-2), E124-E128.

Serdula, M. K., Ivery, D., Coates, R. J., Freedman, D. S., Williamson, D. F., & Byers, T. (1993). Do obese children become obese adults? A review of the literature. *Preventive Medicine, 22*(2), 167-177.

Sherry, B. (2005). Food behaviors and other strategies to prevent and treat pediatric overweight. *International Journal of Obesity, 29*, S116-S126.

Sherry, B., McDivitt, J., Birch, L. L., Cook, F. H., Sanders, S., Prish, J. L., Francis, L. A., & Scanlon, K. S. (2004). Attitudes, practices, and concerns about child feeding and child weight status among socioeconomically diverse white, Hispanic, and African-American mothers. *Journal of the American Dietetic Association, 104*(2), 215-221.

Silva-Sanigorski, A. M., Bell, A. C., Kremer, P., Nichols, M., Crellin, M., Smith, M., Sharp, S., de Groot, F., Carpenter, L., Boak, R., Robertson, N., & Swinburn, B. A. (2010). Reducing obesity in early childhood: results from Romp & Chomp, an Australian community-wide intervention program. *American Journal of Clinical Nutrition, 91*(4), 831-840.

Skouteris, H., Dell'Aquila, D., Baur, L. A., Dwyer, G. M., McCabe, M. P., Ricciardelli, L. A., & Fuller-Tyszkiewicz, M. (2012). Physical activity guidelines for preschoolers: a call for research to inform public health policy. *Medical Journal of Australia, 196*(3), 174-176.

Sleddens, E. F. C., Gerards, S. M. P. L., Thijs, C., de Vries, N. K., & Kremers, S. P. J. (2011). General parenting, childhood overweight and obesity-inducing behaviors: a review. *International Journal Of Pediatric Obesity: IJPO: An Official Journal Of The International Association For The Study Of Obesity, 6*(2-2), e12-e27.

Slusser, W., Frankel, F., Robison, K., Fischer, H., Cumberland, W. G., & Neumann, C. (2012). Pediatric overweight prevention through a parent training program for 2-4 year old Latino children. *Childhood Obesity (Print), 8*(1), 52-59.

Snethen, J. A., Broome, M. E., & Cashin, S. E. (2006). Effective weight loss for overweight children: a meta-analysis of intervention studies. *Journal of Pediatric Nursing, 21*(1), 45-56.

Speiser, P. W., Rudolf, M. C. J., Anhalt, H., Camacho-Hubner, C., Chiarelli, F., Eliakim, A., Freemark, M., Gruters, A., Hershkovitz, E., Iughetti, L., Krude, H., Latzer, Y., Lustig, R. H., Pescovitz, O. H., Hamiel, O. P., Rogol, A. D., Shalitin, S., Sultan, C., Stein, D., Vardi, P., Werther, G. A., Zadik, Z., Zuckerman-Levin, N., Hochberg, Z., & Obesity Consensus Working, G. (2005). Consensus statement: Childhood obesity. *Journal of Clinical Endocrinology & Metabolism, 90*(3), 1871-1887.

Spitzer, M. (2010). A further look at obesity. *Lancet, 376*(9747), 1144-1145.

Stang, J., & Loth, K. A. (2011). Parenting Style and Child Feeding Practices: Potential Mitigating Factors in the Etiology of Childhood Obesity. *Journal of the American Dietetic Association, 111*(9), 1301-1305.

Stanley, K. (2007). Design of randomized controlled trials. *Circulation, 115*(9), 1164-1169.

Stewart, L. (2011). Childhood obesity. *Medicine, 39*(1), 42-44.

Story, M., Kaphingst, K. M., & French, S. (2006a). The role of child care settings in obesity prevention. *Future of Children, 16*(1), 143-168.

Story, M., Kaphingst, K. M., & French, S. (2006b). The role of schools in obesity prevention. *Future of Children, 16*(1), 109-142.

Story, M., Nanney, M. S., & Schwartz, M. B. (2009). Schools and Obesity Prevention: Creating School Environments and Policies to Promote Healthy Eating and Physical Activity. *Milbank Quarterly, 87*(1), 71-100.

Summerbell, C. D., Waters, E., Edmunds, L. D., Kelly, S., Brown, T., & Campbell, K. J. (2005). Interventions for preventing obesity in children. *Cochrane Database Of Systematic Reviews (Online)*(3), CD001871.

Szajewska, H., & Ruszczynski, M. (2010). Systematic review demonstrating that breakfast consumption influences body weight outcomes in children and adolescents in Europe. *Critical Reviews in Food Science & Nutrition, 50*(2), 113-119.

Tanaka, C., & Tanaka, S. (2009). Daily Physical Activity in Japanese Preschool Children Evaluated by Triaxial Accelerometry: The Relationship between Period of Engagement in Moderate-to-Vigorous Physical Activity and Daily Step Counts. *Journal of PHYSIOLOGICAL ANTHROPOLOGY, 28*(6), 283-288.

Tanumihardjo, S. A., Anderson, C., Kalifer-Horwitz, M., Bode, L., Emenaker, N. J., Haqq, A. M., Satia, J. A., Silver, H. J., & Stadler, D. D. (2007). Poverty, obesity, and malnutrition: An international perspective recognizing the paradox. *Journal of the American Dietetic Association, 107*(11), 1966-1972.

Taveras, E. M., Rifas-Shiman, S., Berkey, C. S., Rockett, H. R. H., Field, A. E., Frazir, A. L., Colditz, G. A., & Gillman, M. W. (2005). Family dinner and adolescent overweight. *Obesity Research, 13*(5), 900-906.

Toschke, A. M., Thorsteinsdottir, K. H., Von Kries, R., & Grp, G. M. E. S. (2009). Meal frequency, breakfast consumption and childhood obesity. *International Journal of Pediatric Obesity, 4*(4), 242-248.

Trost, S. G., Fees, B., & Dzewaltowski, D. (2008). Feasibility and efficacy of a "move and learn" physical activity curriculum in preschool children. *Journal Of Physical Activity & Health, 5*(1), 88-103.

Trost, S. G., Pate, R. R., Freedson, P. S., Sallis, J. F., & Taylor, W. C. (2000). Using objective physical activity measures with youth: how many days of monitoring are needed? *Medicine And Science In Sports And Exercise, 32*(2), 426-431.

Trost, S. G., Sirard, J. R., Dowda, M., Pfeiffer, K. A., & Pate, R. R. (2003). Physical activity in overweight and nonoverweight preschool children. *International Journal Of Obesity And Related Metabolic Disorders: Journal Of The International Association For The Study Of Obesity, 27*(7), 834-839.

Tucker, P. (2008). The physical activity levels of preschool-aged children: A systematic review. *Early Childhood Research Quarterly, 23*(4), 547-558.

Tudor-Locke, C., Craig, C. L., Beets, M. W., Belton, S., Cardon, G. M., Duncan, S., Hatano, Y., Lubans, D. R., Olds, T. S., Raustorp, A., Rowe, D. A., Spence, J. C., Tanaka, S., & Blair, S. N. (2011). How many steps/day are enough? for children and adolescents. *The International Journal Of Behavioral Nutrition And Physical Activity, 8*, 78-78.

Tudor-Locke, C., Craig, C. L., Thyfault, J. P., & Spence, J. C. (2013). A step-defined sedentary lifestyle index: <5000 steps/day. *Applied Physiology, Nutrition & Metabolism, 38*(2), 100-114.

United Kingdom Government: Department of Health Social Services and Public Safety. (2011). UK Physical Activity Guidelines for Early Years. Retrieved 3 September 2014, from https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/213738/dh_128143.pdf

Vale, S., Rute, S., Soares-Miranda, L., Rego, C., Moreira, P., & Mota, J. (2011). Prevalence of overweight/obesity among Portuguese preschoolers. *International Journal of Obesity, 35*, S166-S166.

Vale, S., Trost, S., Duncan, M., & Mota, J. (2014). Step based physical activity guidelines for preschool-aged children. *Preventive Medicine*(In Press).

Valente, H., Teixeira, V., Padrao, P., Bessa, M., Cordeiro, T., Moreira, A., Mitchell, V., Lopes, C., Mota, J., & Moreira, P. (2011). Sugar-sweetened beverage intake and overweight in children from a Mediterranean country. *Public Health Nutrition, 14*(1), 127-132.

Van Baak, M. A., & Astrup, A. (2009). Consumption of sugars and body weight. *Obesity Reviews, 10*, 9-23.

Van Cauwenberghe, E., Maes, L., Spittaels, H., van Lenthe, F. J., Brug, J., Oppert, J. M., & De Bourdeaudhuij, I. (2010). Effectiveness of school-based interventions

in Europe to promote healthy nutrition in children and adolescents: systematic review of published and 'grey' literature. *The British Journal Of Nutrition, 103*(6), 781-797.

Vanderloo, L. M. (2014). Screen-viewing among preschoolers in childcare: a systematic review. *BMC Pediatrics, 14*(1), 205-205.

Viana, V., & Sinde, S. (2008). O comportamento alimentar em crianças: Estudo de validação de um questionário numa amostra portuguesa (CEBQ). *Análise Psicológica, 26*(1), 111-120.

Wang, Y., & Lobstein, T. (2006). Worldwide trends in childhood overweight and obesity. *International Journal of Pediatric Obesity, 1*(1), 11-25.

Wardle, J., Guthrie, C. A., Sanderson, S., & Rapoport, L. (2001). Development of the Children's Eating Behaviour Questionnaire. *Journal of Child Psychology & Psychiatry & Allied Disciplines, 42*(7), 963.

Waters, E., de Silva-Sanigorski, A., Hall, B. J., Brown, T., Campbell, K. J., Gao, Y., Armstrong, R., Prosser, L., & Summerbell, C. D. (2011). Interventions for preventing obesity in children. *Cochrane Database of Systematic Reviews*(12).

Wells, J. C. K. (2012). Obesity as malnutrition: The role of capitalism in the obesity global epidemic. *American Journal of Human Biology, 24*(3), 261-276.

Whitaker, R. C., Pepe, M. S., Wright, J. A., Seidel, K. D., & Dietz, W. H. (1998). Early adiposity rebound and the risk of adult obesity. *Pediatrics, 101*(3).

Whitaker, R. C., Wright, J. A., Pepe, M. S., Seidel, K. D., & Dietz, W. H. (1997). Predicting obesity in young adulthood from childhood and parental obesity. *New England Journal of Medicine, 337*(13), 869-873.

White, R. O., Thompson, J. R., Rothman, R. L., McDougald Scott, A. M., Heerman, W. J., Sommer, E. C., & Barkin, S. L. (2013). A health literate approach to the prevention of childhood overweight and obesity. *Patient Education And Counseling, 93*(3), 612-618.

Whitehead, M., & Dahlgren, G. (2007). *European strategies for tackling social inequities in health: Levelling up Part 1*. Copenhagen: World Health Organization.

Whitehead, M., Dahlgren, G., & Gilson, L. (2001). Developing the policy response to inequities in Health: aglobal perspective. In *Challenging inequities in health care: from ethics to action* (pp. 309-322). New York: Oxford University Press.

Williams, C. L. (2006). Dietary fiber in childhood. *Journal of Pediatrics, 149*(5), S121-S130.

Wofford, L. G. (2008). Systematic Review of Childhood Obesity Prevention. *Journal of Pediatric Nursing, 23*(1), 5-19.

World Health Organization. (2000). *Obesity: Preventing and Managing the Global Epidemic*. Geneva: World Health Organization.

World Health Organization. (2002). *The world health report 2002 - Reducing risks, promoting healthy life*. Geneva: WHO.

World Health Organization. (2003). Diet, nutrition and the prevention of chronic diseases - Introduction. In *Diet, Nutrition and the Prevention of Chronic Diseases* (Vol. 916, pp. 1-149). Geneva: World Health Organization.

World Health Organization. (2004). *Global strategy on diet, physical activity and health*. Geneva: World Health Organization.

World Health Organization. (2008a). *2008-2013 Action Plan for the Global Strategy for the Prevention and Control of Noncommunicable Diseases.* Geneva.

World Health Organization. (2008b). WHO child growth standards : training course on child growth assessment. World Health Organization. Retrieved 14 September 2014, from http://www.who.int/childgrowth/training/module_b_measuring_growth.pdf

World Health Organization. (2009). *Interventions on diet and physical activity: what works: summary report.* Geneva: World Health Organization.

World Health Organization. (2010a). *Global status report on noncommunicable diseases 2010*. Geneva: World Health Organization.

World Health Organization. (2010b). *Population-based prevention strategies for childhood obesity: report of a WHO forum and technical meeting*. Geneva: World Health Organization.

World Health Organization. (2011). Waist Circumference and Waist–Hip Ratio: Report of a WHO Expert Consultation. *World Health Organization* World Health Organization. Retrieved 14 September 2014, from http://apps.who.int/iris/bitstream/10665/44583/1/9789241501491_eng.pdf

World Health Organization. (2012a). *Population-based approaches to childhood obesity prevention.* Geneva: World Health Organization.

World Health Organization. (2012b). *Prioritizing areas for action in the field of population-based prevention of childhood obesity: a set of tools for Member States to determine and identify priority areas for action.* Geneva: World Health Organization.

World Health Organization. (2013a). *Global action plan for the prevention and control of noncommunicable diseases 2013-2020*. Geneva: World Health Organization.

World Health Organization. (2013b). Health 2020. A European policy framework and strategy for the 21st century. WHO. Retrieved 31 August 2014, from http://www.euro.who.int/__data/assets/pdf_file/0011/199532/Health2020-Long.pdf?ua=1

World Health Organization. (2013c). *Health literacy: The solid facts*. Copenhagen: WHO.

World Health Organization. (2013d). WHO issues guidance on emerging double threat of childhood obesity and undernutrition in low- and middle-income countries. Retrieved july 2014, from http://www.who.int/mediacentre/news/notes/2013/obesity_undernutrition_20130605/en/

World Health Organization. (2013e). WHO issues guidance on emerging double threat of childhood obesity and undernutrition in low- and middle-income countries. Retrieved 25 July 2014, from http://www.who.int/mediacentre/news/notes/2013/obesity_undernutrition_20130605/en/

World Health Organization. (2014a). *Comprehensive Implementation Plan on Maternal, Infant and Young Child Nutrition*. Geneva: World Health Organization.

World Health Organization. (2014b). Global Strategy on Diet, Physical Activity and Health: Childhood overweight and obesity. WHO. Retrieved 2 December 2014, from http://www.who.int/dietphysicalactivity/childhood/en/

World Health Organization. (2014c). Global Strategy on Diet, Physical Activity and Health: Commission on Ending Childhood Obesity. Retrieved 26 December 2014, from http://www.who.int/dietphysicalactivity/en/

World Health Organization. (2014d). New WHO analysis shows alarming rates of overweight children. WHO. Retrieved 28 August 2014, from New WHO analysis shows alarming rates of overweight children

World Health Organization. (2014e). Obesity and overweight. WHO. Retrieved 13 July 2014, from http://www.who.int/mediacentre/factsheets/fs311/en/

World Medical Association. (2013). Declaration of Helsinki. Retrieved 12 December 2014, from http://www.wma.net/en/30publications/10policies/b3/index.html.pdf?print-media-type&footer-right=[page]/[toPage]

Xiaoli, C., Beydoun, M. A., & Youfa, W. (2008). Is Sleep Duration Associated With Childhood Obesity? A Systematic Review and Meta-analysis. *Obesity (19307381), 16*(2), 265-274.

Zask, A., Adams, J. K., Brooks, L. O., & Hughes, D. F. (2012). Tooty Fruity Vegie: an obesity prevention intervention evaluation in Australian preschools. *Health Promotion Journal of Australia, 23*(1), 10-15.

Zimmerman, F. J., & Bell, J. F. (2010). Associations of Television Content Type and Obesity in Children. *American Journal of Public Health, 100*(2), 334-340.

8. Appendices

Appendix I Written informed consent

Appendix II Questionnaire about eating behaviors and physical activity

Appendix III Lyrics of the song "*Vamos melhor comer, vamos mais ativos ser*"

Appendix IV Paper "*Determinantes do peso corporal de crianças em idade pré-escolar*"

Appendix I

Estudo sobre "Promoção da Alimentação Saudável e da Atividade Física em Crianças do Pré-Escolar"
Autora: Teresa Sofia Sancho (Nutricionista, ARS Algarve, IP/ Universidade do Porto)

CONSENTIMENTO INFORMADO

No âmbito do Programa Nacional de Promoção da Alimentação Saudável, a Administração Regional de Saúde do Algarve, IP e a Direção de Serviços de Educação Região Algarve, em colaboração com a Faculdade de Desporto da Universidade do Porto, realizam um estudo sobre "Promoção da Alimentação Saudável e da Atividade Física em Crianças do Pré-Escolar". Este trabalho vai decorrer em todas as Pré-Escolas da rede pública do concelho de Faro e tem como objetivo prevenir a obesidade com a promoção de estilos de vida saudável.

Este estudo consistirá na avaliação de cada criança no que respeita o peso, a altura, o perímetro de cintura e os hábitos de alimentação e de atividade física, antes e após as atividades de educação para a saúde. Estas atividades serão realizadas apenas com cerca de metade das crianças a estudar, grupo de intervenção, sendo que as restantes constituirão o grupo controlo. Para o efeito, cada criança será avaliada (com roupa leve ou interior) por técnicos treinados, e será ainda solicitado ao pai/mãe/encarregado de educação o preenchimento de questionários sobre hábitos de alimentação e de atividade física (tempo de preenchimento de aproximadamente 30 minutos). Considerando que o trabalho consiste na comparação dos dados obtidos, no início e no final do ano letivo 2013/2014, necessitaremos da sua colaboração no preenchimento dos questionários, bem como da sua autorização para a avaliação do/a seu/sua filho/a, nestes dois momentos (set-out/2013 e mai-jun/2014). Mais informamos, que não se prevê qualquer tipo de desconforto para o/a seu/sua filho/a, sendo assegurada a respectiva privacidade durante a avaliação, bem como a absoluta confidencialidade de todos os dados obtidos, os quais permanecerão apenas na posse do responsável pelo estudo.

Este estudo permitirá conhecer melhor o estado nutricional e os hábitos de alimentação e de atividade física das crianças desta faixa etária, bem como investigar sobre a eficácia de intervenções simultâneas em alimentação e atividade física no pré-escolar com vista à prevenção da obesidade, até ao momento, inexistentes em Portugal. Mais informamos, que se durante o estudo se detetar que o crescimento do/a seu/sua filho/a merece observação pelo médico de família, facilitaremos, caso concorde, a respectiva referenciação, após a conclusão do estudo. A sua participação neste estudo é voluntária, podendo recusar-se participar em qualquer altura, sem que tal facto tenha alguma consequência para si.

Para esclarecimento de quaisquer dúvidas pode contactar a responsável pelo estudo, Dr.ª Teresa Sofia Sancho através do email nutricao@arsalgarve.min-saude.pt ou pelo telefone 289 889 514.

✂----------

_____, encarregado/a de educação do/a aluno/a _____, declaro que li toda a informação fornecida e **autorizo/ não autorizo** (riscar o que não interessa) que o/a meu/minha filho/a participe no Estudo "Promoção da Alimentação Saudável e da Atividade Física em Crianças do Pré-Escolar", nos termos da informação prestada.

Assinatura do Encarregado de Educação

Data _____/_____/_____ _____

Estudo sobre "Promoção da Alimentação Saudável e da Atividade Física em Crianças do Pré-Escolar"

Teresa Sofia Sancho (Nutricionista, ARS Algarve, IP/ Universidade do Porto)

Questionário de hábitos alimentares e de atividade física

Este questionário faz parte do estudo sobre "Promoção da Alimentação Saudável e da Atividade Física em Crianças do Pré-Escolar" e permite caracterizar o/a seu/sua filho/a relativamente a aspetos que podem interferir na saúde, nomeadamente no que respeita o comportamento alimentar, a atividade física, a amamentação, o sono, os hábitos de visualização de televisão e de utilização de videojogos, bem como os fatores que influenciam estes comportamentos: ambiente familiar e área envolvente. As respostas, quaisquer que sejam, são sempre adequadas uma vez que traduzem as características da criança, da família e do seu meio ambiente. O questionário está estruturado para ser preenchido pelo pai, mãe ou outra pessoa que cuide ou resida com a criança. Estimamos que o questionário demore cerca de 20 minutos a ser preenchido. Obrigada pela atenção dispensada!

Número de registo do questionário: |__|-|__|__|__|-|__|__|__|__|-|__|__|__|
Reservado para codificação do estudo (não preencher)

Data de hoje: ☐☐-☐☐-☐☐☐☐
dia mês ano

Nome da criança: _____

Sexo da criança: ☐ Masculino ☐ Feminino

Data de nascimento da criança: ☐☐-☐☐-☐☐☐☐
dia mês ano

Morada da criança: _____

Código Postal: |__|__|__|__|-|__|__|__| _____

Telemóvel de quem preenche o questionário: |__|__|__|__|__|__|__|__|__|

Email de quem preenche o questionário: _____@_____Não tem: ◯

Outro contacto: |__|__|__|__|__|__|__|__|__| Qual? _____

Q1 Qual é a sua **relação com a criança**?

◯ Mãe ◯ Pai ◯ Avó ◯ Avô ◯ Outra; Qual? _____

Q2 Quem **reside com a criança** (assinale apenas uma opção)?

◯ Mãe, pai e irmã(o)(s) ◯ Mãe e pai ◯ Mãe e irmã(o)(s) ◯ Pai e irmã(o)(s) ◯ Mãe ◯ Pai
◯ Mãe/pai e parceiro/a ◯ Mãe/pai, parceiro/a e irmã(o)(s) ◯ Outra situação; Qual? _____

Q3 Que **idade** tem?

◯ Menos de 20 anos ◯ 20-29 anos ◯ 30-39 anos ◯ 40-49 anos ◯ 50-59 anos ◯ 60-69 anos ◯ Mais de 70 anos

Q4 Qual é **o grau académico que completou** (assinale apenas uma opção)?

◯ 1º Ciclo do Ensino Básico (Primária) ◯ 2º Ciclo do Ensino Básico (6ºano) ◯ 3º Ciclo do Ensino Básico (9º ano)

◯ Ensino Secundário (12º ano) ◯ Bacharelato/ Licenciatura ◯ Mestrado/ Doutoramento

◯ Outro; Especifique _____

Q5 Qual é **o grau académico que o/a seu/sua parceiro/a completou** (assinale apenas uma opção)?

◯ 1º Ciclo do Ensino Básico (Primária) ◯ 2º Ciclo do Ensino Básico (6ºano) ◯ 3º Ciclo do Ensino Básico (9º ano)

◯ Ensino Secundário (12º ano) ◯ Bacharelato/ Licenciatura ◯ Mestrado/ Doutoramento

◯ Outro; Especifique _____

Q6 No que respeita os **pais (ou cuidadores) da criança**, gostaríamos de ter algumas informações complementares.

Pai		**Mãe**	
Profissão:	_____	Profissão:	_____
Idade:	|__|__|anos	Idade:	|__|__|anos
Peso atual:	|__|__|__|,|__|Kg	Peso atual:	|__|__|__|,|__|Kg
Altura atual:	|__|,|__|__|m	Altura atual:	|__|,|__|__|m

Se desconhecer a altura, coloque o valor que está num documento de identificação (Cartão de Cidadão, Bilhete de Identidade ou Passaporte).

Q7 Qual foi o **peso do/a seu/sua filho/a à nascença**: |__|__|__|__|g

Q8 O/a seu/sua filho/a nasceu com quanto **tempo de gravidez**? |__|__|semanas

Q9 O/a seu/sua filho/a foi **amamentado/a**? ◯ Sim ◯ Não (passe para a questão 11)

Q10 O/a seu/sua filho/a foi alimentado/a **só com leite materno** durante quanto tempo?

◯ Menos de 1 mês ◯ Cerca de 1 mês ◯ Cerca de 2 meses ◯ Cerca de 3 meses

◯ Cerca de 4 meses ◯ Cerca de 5 meses ◯ Cerca de 6 meses ◯ Mais de 6 meses

Q11 Quanto tempo **dorme** o/a seu/sua filho/a por dia (some o tempo de sono noturno e diurno)?

Dia de semana (segunda a sexta)	|__|__|h |__|__|min
Dia de fim de semana (sábado ou domingo)	|__|__|h |__|__|min

Q12 No que respeita a **compra de alimentos**, a **estrutura** e a **preparação das refeições em família**, para cada uma das afirmações seguintes, por favor escolha a opção que melhor descreve as refeições na sua casa.

	Nunca	**Rara_ mente**	**Às vezes**	**Frequen_ temente**	**Sempre ou quase sempre**
1.O/a meu/minha filho/a faz as refeições comigo ou com outros membros da família.	◯	◯	◯	◯	◯
2R. Durante a refeição do/a meu/minha filho/a, a televisão está ligada na mesma divisão da casa.	◯	◯	◯	◯	◯
3.A nossa família janta regularmente à mesma hora.	◯	◯	◯	◯	◯
4R. Em nossa casa, as refeições são feitas à pressa.	◯	◯	◯	◯	◯
5.As refeições têm lugar na cozinha ou na sala de jantar.	◯	◯	◯	◯	◯
6R. Fazemos refeições no carro.	◯	◯	◯	◯	◯
7.Às refeições, o/a meu/minha filho/a come o mesmo que todos os outros.	◯	◯	◯	◯	◯
8.Em nossa casa, há alguém que prepara as refeições.	◯	◯	◯	◯	◯
9.A compra de alimentos faz-se com uma lista preparada previamente.	◯	◯	◯	◯	◯
10. Na compra de alimentos, leio as informações dos rótulos.	◯	◯	◯	◯	◯

Q13 Para cada uma das afirmações seguintes, por favor escolha a opção que melhor o descreve a si e/ou à sua criança.

	Nunca	Rara_ mente	Às vezes	Frequen_ temente	Muito frequente_ mente
1.Dou alimentos ao/à meu/minha filho/a para que se mantenha calmo/a e calado/a enquanto faço compras ou viajo.	○	○	○	○	○
2.Dou alimentos ao/à meu/minha filho/a para o/a compensar pelo bom comportamento.	○	○	○	○	○
3.Bloqueio a oferta ao/à meu/minha filho/a de alimentos de que ele/a gosta, como consequência de mau comportamento.	○	○	○	○	○
4.Dou ao/à meu/minha filho/a um alimento especial para comemorar um objetivo atingido.	○	○	○	○	○
5.Dou alimentos ao/à meu/minha filho/a para o/a persuadir a fazer alguma coisa que ele/a claramente não quer fazer.	○	○	○	○	○

Q14 Nos últimos 6 meses, com que **frequência** o/a seu/sua filho/a consumiu os seguintes **alimentos/ bebidas** (assinale apenas uma opção em cada linha)?

	Nunca ou < 1 mês	1-3 por mês	1 por sem	2-4 por sem	5-6 por sem	1 por dia	2-3 por dia	4-5 por dia	6 ou + por dia
1.Pão branco	○	○	○	○	○	○	○	○	○
2.Pão mistura, integral ou com sementes	○	○	○	○	○	○	○	○	○
3.Cereais de pequeno-almoço (Chocapic®, Nestum®, Corn flakes, Special K®, Estrelitas®, etc.)	○	○	○	○	○	○	○	○	○
4.Arroz, massa, batata (sem ser frita)	○	○	○	○	○	○	○	○	○
5.Sopa de hortícolas (legumes e/ou hortaliça)	○	○	○	○	○	○	○	○	○
6.Saladas ou legumes no prato da refeição	○	○	○	○	○	○	○	○	○
7.Saladas ou legumes no pão (sandes)	○	○	○	○	○	○	○	○	○
8.Fruta fresca	○	○	○	○	○	○	○	○	○
9.Leite simples (branco)	○	○	○	○	○	○	○	○	○
10.Leite com aroma (ex.: chocolate, morango)	○	○	○	○	○	○	○	○	○
11.Iogurte (sólido ou líquido)	○	○	○	○	○	○	○	○	○
12.Queijo (fresco ou curado)	○	○	○	○	○	○	○	○	○
13.Sobremesas lácteas e outros produtos lácteos (ex.: Suissinho®, Danoninho®, iogurte grego, gelado de leite, etc.)	○	○	○	○	○	○	○	○	○
14.Carne (porco, vaca, cabrito, borrego)	○	○	○	○	○	○	○	○	○
15.Aves (frango, peru) e coelho	○	○	○	○	○	○	○	○	○
16.Peixe (fresco, congelado ou enlatado)	○	○	○	○	○	○	○	○	○
17.Ovos	○	○	○	○	○	○	○	○	○
18.Leguminosas (feijão, grão, ervilhas, favas ou lentilhas)	○	○	○	○	○	○	○	○	○
19.Pizza, batata frita(*), hambúrgueres, salsichas, rissóis, croquetes, folhados ou preparações pré-confecionadas	○	○	○	○	○	○	○	○	○
20.Batatas fritas de pacote, pipocas, tiras de milho ou outros aperitivos salgados	○	○	○	○	○	○	○	○	○
21.Bolos, biscoitos/bolachas com açúcar, bolos, Snacks tipo Donuts®, Bollycao®, Manhãzitos®, Donettes®, etc.	○	○	○	○	○	○	○	○	○
22.Chocolates (Kinder®, Mars®, Twix®, Kit Kat®, etc.)	○	○	○	○	○	○	○	○	○
23.Rebuçados, gomas ou pastilhas	○	○	○	○	○	○	○	○	○
24.Açúcar, mel, compotas ou geleias	○	○	○	○	○	○	○	○	○
25.Refrigerantes açucarados com ou sem gás (**)	○	○	○	○	○	○	○	○	○
26.Sumos 100% ou néctares	○	○	○	○	○	○	○	○	○

(*) Considere batata frita em casa (palitos, rodelas, etc.).
(**) Não considere as versões *light*, *diet* ou zero.

Q15 Indique **a sua opinião** relativamente às seguintes afirmações (assinale apenas uma opção para cada frase).

	Nunca	Rara_ mente	Por vezes	Muitas vezes	Sempre
1.O/a meu/minha filho/a adora comida.	○	○	○	○	○
2.O/a meu/minha filho/a come mais quando anda preocupado/a.	○	○	○	○	○
3.O/a meu/minha filho/a tem um grande apetite.	○	○	○	○	○
4.O/a meu/minha filho/a termina as refeições muito rapidamente.	○	○	○	○	○
5.O meu filho(a) interessa-se por comida.	○	○	○	○	○
6.O/a meu/minha filho/a anda sempre a pedir de beber (refrigerante ou sumos).	○	○	○	○	○
7.Perante novos alimentos o/a meu/minha filho/a começa por recusá-los.	○	○	○	○	○
8.O/a meu/minha filho/a come vagarosamente.	○	○	○	○	○
9.O/a meu/minha filho/a come menos quando está zangado/a.	○	○	○	○	○
10.O/a meu/minha filho/a gosta de experimentar novos alimentos.	○	○	○	○	○
11.O/a meu/minha filho/a come menos quando está cansado/a.	○	○	○	○	○
12.O/a meu/minha filho/a está sempre a pedir comida.	○	○	○	○	○
13.O/a meu/minha filho/a come mais quando está aborrecido/a.	○	○	○	○	○
14. Se o/a deixassem o/a meu/minha filho/a comeria demais.	○	○	○	○	○
15.O/a meu/minha filho/a come mais quando está ansioso/a.	○	○	○	○	○
16.O/a meu/minha filho/a gosta de uma grande variedade de alimentos.	○	○	○	○	○
17.O/a meu/minha filho/a deixa comida no prato no fim das refeições.	○	○	○	○	○
18.O/a meu/minha filho/a gasta mais que 30 minutos para terminar uma refeição.	○	○	○	○	○
19. Se tivesse oportunidade o/a meu/minha filho/a passaria a maior parte do tempo a comer.	○	○	○	○	○
20.O/a meu/minha filho/a está sempre à espera da hora das refeições.	○	○	○	○	○
21.O/a meu/minha filho/a fica cheio/a antes de terminar a refeição.	○	○	○	○	○
22.O/a meu/minha filho/a adora comer.	○	○	○	○	○
23.O/a meu/minha filho/a come mais quando está feliz.	○	○	○	○	○
24.O/a meu/minha filho/a é difícil de contentar com as refeições.	○	○	○	○	○
25.O/a meu/minha filho/a come menos quando anda transtornado/a.	○	○	○	○	○
26.O/a meu/minha filho/a fica cheio/a muito facilmente.	○	○	○	○	○
27.O/a meu/minha filho/a come mais quando não tem nada para fazer.	○	○	○	○	○
28. Mesmo se já está cheio o/a meu/minha filho/a arranja espaço para comer um alimento preferido.	○	○	○	○	○
29. Se tivesse oportunidade o/a meu/minha filho/a passaria o dia a beber continuamente (refrigerante ou sumos).	○	○	○	○	○
30.O/a meu/minha filho/a é incapaz de comer a refeição se antes tiver comido alguma coisa.	○	○	○	○	○
31. Se tivesse a oportunidade o/a meu/minha filho/a estaria sempre a tomar uma bebida (refrigerante ou sumos).	○	○	○	○	○
32.O/a meu/minha filho/a interessa-se por experimentar alimentos que nunca provou antes.	○	○	○	○	○
33.O/a meu/minha filho/a decide que não gosta de um alimento mesmo que nunca o tenha provado.	○	○	○	○	○
34. Se tivesse a oportunidade o/a meu/minha filho/a estaria sempre com comida na boca.	○	○	○	○	○
35.O/a meu/minha filho/a come cada vez mais devagar ao longo da refeição.	○	○	○	○	○

Q16 As questões seguintes são sobre **a sua atividade física** durante a última semana.

	Dias de semana (segunda a sexta)	Fim de semana (sábado e domingo)
1.Na última semana, quantas vezes caminhou de forma contínua, durante pelo menos 10 minutos (sem parar), como lazer, exercício ou para se deslocar de um lugar para outro?	|__|__| vezes	|__|__| vezes
2.Quanto tempo total calcula que gastou a caminhar de forma contínua, durante a última semana? Registe "0" se não caminhou.	|__|h |__|__|min	|__|h |__|__|min
3.Na última semana, quantas vezes fez alguma outra atividade física mais moderada que não tenha ainda mencionado (natação suave, ténis de lazer, golfe, etc.)?	|__|__| vezes	|__|__| vezes
4.Quanto tempo total calcula que gastou a fazer essa/s atividade/s física/s mais moderada/s durante a última semana? Registe "0" se não gastou tempo neste tipo de atividade.	|__|h |__|__|min	|__|h |__|__|min
5.Na última semana, quantas vezes fez alguma atividade física vigorosa que o fez respirar mais depressa ou ficar ofegante (corrida, ciclismo, aeróbica, ténis competitivo, jardinagem ou trabalho pesado)?	|__|__| vezes	|__|__| vezes
6.Quanto tempo total calcula que gastou a fazer essa atividade física vigorosa durante a última semana? Registe "0" se não gastou tempo neste tipo de atividade.	|__|h |__|__|min	|__|h |__|__|min

As questões seguintes dizem respeito ao que fez **no seu tempo livre durante a semana passada** (tempo que passou sentado e sem fazer tarefas).

7.Quanto tempo total calcula que gastou a ver televisão, vídeos ou DVDs como principal atividade, durante a última semana? (Não inclua o tempo em que a televisão esteve ligada enquanto fazia outra coisa, como preparar uma refeição, por exemplo)	|__|h |__|__|min	|__|h |__|__|min
8.Quanto tempo total calcula que gastou com jogos electrónicos (PlayStation, Nintendo, Wii II, etc.) na última semana?	|__|h |__|__|min	|__|h |__|__|min
9.Quanto tempo total calcula que passou ao computador em casa, no seu tempo livre durante a última semana? (Sem o tempo de trabalho)	|__|h |__|__|min	|__|h |__|__|min

Q17 Indique **a sua opinião** relativamente às seguintes afirmações (assinale uma opção para cada frase).

	Nunca	Rara_ mente	Ocasional_ mente	Frequente_ mente	Sempre
1.Encorajo o/a meu/minha filho/a a brincar fora de casa quando o tempo permite.	○	○	○	○	○
2.Sou fisicamente ativo quando estou com o/a meu/minha filho/a.	○	○	○	○	○
3.Limito o que o/a meu/minha filho/a faz porque tenho receio que se possa magoar.	○	○	○	○	○
4.Dou importância a que o/a meu/minha filho/a desenvolva as suas competências básicas de aprendizagem, relativamente a números e a letras.	○	○	○	○	○
5.O meu horário de trabalho ou outros compromissos limitam o tempo que tenho para brincar com o/a meu/minha filho/a.	○	○	○	○	○

Q18 Da lista seguinte, **indique o número de aparelhos que tem em casa?**

|__| Televisões

|__| Leitores de DVD ou vídeo

|__| Computadores (portáteis ou de secretária)

|__| Jogos electrónicos (Play Station, Nintendo, Wii II, i-Pad, Gameboy)

Q19 Da lista seguinte, que ligações tem em casa?

19a Internet: ◯ Sim ◯ Não **19b** Televisão paga: ◯ Sim ◯ Não

Q20 Há **televisão no quarto** do/a seu/sua filho/a? ◯ Sim ◯ Não

Q21 O que melhor descreve o **quintal/jardim da sua casa** (assinale uma resposta)**?**

◯ Sem quintal/jardim ◯ Quintal/jardim pequeno ◯ Quintal/jardim médio ◯ Quintal/jardim grande

Q22 Tem **acesso a** algum dos seguintes **equipamentos** no seu quintal/jardim ou perto de casa (assinale todas as opções que se aplicam)?

◯ Equipamento para brincar (baloiço, escorrega, parede para escalada, etc.)

◯ Área adequada para andar de triciclo, bicicleta ou trotinete

◯ Piscina

Q23 O local onde vive tem **espaços ou instalações** onde o/a seu/sua filho/a pode **brincar e ser fisicamente ativo/a** (assinale todas as opções que se aplicam)?

	Sim	Não	Não sei
1.Áreas abertas, como praias, rios, campo ou reservas naturais	◯	◯	◯
2.Parque público	◯	◯	◯
3.Parque infantil	◯	◯	◯
4.Piscina municipal	◯	◯	◯
5.Ginásio com programas para crianças pequenas	◯	◯	◯
6. Clube com atividades/desportos para crianças/ jovens (futebol, dança, etc.)	◯	◯	◯

Q24 Indique a sua opinião relativamente às seguintes afirmações (assinale uma opção para cada frase)**.**

	Concordo totalmente	Concordo	Discordo	Discordo totalmente
1.É seguro para o/a meu/minha filho/a brincar fora de casa na minha área de residência (se supervisionado).	◯	◯	◯	◯
2.Há passeios na maioria das ruas do local onde vivo.	◯	◯	◯	◯
3.Há grandes barreiras ou perigos para passear com o/a meu/minha filho/a no local onde vivo, que tornam difícil ir de um lugar para outro (estradas principais, linhas de comboio, canais ou rios).	◯	◯	◯	◯
4.Há tanto tráfego nas ruas que é difícil ou perigoso passear com o/a meu/minha filho/a no local onde vivo.	◯	◯	◯	◯
5.Há semáforos ou passadeiras suficientes que permitem passear com o/a meu/minha filho/a em segurança no local onde vivo.	◯	◯	◯	◯
6.O nível de criminalidade no local onde vivo torna-o inseguro para passear com a minha criança durante o dia.	◯	◯	◯	◯
7.Os locais para compras estão a uma curta distância a pé da minha casa.	◯	◯	◯	◯
8.Há perigos (cães, pessoas indesejáveis, etc.) no parque público, de tal modo que evito ir até lá com o/a meu/minha filho/a.	◯	◯	◯	◯

Q25 Habitualmente, como é que o/a seu/sua filho/a se desloca **entre casa e escola**? Por favor, assinale apenas uma opção para cada deslocação ("ida para a escola" e "regresso da escola"):

Ida para a escola		
◯ Automóvel	◯ Transporte público	◯ A pé
◯ Bicicleta	◯ Outro; Qual:_____	

Regresso da escola		
◯ Automóvel	◯ Transporte público	◯ A pé
◯ Bicicleta	◯ Outro; Qual:_____	

Q26 Na sua opinião, o **caminho entre casa e escola é seguro** para deslocação a pé? ◯ Sim ◯ Não

Q27 Quanto **tempo** demora a percorrer pé a distância entre a **casa** onde vive e a **escola**?

◯ Menos de 5 min. ◯ Entre 5 e 10 min. ◯ Entre 10 e 15 min. ◯ Entre 15 e 20 min. ◯ Mais de 20 min.

Q28 Quanto tempo passou o/a seu/sua filho/a a **andar de carro**, no total, durante a **última semana**?

Dias de semana (segunda a sexta) em média |__|h |__|__|min

Sábado |__|h |__|__|min

Domingo |__|h |__|__|min

Q29 Quantas vezes se **deslocou a pé** o/a seu/sua filho/a na área da sua residência, durante a **última semana**, como ir a casa de amigos, lojas, parques, jardim de infância, etc. (assinale uma opção)?

◯ Nunca ◯ 1 a 2 dias ◯ 3 a 4 dias ◯ 5 a 7 dias

Q30 Como classificaria o/a seu/sua filho/a quanto à sua **atividade** comparando-o/a com outras crianças da mesma idade?

◯ Muito menos ativa ◯ Menos ativa ◯ O mesmo ◯ Mais ativa ◯ Muito mais ativa

Q31 O/a seu/sua filho/a toma as **refeições em frente da televisão**?

◯ Nunca ou raramente ◯ 1 refeição por dia ◯ 2 refeições por dia ◯ 3 refeições por dia ◯ Sempre

Q32 O/a seu/sua filho/a participa em alguma atividade física organizada (educação física, natação, ginástica, dança, futebol, ballet, etc.), dentro e/ou fora do jardim de infância?

◯ Sim ◯ Não

Se sim, quantas horas passa o/a seu/sua filho/a nessas atividades durante a semana?

Nome da atividade organizada	**Tempo total gasto normalmente em cada atividade por semana**
1._____	|__|h |__|__|min
2._____	|__|h |__|__|min
3._____	|__|h |__|__|min
4._____	|__|h |__|__|min

Q33 Durante um mês "normal", **quantas vezes** é que o/a seu/sua filho/a **usa os espaços** listados abaixo para **brincar e ser fisicamente ativo/a**, quando está bom tempo (assinale todas as opções que se aplicam)?

	Diariamente	**Algumas vezes por semana**	**Uma vez por semana**	**Algumas vezes por mês**	**Uma vez por mês**	**Raramente**
Ar livre (praia, rio, campo, percurso pedestre ou reserva natural)	◯	◯	◯	◯	◯	◯
Instalações desportivas (ginásio, polidesportivo, etc.)	◯	◯	◯	◯	◯	◯
Parque infantil	◯	◯	◯	◯	◯	◯
Piscina (pública ou privada)	◯	◯	◯	◯	◯	◯

Appendix II

Considerando o **dia de semana (segunda a sexta-feira) mais recente** em que o seu/sua filho/a esteve sob o seu cuidado, responda às seguintes questões como se tivesse sido **"ontem"**.

Q34 Como esteve o **tempo ontem** (assinale uma opção)**?**

◯ Bom para brincar ao ar livre
◯ Muita chuva para brincar ao ar livre
◯ Muito quente ou húmido para brincar ao ar livre
◯ Muito frio para brincar ao ar livre

Q35 Quanto tempo esteve ontem o/a seu/sua filho/a a brincar ativamente ao ar livre (registe "0" se a sua criança não brincou ao ar livre)**?**

|__|horas |__|__|minutos

Q36 Qual das seguintes atividades o/a seu/sua filho/a fez ontem (registe "sim" para as atividades que foram feitas e "não" para as que não foram feitas)**?**

	A sua criança fez esta atividade?		**Tempo total gasto na atividade**
	Sim	**Não**	**Horas/ Minutos**
1.Esteve sentado/a ou deitado/a a ver televisão *sem se mexer*	◯	◯	|__|h |__|__|min
2.Esteve sentado/a ou deitado/a a ver um DVD ou um vídeo *sem se mexer*	◯	◯	|__|h |__|__|min
3.Esteve sentado/a ou deitado/a *sem se mexer* (ver livros ou ouvir histórias)	◯	◯	|__|h |__|__|min
4.Jogou no computador ou com jogos electrónicos (*PlayStation*, *Nintendo*, *Wii II*, i-Pad, *Gameboy*, telemóvel, *tablet*, etc.)	◯	◯	|__|h |__|__|min
5.Esteve parado/a, mas movendo uma parte do corpo, como baloiçando o tronco ou movendo o braço ou a perna (por exemplo, sentado/a fazendo puzzles, legos, desenhos, pinturas ou outras atividades manuais)	◯	◯	|__|h |__|__|min
6.Fez caminhada	◯	◯	|__|h |__|__|min
7.Fez corrida	◯	◯	|__|h |__|__|min
8.Subiu encostas íngremes	◯	◯	|__|h |__|__|min
9.Brincou com esforço moderado	◯	◯	|__|h |__|__|min
10. Brincou intensamente com esforço vigoroso	◯	◯	|__|h |__|__|min
11. Saltitou, pulou, saltou ou marchou em ritmo lento	◯	◯	|__|h |__|__|min
12. Saltitou, pulou, saltou ou marchou em ritmo acelerado	◯	◯	|__|h |__|__|min
13. Dançou ou fez atividades de movimentação com música	◯	◯	|__|h |__|__|min
14. Trepou ou escalou	◯	◯	|__|h |__|__|min
15. Andou de baloiço (sem ser empurrada por outra pessoa)	◯	◯	|__|h |__|__|min
16. Andou de triciclo, bicicleta ou trotinete em ritmo lento	◯	◯	|__|h |__|__|min
17. Andou de triciclo, bicicleta ou trotinete em ritmo acelerado	◯	◯	|__|h |__|__|min
18. Jogou à bola em ritmo lento	◯	◯	|__|h |__|__|min
19. Jogou à bola em ritmo acelerado	◯	◯	|__|h |__|__|min
20. Nadou sozinho/a com dispositivos de flutuação	◯	◯	|__|h |__|__|min
21. Nadou com o apoio de um adulto	◯	◯	|__|h |__|__|min
22. Jogou raquetes	◯	◯	|__|h |__|__|min
23. Outro; Indique: _____	◯	◯	|__|h |__|__|min
24. Outro; Indique: _____	◯	◯	|__|h |__|__|min

Considerando o **fim de semana mais recente (sábado e domingo)**, responda às seguintes questões.

Q37 Como esteve o **tempo no último fim de semana** (assinale uma opção)?

	sábado	**domingo**
Bom para brincar ao ar livre	○	○
Muita chuva para brincar ao ar livre	○	○
Muito quente ou húmido para brincar ao ar livre	○	○
Muito frio para brincar ao ar livre	○	○

Q38 Quanto tempo esteve o/a seu/sua filho/a a brincar ativamente ao ar livre no último fim de semana (registe "0" se o/a seu/sua filho/a não brincou ao ar livre)?

Sábado: |__|h |__|__|min **Domingo:** |__|h |__|__|min

Q39 Qual das seguintes atividades o/a seu/sua filho/a fez no último fim de semana (registe "sim" para as atividades que foram feitas e "não" para as que não foram feitas)**?**

	sábado			**domingo**		
	A sua criança fez esta atividade?		**Tempo total gasto na atividade**	**A sua criança fez esta atividade?**		**Tempo total gasto na atividade**
	Sim	**Não**	**Horas/ Minutos**	**Sim**	**Não**	**Horas/ Minutos**
1.Esteve sentado/a ou deitado/a a ver televisão *sem se mexer*	○	○	|__|h |__|__|min	○	○	|__|h |__||__|min
2.Esteve sentado/a ou deitado/a a ver um DVD ou um vídeo *sem se mexer*	○	○	|__|h |__|__|min	○	○	|__|h |__||__|min
3.Esteve sentado/a ou deitado/a *sem se mexer* (ver livros ou ouvir histórias)	○	○	|__|h |__|__|min	○	○	|__|h |__||__|min
4.Jogou no computador ou com jogos electrónicos (*PlayStation*, *Nintendo*, *Wii II*, i-Pad, *Gameboy*, telemóvel, *tablet*, etc.)	○	○	|__|h |__|__|min	○	○	|__|h |__||__|min
5.Esteve parado/a, mas movendo uma parte do corpo, como baloiçando o tronco ou movendo o braço ou a perna (por exemplo, sentado/a fazendo puzzles, legos, desenhos, pinturas ou outras atividades manuais)	○	○	|__|h |__|__|min	○	○	|__|h |__||__|min
6.Fez caminhada	○	○	|__|h |__|__|min	○	○	|__|h |__||__|min
7.Fez corrida	○	○	|__|h |__|__|min	○	○	|__|h |__||__|min
8.Subiu encostas íngremes	○	○	|__|h |__|__|min	○	○	|__|h |__||__|min
9.Brincou com esforço moderado	○	○	|__|h |__|__|min	○	○	|__|h |__||__|min

	Sábado			Domingo		
	A sua criança fez esta atividade?		Tempo total gasto na atividade	A sua criança fez esta atividade?		Tempo total gasto na atividade
	Sim	Não	Horas/ Minutos	Sim	Não	Horas/ Minutos
10. Brincou intensamente com esforço vigoroso	○	○	__|h __|__|min	○	○	__|h __|__|min
11. Saltitou, pulou, saltou ou marchou em ritmo lento	○	○	__|h __|__|min	○	○	__|h __|__|min
12. Saltitou, pulou, saltou ou marchou em ritmo acelerado	○	○	__|h __|__|min	○	○	__|h __|__|min
13. Dançou ou fez atividades de movimentação com música	○	○	__|h __|__|min	○	○	__|h __|__|min
14. Trepou ou escalou	○	○	__|h __|__|min	○	○	__|h __|__|min
15. Andou de baloiço (sem ser empurrada por outra pessoa)	○	○	__|h __|__|min	○	○	__|h __|__|min
16. Andou de triciclo, bicicleta ou trotinete em ritmo lento	○	○	__|h __|__|min	○	○	__|h __|__|min
17. Andou de triciclo, bicicleta ou trotinete em ritmo acelerado	○	○	__|h __|__|min	○	○	__|h __|__|min
18. Jogou à bola em ritmo lento	○	○	__|h __|__|min	○	○	__|h __|__|min
19. Jogou à bola em ritmo acelerado	○	○	__|h __|__|min	○	○	__|h __|__|min
20. Nadou sozinho/a com dispositivos de flutuação	○	○	__|h __|__|min	○	○	__|h __|__|min
21. Nadou com o apoio de um adulto	○	○	__|h __|__|min	○	○	__|h __|__|min
22. Jogou raquetes	○	○	__|h __|__|min	○	○	__|h __|__|min
23. Outro; Indique: _____	○	○	__|h __|__|min	○	○	__|h __|__|min
24. Outro; Indique: _____	○	○	__|h __|__|min	○	○	__|h __|__|min

Q40 Indique **a sua opinião** relativamente às seguintes afirmações (assinale apenas uma opção para cada frase).

	Nunca	Rara_ mente	Às vezes	Frequen_ temente	Sempre ou quase sempre
1.Sou capaz de contribuir para a mudança do comportamento alimentar/ atividade física do/a meu/minha filho/a.	○	○	○	○	○
2.O/a meu/minha filho/a é capaz de mudar o seu comportamento alimentar/ atividade física.	○	○	○	○	○
3.Considera que o/a seu/sua filho/a se sente satisfeito por ser como é.	○	○	○	○	○
4.O/a meu/minha filho/a sente prazer em comer alimentos saudáveis.	○	○	○	○	○
5.O/a meu/minha filho/a sente prazer em praticar atividade física.	○	○	○	○	○
6.A nossa casa e o local onde residimos oferecem boas condições para a prática de atividade física.	○	○	○	○	○

Obrigada por ter preenchido o questionário até ao fim!

“Vamos melhor comer,
Vamos mais ativos ser”

Alimentação & Atividade física no pré-escolar

Vamos melhor comer
Vamos melhor beber
Vamos exercício fazer
Vamos mais ativos ser

Vamos melhor comer
Pão e peixe escolher
Grão e feijão querer
Sopa e salada comer

Vamos melhor beber
Muita água sem falhar
Leite e iogurte beber
Refrigerantes evitar

Vamos refeições fazer
Pequeno-almoço tomar
Lanchar não esquecer
Vamos almoçar e jantar

Vamos exercício fazer
Com arcos e cordas saltar
Andar, subir e descer
Com bolas muito jogar

Vamos mais ativos ser
Na bicicleta pedalar
Dançar, pular e correr
Na trotinete andar

Vamos na escola andar
De baloiço sem parar
No sobe e desce brincar
No escorrega andar

Vamos mais ativos ser
A televisão limitar
E para melhor crescer
Os jogos de ecrã evitar

Vamos cedo adormecer
Para energia ganhar
Com a família comer
Sem a televisão ligar

Teresa Sofia Sancho, 2013

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Determinantes do peso corporal de crianças em idade pré-escolar

Palavras-chave: *Obesidade; Determinantes; Peso corporal; Crianças; Pré-escolar*

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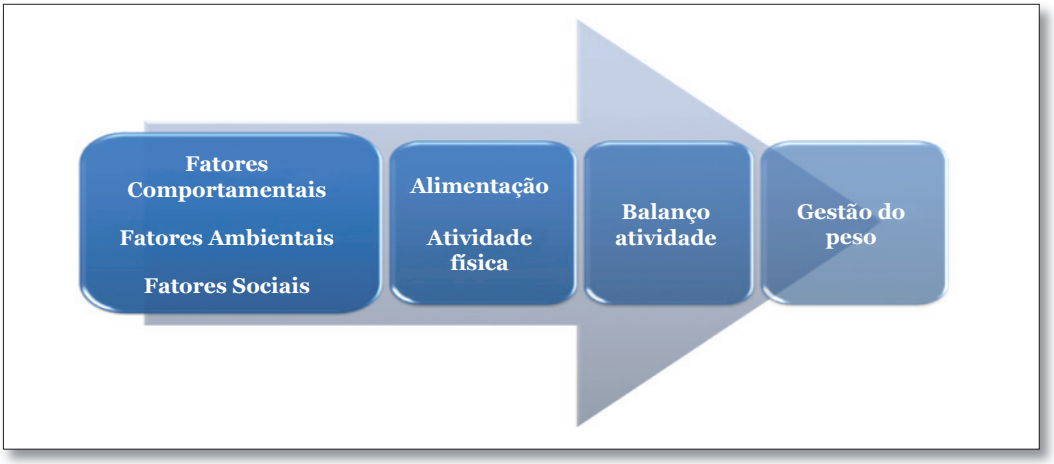
Resumo

A obesidade infantil é um problema de saúde pública, sendo atualmente considerada a doença mais prevalente na infância e adolescência em todo o mundo. A sua etiologia é multifatorial, podendo ser globalmente sumariada em determinantes biológicos, comportamentais, ambientais e sociais. Dado que as causas de natureza biológica têm uma diminuta expressão, serão abordados apenas aqueles determinantes cuja mudança pode contribuir para um balanço energético mais equilibrado e consequentemente para uma gestão mais eficaz do peso, ou seja, os determinantes comportamentais (ingestão alimentar/aporte nutricional, ambiente das refeições, influência parental na ingestão alimentar, atividade física, sedentarismo e padrão de sono), ambientais (família, escola e comunidade) e sociais (estatuto socioeconómico e literacia). A abordagem do excesso de peso infantil deve ser tão precoce quanto possível e desenvolvida a diversos níveis. A gestão do peso infantil deve, pois, envolver a família, a escola, a comunidade e as estruturas sociais, com políticas de promoção da saúde transversais.

Introdução

A obesidade, anteriormente considerada um problema de saúde individual, sendo cada vez mais prevalente entre as famílias em todo o mundo, é neste momento considerada um desafio para a saúde pública com grandes repercussões sociais[1]. A obesidade é a doença mais prevalente na infância e adolescência em todo o mundo[2], sendo um problema de saúde de etiologia multifatorial[3,4]. Considerando o aumento da prevalência de pré-obesidade e obesidade na infância, bem como o risco de complicações na idade adulta, é importante identificar os determinantes do ex-

Figura 1
Diagrama dos determinantes na gestão do peso



cesso de peso em idades precoces[5]. Por outro lado, uma maior compreensão acerca das causas da obesidade proporciona uma boa base de trabalho para o desenvolvimento de intervenções precoces e eficazes com vista à prevenção do excesso de peso, nomeadamente na primeira infância[3, 6].

Os determinantes no desenvolvimento do excesso de peso na infância envolvem interações entre múltiplos fatores de risco, dos quais destacamos os comportamentais (por exemplo, padrões alimentares e de atividade física, gosto pela prática de atividade física), ambientais (por exemplo, casa, escola, comunidade), sociais (por exemplo, publicidade de alimentos, redes sociais, influência de pares), cuidados de saúde (por exemplo, acesso, prestação de serviços) e biológicos (por exemplo, predisposição genética, programação metabólica durante a gravidez, mecanismos de regulação apetite/saciedade)[7].

Neste contexto, sendo a obesidade multifatorial, a sua etiologia pode ser globalmente sumariada em determinantes biológicos, compor-, tamentais, ambientais e sociais. No entanto, contrariamente ao mito popular, apenas 1-2% dos casos de obesidade infantil são complicações secundárias de uma determinada patologia[8, 9].

Nesta revisão bibliográfica, abordaremos apenas aqueles fatores de risco cuja mudança pode contribuir para um balanço energético mais equilibrado e consequentemente para uma gestão mais eficaz do peso na infância, ou seja, os determinantes comportamentais, ambientais e sociais, conforme representado no diagrama seguinte. Faremos alusão específica ao caso particular das crianças em idade pré-escolar, em conformidade com os estudos existentes.

Determinantes comportamentais

Embora os fatores biológicos ajudem a explicar as diferenças inter-individuais no ganho de peso, o recente aumento quase exponencial na prevalência da obesidade infantil demonstra que os fatores comportamentais são importantes determinantes na etiologia da obesidade[6]. Efetivamente, a interação entre o aporte nutricional, a atividade física e os comportamentos alimentar e sedentário, podem determinar um desequilíbrio energético crónico, conduzindo maioritariamente a balanços energéticos positivos[3, 10, 11], os quais acumulados ao longo do tempo culminam em excesso de peso[6]. (Figura 1)

Ingestão alimentar e nutricional

Os fatores nutricionais de risco na obesidade infantil incluem o consumo de alimentos de elevada densidade energética[12-14], elevado consumo de bebidas açucaradas[15-18], especialmente entre refeições[19] e ingestão de alimentos salgados[16]. Relativamente aos fatores protetores na obesidade infantil, salienta-se a relação inversa entre obesidade

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e o consumo de água[19, 20], a ingestão de fibras[21-24], especialmente em crianças com menor frequência de refeições ao longo do dia [25] e ainda o consumo de sopa, particularmente no sexo feminino[26].

Ambiente das refeições

Considerando os comportamentos de risco para a obesidade infantil no que respeita ao ambiente familiar das refeições, existe uma associação inversa com a elevada frequência de refeições[27-30], a toma regular de pequeno-almoço[28-33], as refeições realizadas com a família[4,34-43], e em particular o jantar[44-46].

As refeições em família podem, portanto, desempenhar um importante papel na prevenção do excesso de peso na infância, pois permitem que os pais sejam modelos positivos de comportamentos alimentares para os filhos[32]. Esta modelagem pode ser feita através quer do fomento do consumo de alimentos saudáveis de elevada densidade nutricional quer da diminuição do consumo de alimentos de elevada densidade calórica cujo consumo deve ser limitado[32, 40, 42], bem como pela monitorização do tamanho das porções ingeridas pelas crianças[42]. Efetivamente, existe uma associação positiva entre a obesidade infantil e o tamanho das porções de alimentos[42, 47-49], bem como com a ingestão de alimentos de elevada densidade energética[47, 50].

Influência parental na ingestão alimentar

A modelagem dos comportamentos alimentares na infância compreende uma vasta gama de procedimentos que influenciam a acessibilidade a determinados alimentos, mais saudáveis ou menos saudáveis. Desta forma, podem considerar-se várias formas de modelagem: coagir ou pressionar as crianças a comer alimentos específicos, recompensar certos comportamentos das crianças com alimentos altamente energéticos da sua preferência, proibir ou restringir o consumo de certos alimentos como punição[51].

Os pais desempenham um papel muito importante nos comportamentos alimentares precoces das crianças[52]. O controlo do consumo alimentar pode assumir duas perspetivas distintas: restrição, a qual consiste em limitar o acesso das crianças a *junk food* (alimentos pouco saudáveis) no todo ou em parte, e coação, a qual implica pressionar as crianças a comer alimentos saudáveis ou a comer mais em geral[53].

As práticas parentais relativas à restrição e/ou pressão para comer podem ter um impacto negativo no consumo alimentar atual e futuro das crianças, dado que a utilização aleatória destas práticas pode contribuir para o risco de excesso de peso e obesidade[54].

Atividade física e sedentarismo

O dispêndio energético, tal como a ingestão de energia, é um fator importante no desenvolvimento ou prevenção da obesidade[9]. Atualmente, verifica-se que em diversos *settings* uma boa parte das crianças não praticam a quantidade necessária de atividade física, gastando a maior parte do seu tempo em atividades sedentárias, como ver televisão, brincar com videojogos no computador, no telemóvel ou no *tablet*, sem cumprir as recomendações de atividade física[55-57]. No entanto, no que diz respeito à idade pré-escolar, é habitual que pais e professores partam do pressuposto de que as crianças são muito ativas, dado o comportamento de permanente movimento, concluindo que estas se envolvem em atividade física suficiente[58]. Esta perceção errada tem conduzido à sobrevalorização dos níveis de atividade física das crianças, resultando numa diminuição do incentivo e apoio à promoção de estilos de vida ativos nesta faixa etária[58],

constituindo também este facto um risco plausível de obesidade infantil.

No que respeita à associação entre a atividade física e a obesidade infantil, os estudos têm mostrado que existe uma relação direta entre o peso saudável e os níveis mais elevados de gasto energético[56]. Consistentemente associados à atividade cada ano a mais de idade[62]. Convém, ainda, salientar que uma proporção significativa de crianças com excesso de peso apresenta baixos níveis de atividade física durante o dia na pré-escola, pelo que a atividade física insuficiente constitui um risco aumentado para maior ganho de adiposidade[58, 63, 64].

Os fatores nutricionais de risco na obesidade infantil incluem o consumo de alimentos de elevada densidade energética, elevado consumo de bebidas açucaradas, especialmente entre as refeições e a ingestão de alimentos salgados. Quanto aos fatores protetores salienta-se o consumo de água, de fibras e sopa de hortícolas

física das crianças, e portanto considerados fatores de proteção para a obesidade infantil, destacam-se o sexo masculino[56, 59], o gosto de ser ativo, a facilidade de acesso a programas de atividade física, o tempo passado ao ar livre, a prática de alimentação saudável[59] e a existência de equipamentos para atividade física em casa[60]. Como fatores de risco para a obesidade infantil, destacam-se as barreiras percebidas pela criança à prática de atividade física[59] e os aparelhos eletrónicos, nomeadamente a existência de televisão no quarto[60].

Relativamente às associações de comportamentos de atividade física específicas de crianças do pré-escolar, verificou-se que os meninos, as crianças com pais ativos e as crianças que passam mais tempo ao ar livre são mais ativas[61]. A idade é outro correlato consistente com a atividade física, observando-se um decréscimo de 10% no tempo gasto em prática de atividade física por

O impacto de ver televisão na obesidade infantil tornou-se relevante quando Dietz e Gortmaker encontraram uma associação positiva entre este comportamento sedentário e a obesidade em crianças[65], nomeadamente a visualização de publicidade[66]. Efetivamente, têm sido propostos quatro mecanismos para tentar explicar de que forma ver televisão tem impacto no ganho de peso: (1) ver televisão substitui tempo que poderia ser utilizado em atividade física, (2) a visualização de televisão promove o consumo de alimentos entre refeições e, portanto, uma maior ingestão calórica diária total, (3) os conteúdos dos programas televisivos podem exercer uma influência negativa sobre as escolhas alimentares das crianças e (4) ver televisão diminui o metabolismo basal[67].

No que respeita ao ambiente familiar das refeições são fatores preventivos da obesidade infantil a elevada frequência de refeições, a toma regular de pequeno-almoço e as refeições realizadas com a família, em particular o jantar

Geralmente, três indicadores descrevem o comportamento das crianças quanto à visualização de televisão com associação positiva à obesi-

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dade infantil: tempo de exposição habitual a ver televisão[12, 38, 46, 68-70], ver televisão durante as refeições[68, 71] e ter televisão no quarto[60, 68, 72]. Ver televisão está ainda positivamente associado à ingestão de alimentos de elevado teor em gordura e/ou açúcar[13, 68], tais como refrigerantes e *snacks*

Determinantes ambientais

Numa contextualização ampla, o ambiente proporciona quer os *settings* (espaços físicos), quer os recursos para que cada indivíduo use a sua própria motivação, a autoeficácia, bem como as suas capacidades e conhecimentos para seguir

Três indicadores quanto à visualização de televisão com associação positiva à obesidade infantil: tempo de exposição habitual a ver televisão, ver televisão durante as refeições e ter televisão no quarto

e inversamente associado com o consumo de fruta e hortícolas[3].

Em termos de balanço energético, as crianças conseguem combinar comportamentos fisicamente ativos (por exemplo, praticar desporto e exercício) com comportamentos sedentários (por exemplo, jogar no computador), no mesmo dia; porém, na essência, a questão mais importante é que a energia despendida seja igual à ingerida[73].

Padrão de sono

Para além dos comportamentos anteriormente referidos, outros fatores de risco podem estar relacionados com a obesidade infantil, designadamente o padrão de sono, embora este comportamento tenha sido muito menos estudado do que a alimentação ou a atividade física. Estudos epidemiológicos sugerem que o sono de curta duração pode estar associado com o aumento do risco de desenvolvimento de obesidade infantil[46, 70, 74-77], mesmo após controlo dos fatores

determinados padrões de comportamento[40, 80]. Em termos da obesidade infantil, os *settings* mais estudados são o ambiente familiar, a escola e a comunidade [55].

Os fatores do ambiente familiar incluem o ambiente físico, como a disponibilidade e a acessibilidade a alimentos, as oportunidades para a prática de atividade física, bem como os estímulos comportamentais, tais como o conceito de autoeficácia para mudar, as habilidades de autorregulação, e as práticas alimentares que os pais usam com os seus filhos[40].

O ambiente escolar abrange o tipo de pavimento da escola, as características das instalações e equipamentos, a área e infraestruturas em torno da escola, os quais têm impacto na adiposidade das crianças[81]. Desta forma, as escolas podem oferecer oportunidades para incentivar a atividade física ou estimular o consumo de alimentos saudáveis[82, 83], através de refeições escolares (merendas, almoço ou até mesmo pequeno-almoço),

O sono de curta duração pode estar associado com o aumento do risco de desenvolvimento de obesidade infantil

sociodemográficos[78]. De facto, um estudo recente evidencia que o sono noturno de curta duração tem uma associação linear com um maior consumo de energia, nos primeiros anos de vida, culminando no aumento da adiposidade[79].

educação física, recreios ativos ou atividade física extracurricular[84].

O ambiente comunitário, com impacto na alimentação e atividade física, pode incluir a proximidade de locais de comércio de produtos alimentares (supermercados) bem como os ali-

mentos que estes têm disponíveis à venda, o tipo de oferta alimentar para comer fora de casa (tipo de restaurantes), a densidade residencial, a existência de espaços públicos abertos (parques infantis e jardins), instalações para a prática de atividade física (passeios, trilhos pedestres e ciclovias), o ambiente construído, a acessibilidade entre estruturas e a segurança[84].

Determinantes sociais

Para além dos fatores anteriormente referidos, o estatuto socioeconómico constitui também um importante fator de risco para a obesidade infantil. Atualmente, existe alguma evidência de que nos países de maior rendimento, as crianças de menor estatuto socioeconómico têm apresentado uma prevalência maior de obesidade[85]. Da mesma forma, em países de maior ou menor rendimento *per capita*, as crianças de áreas urbanas são mais propensas a serem obesas do que as de áreas rurais[2].

A insegurança alimentar é complexa e paradoxal, pois esta não só pode levar à desnutrição e fome recorrente, mas também à sobrenutrição, o que por sua vez pode conduzir ao excesso de peso e obesidade[86], como acontece com as crianças que vivem em famílias que enfrentam a insuficiência de alimentos[87].

Nos países desenvolvidos, observa-se uma tendência significativa para obesidade em crianças de estatuto socioeconómico mais baixo[88, 89], enquanto em alguns países em desenvolvimento, pelo contrário, têm sido encontradas crianças mais vulneráveis à obesidade, embora em famílias relativamente abastadas[88]. A prevalência da obesidade na Europa está a aumentar em muitos países, o que ocorre mais rápido em populações de baixas condições socioeconómicas, especialmente crianças[90].

Finalmente, e ainda no âmbito da área social, a literacia é também um determinante importante no estado de saúde do indivíduo, pois está associada a múltiplos fatores de risco modificáveis, principalmente os determinantes comportamentais, tais como o sedentarismo, a atividade física ou a alimentação[91, 92]. Alguns estudos recentes destacam o relevante papel da literacia em saúde dos pais para abordar o excesso de peso de crianças em idade escolar[93, 94]. A Organização Mundial da Saúde refere mesmo que a literacia é um fator preditor do estado de saúde dos indivíduos mais forte do que o rendimento, a situação laboral, o nível de educação e o grupo racial ou étnico[92].

Conclusão

Os diversos determinantes que estão implicados no peso corporal das crianças em idade pré-escolar são múltiplos e de natureza distinta, nomeadamente comportamentais, ambientais e sociais. Desta forma, é crucial que a abordagem da problemática do excesso de peso infantil seja tão precoce quanto possível e desenvolvida a diversos níveis conforme preconizado pelo modelo socioecológico, envolvendo a família, a escola, a comunidade e as estruturas sociais, com políticas de promoção da saúde e gestão do peso transversais.

Referências bibliográficas

1. Penhollow TM e Rhoads, KE. Preventing Obesity and Promoting Fitness: An Ecological Perspective 2014 [updated Jan 12, 2014; cited 2014 23 February]. 21-4]. Available from: http://ajl.sagepub.com/content/8/1/21.

2. Wang Y e Lobstein, T. Worldwide trends in childhood overweight and obesity. International Journal of Pediatric Obesity. 2006;1:11-25.

3. De Craemer M, De Decker, E, De Bourdeaudhuij, I, et al. Correlates of energy balance-related behaviours in preschool children: a systematic review. Obesity Reviews. 2012;13:13-28.

4. Cason KL. Family mealtimes: More than just eating together. Journal of the American Dietetic Association. 2006;106:532-3.

5. Mota J, Ribeiro, J, Santos, MP, et al. Obesity, physical activity, computer use, and TV viewing in Portuguese adolescents. Pediatric Exercise Science. 2006;18:113-21.

6. Rennie KL, Johnson, L, Jebb SA. Behavioural determinants of obesity. Best Practice & Research Clinical Endocrinology & Metabolism. 2005;19:343-58.

7. Pratt CA, Stevens J Daniels S. Childhood obesity prevention and treatment: recommendations for future research. American Journal of Preventive Medicine. 2008;35:249-52.

8. Ells LJ, Campbell, K, Lidstone, J, et al. Prevention of childhood obesity. Best Practice & Research Clinical Endocrinology & Metabolism. 2005;19:441-54.

9. Lobstein T, Baur L, Uauy R. Obesity in children and young people: a crisis in public health. Obesity Reviews: An Official Journal Of The International Association For The Study Of Obesity. 2004;5 Suppl 1:4-104.

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10. Kremers SPJ, de Bruijn, G-J, Visscher, TLS, et al. Environmental influences on energy balance-related behaviors: a dual-process view. The international journal of behavioral nutrition and physical activity. 2006;3:9.

11. Moreno LA, Bel-Serrat S, Santaliestra-Pasias AM, et al. Obesity prevention in children. World review of nutrition and dietetics. 2013;106:119-26.

12. Proctor MH, Moore LL, Gao D, et al. Television viewing and change in body fat from preschool to early adolescence: The Framingham Children's Study. International Journal of Obesity. 2003;27:827-33.

13. Manios Y, Kondaki, K, Kourlaba, G, et al. Television viewing and food habits in toddlers and preschoolers in Greece: the GENESIS study. European Journal Of Pediatrics. 2009;168:801-8.

14. World Health Organization. Diet, nutrition and the prevention of chronic diseases - Introduction. Diet, Nutrition and the Prevention of Chronic Diseases. Who Technical Report Series. 916. Geneva: World Health Organization; 2003. P. 1-149.

15. Morenga LT, Mallard S, Mann J. Dietary sugars and body weight: systematic review and meta-analyses of randomised controlled trials and cohort studies. British Medical Journal. 2013;346.

16. Grimes CA, Riddell LJ, Campbell KJ, et al. Dietary Salt Intake, Sugar-Sweetened Beverage Consumption, and Obesity Risk. Pediatrics. 2013;131:14-21.

17. Pabayo R, Spence JC, Cutumisu N, et al. Sociodemographic, behavioural and environmental correlates of sweetened beverage consumption among pre-school children. Public Health Nutrition. 2012;15:1338-46.

18. Malik VS, Schulze, MB e Hu, FB. Intake of sugar-sweetened beverages and weight gain: a systematic review. American Journal of Clinical Nutrition. 2006;84:274-88.

19. Dubois L, Farmer A, Girard, M, et al. Regular sugar-sweetened beverage consumption between meals increases risk of overweight among preschool-aged children. Journal of the American Dietetic Association. 2007;107:924-34.

20. Muckelbauer R, Libuda, L, Clausen, K, et al. Promotion and Provision of Drinking Water in Schools for Overweight Prevention: Randomized, Controlled Cluster Trial. Pediatrics. 2009;123):E661-E7.

21. Brauchla M, Juan W, Story J, et al. Sources of Dietary Fiber and the Association of Fiber Intake with Childhood Obesity Risk (in 2-18 Year Olds) and Diabetes Risk of Adolescents 12-18 Year Olds: NHANES 2003-2006. Journal of nutrition and metabolism. 2012;2012.

22. Kimm SY. The role of dietary fiber in the development and treatment of childhood obesity. Pediatrics. 1995;96(5 Pt 2):1010-4.

23. Williams CL. Dietary fiber in childhood. Journal of Pediatrics. 2006;149:S121-S30.

24. Mendoza JA, Drewnowski A, Cheadle A, et al. Dietary energy density is associated with selected predictors of obesity in U.S. Children. The Journal Of Nutrition. 2006;136:1318-22.

25. Buyken AE, Cheng, G, Guenther, ALB, et al. Relation of dietary glycemic index, glycemic load, added sugar intake, or fiber intake to the development of body composition between ages 2 and 7 y. American Journal of Clinical Nutrition. 2008;88:755-62.

26. Bessa M, Valente, H, Cordeiro, T, et al. Fluid intake and overweight risk in children. Acta Medica Port. 2008;21:161-9.

27. Franko DL, Striegel-Moore RH, Thompson D, et al. The relationship between meal frequency and body mass index in black and white adolescent girls: more is less. International Journal of Obesity. 2008;32:23-9.

28. Antonogeorgos G, Panagiotakos DB, Papadimitriou A et al. Breakfast consumption and meal frequency interaction with childhood obesity. Pediatric Obesity. 2012;7:65-72.

29. Toschke AM, Thorsteinsdottir, KH, Von Kries, R, et al. Meal frequency, breakfast consumption and childhood obesity. International Journal of Pediatric Obesity. 2009;4:242-8.

30. Mota J, Fidalgo F, Silva R, et al. Relationships between physical activity, obesity and meal frequency in adolescents. Annals of Human Biology. 2008;35:1-10.

31. Szajewska H, Ruszczynski, M. Systematic review demonstrating that breakfast consumption influences body weight outcomes in children and adolescents in Europe. Critical Reviews in Food Science & Nutrition. 2010;50:113-9.

32. Pearson N, Biddle SJH, Gorely T. Family correlates of breakfast consumption among children and adolescents. A systematic review. Appetite. 2009;52:1-7.

33. Rampersaud GC, Pereira, MA, Girard, BL, et al. Breakfast habits, nutritional status, body weight, and academic performance in children and adolescents. Journal of the American Dietetic Association. 2005;105:743-62.

34. Fiese BH, Hammons, A, Grigsby-Toussaint D. Family mealtimes: a contextual approach to understanding childhood obesity. Economics And Human Biology. 2012;10:365-74.

35. Hammons AJ e Fiese, BH. Is Frequency of Shared Family Meals Related to the Nutritional Health of Children and Adolescents? Pediatrics. 2011;127:E1565-E74.

36. Fiese BH, Schwartz, M e Development, SfRiC. Reclaiming the Family Table: Mealtimes and Child Health and Wellbeing: Social Policy Report. Society for Research in Child Development. 2008;22:3-19.

37. Berge JM, Jin SW, Hannan P, et al. Structural and Interpersonal Characteristics of Family Meals: Associations with Adolescent Body Mass Index and Dietary Patterns. Journal of the Academy of Nutrition and Dietetics. 2013;113:816-22.

38. Gable S, Chang, Y, Krull JL. Television watching and frequency of family meals are predictive of overweight onset and persistence in a national sample of school-aged children. Journal of the American Dietetic Association. 2007;107:53-61.

39. Godfrey K, Rhodes, P, Hunt, C. The relationship between family mealtime interactions and eating disorder in childhood and adolescence: A systematic review. Australian and New Zealand Journal of Family Therapy. 2013;34:54-74.

40. Martin-Biggers J, Spaccarotella, K, Berhaupt-Glickstein, A, et al. Come and get it! A discussion of family mealtime literature and factors affecting obesity risk. Advances in Nutrition. 2014;5:235-47.

41. Fruh SM, Fulkerson, JA, Mulekar, MS, et al. The surprising benefits of the family meal. Journal for Nurse Practitioners. 2011;7:18-22.

42. Fulkerson JA, Larson, N, Horning, M, et al. A review of associations between family or shared meal frequency and dietary and weight status outcomes across the lifespan. Journal of Nutrition Education and Behavior. 2014;46:2-19.

43. Fulkerson JA, Neumark-Sztainer D, Hannan PJ, et al. Family Meal Frequency and Weight Status Among Adolescents: Cross- sectional and 5-year Longitudinal Associations. Obesity. 2008;16:2529-34.

44. Rockett HRH. Family dinner: More than just a meal. Journal of the American Dietetic Association. 2007;107:1498-501.

45. Taveras EM, Rifas-Shiman S, Berke CS, et al. Family dinner and adolescent overweight. Obesity Research. 2005;13:900-6.

46. Anderson SE, Whitaker RC. Household Routines and Obesity in US Preschool-Aged Children. Pediatrics. 2010;125:420-8.

47. Lioret S, Volatier JL, Lafay L et al. Is food portion size a risk factor of childhood overweight? European Journal Of Clinical Nutrition. 2009;63:382-91.

48. Croker H, Sweetman C, Cooke L. Mothers' views on portion sizes for children. Journal of Human Nutrition and Dietetics. 2009;22:437-43.

49. Ledikwe JH, Ello-Martin JA, Rolls BJ. Portion sizes and the obesity epidemic. Journal of Nutrition. 2005;135:905-9.

50. Prentice AM, Jebb SA. Fast foods, energy density and obesity: a possible mechanistic link. Obesity reviews : an official journal of the International Association for the Study of Obesity. 2003;4:187-94.

51. Stang J, Loth, KA. Parenting Style and Child Feeding Practices: Potential Mitigating Factors in the Etiology of Childhood Obesity. Journal of the American Dietetic Association. 2011;111:1301-5.

52. Bost KK, Wiley AR, FieseB, et al. Associations between adult attachment style, emotion regulation, and preschool children's food consumption. Journal Of Developmental And Behavioral Pediatrics: JDBP. 2014;35:50-61.

53. Johannsen DL, Johannsen, NM e Specker, BL. Influence of parents' eating Behaviors and child feeding practices on children's weight status. Obesity. 2006;14:431-9.

54. Loth KA, MacLehose RF, Fulkerson, JA, et al. Eat this, not that! Parental demographic correlates of food-related parenting practices. Appetite. 2013;60:140-7.

55. Karnik S e Kanekar, A. Childhood obesity: a global public health crisis. International Journal Of Preventive Medicine. 2012;3:1-7.

56. Hills AP, Andersen LB, Byrne, NM. Physical activity and obesity in children. British Journal of Sports Medicine. 2011;45:866-70.

57. Hinkley T, Salmon JO, Okely AD, et al. Preschoolers' Physical Activity, Screen Time, and Compliance with Recommendations. Medicine & Science in Sports & Exercise. 2012;44:458-65.

58. Tucker P. The physical activity levels of preschool-aged children: A systematic review. Early Childhood Research Quarterly. 2008;23:547-58.

59. Sallis JF, Prochaska JJ, Taylor WC. A review of correlates of physical activity of children and adolescents. Medicine and Science in Sports and Exercise. 2000;32:963-75.

60. Rosenberg DE, Sallis, JF, Kerr, J, et al. Brief scales to assess physical activity and sedentary equipment in the home. International Journal of Behavioral Nutrition & Physical Activity. 2010;7:10-20.

61. Hinkley T, Crawford, D, Salmon, J, et al. Preschool children and physical activity - A review of correlates. American Journal of Preventive Medicine. 2008;34:435-41.

62. Hinkley T, Salmon, J, Okely, AD, et al. Correlates of Preschool Children's Physical Activity. American Journal of Preventive Medicine. 2012;43:159-67.

63. Trost SG, Sirard, JR, Dowda, M, et al. Physical activity in overweight and nonoverweight preschool children. International Journal Of Obesity And Related Metabolic Disorders: Journal Of The International Association For The Study Of Obesity. 2003;27:834-9.

64. Reilly JJ. Low Levels of Objectively Measured Physical Activity in Preschoolers in Child Care. Medicine and Science in Sports and Exercise. 2010;42:502-7.

65. Dietz WHJ, Gortmaker SL. Do we fatten our children at the television set? Obesity and television viewing in children and adolescents. Pediatrics. 1985;75:807-12.

66. Zimmerman FJ, Bell, JF. Associations of Television Content Type and Obesity in Children. American Journal of Public Health. 2010;100:334-40.

67. Bryant MJ, Lucove, JC, Evenson KR, et al. Measurement of television viewing in children and adolescents: a systematic review. Obesity Reviews: An Official Journal Of The International Association For The Study Of Obesity. 2007;8:197-209.

68. Lissner L, Lanfer A, Gwozdz W, et al. Television habits in relation to overweight, diet and taste preferences in European children: the IDEFICS study. European Journal Of Epidemiology. 2012;27:705-15.

69. Braithwaite I, Stewart AW, Hancox RJ, et al. The Worldwide Association between Television Viewing and Obesity in Children and Adolescents: Cross Sectional Study. PloS one. 2013;8:1-8.

70. Haines J, McDonald J, O'Brien, A, et al. Healthy Habits, Happy Homes Randomized Trial to Improve Household Routines for Obesity Prevention Among Preschool-Aged Children. Jama Pediatrics. 2013;167:1072-9.

71. Dubois L, Farmer, A, Girard, M, et al. Social factors and television use during meals and snacks is associated with higher BMI among pre-school children. Public Health Nutrition. 2008;11:1267-79.

72. Dennison BA, Erb TA, Jenkins PL. Television Viewing and Television in Bedroom Associated With Overweight Risk Among Low-Income Preschool Children. Pediatrics. 2002;109:1028.

73. Hills AP, King NA, Armstrong TP. The Contribution of Physical Activity and Sedentary Behaviours to the Growth and Development of Children and Adolescents: Implications for Overweight and Obesity. Sports Medicine. 2007;37:533-46.

74. Cappuccio FP, Taggart FM, Kandala NB, et al. Meta-analysis of short sleep duration and obesity in children and adults. Sleep. 2008;31:619-26.

75. Xiaoli C, Beydoun MA, Youfa W. Is Sleep Duration Associated With Childhood Obesity? A Systematic Review and Meta-analysis. Obesity (19307381). 2008;16:265-74.

76. Dev DA, McBride BA, Fiese BH, et al. Risk factors for overweight/obesity in preschool children: an ecological approach. Childhood Obesity (Print). 2013;9:399-408.

77. Padez C, Mourao I, Moreira P, et al. Long Sleep Duration and Childhood Overweight/Obesity and Body Fat. American Journal of Human Biology. 2009;21:371-6.

78. Jones BL, Fiese BH. Parent routines, child routines, and family demographics associated with obesity in parents and preschool-aged children. Frontiers In Psychology. 2014;5:374-.

79. Fisher A, McDonald L, van Jaarsveld, CHM, et al. Sleep and energy intake in early childhood. International Journal Of Obesity . 2014;38:926-9.

80. Currie C, Cara Zanotti, Antony Morgan al. Social determinants of health and well-being among young people : Health Behaviour in School-Aged Children (HBSC) study : international report from the 2009/2010 survey. Copenhagen: World Health Organization; 2012.

81. Harrison F, Jones AP. A framework for understanding school based physical environmental influences on childhood obesity. Health & Place. 2012;18:639-48.

82. Story M, Kaphingst KM e French S. The role of schools in obesity prevention. Future of Children. 2006;16:109-42.

83. Story M, Nanney MS, Schwartz MB. Schools and Obesity Prevention: Creating School Environments and Policies to Promote Healthy Eating and Physical Activity. Milbank Quarterly. 2009;87:71-100.

84. Pate RR, O'Neill JR, Liese AD, et al. Factors associated with development of excessive fatness in children and adolescents: a review of prospective studies. Obesity Reviews. 2013;14:645-58.

85. De Moira AP, Power C, Li L. Changing Influences on Childhood Obesity: A Study of 2 Generations of the 1958 British Birth Cohort. American Journal of Epidemiology. 2010;171:1289-98.

86. Tanumihardjo SA, Anderson C, Kalifer-Horwitz M, et al. Poverty, obesity, and malnutrition: An international perspective recognizing the paradox. Journal of the American Dietetic Association. 2007;107):1966-72.

87. Dubois L, Farmer A, Girard M, et al. Family food insufficiency is related to overweight among preschoolers'. Social Science & Medicine. 2006;63:1503-16.

88. Waters E, de Silva-Sanigorski A, Hall BJ, et al. Interventions for preventing obesity in children. Cochrane Database of Systematic Reviews. 2011(12).

89. Branca F, Nikogosia H e Lobstein, T. The challenge of obesity in the WHO European Region and the strategies for response. Organization WH, editor. Copenhagen: World Health Organization; 2007.

90. Loring B, Robertson A. Obesity and inequities: Guidance for addressing inequities in overweight and obesity. Organization WH, editor. Copenhagen: World Health Organization; 2014 2014.

91. Santos O. O papel da literacia em Saúde: capacitando a pessoa com excesso de peso para o controlo e redução da carga ponderal. Endocrinologia, Diabetes & Obesidade. 2010;4:127-34.

92. World Health Organization. Health literacy: The solid facts. Copenhagen: WHO; 2013 28 August 2014.

93. Chari R, Warsh J, Ketterer T, et al. Association between health literacy and child and adolescent obesity. Patient Education & Counseling. 2014;94:61-6.

94. White RO, Thompson JR, Rothman RL, et al. A health literate approach to the prevention of childhood overweight and obesity. Patient Education And Counseling. 2013;93:612-8.