Universitat Autònoma de Barcelona

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Elizabeth Virginia Añez

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Universitat Autònoma de Barcelona

Department of Clinical and Health Psychology

Doctoral Thesis

Physical activity in adolescence and its relationship with body dissatisfaction, screen-time and weight status: Evidence from a sample of Spanish students

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LIST OF ACRONYMS

BMI: body- mass index

CDC: Center for Disease Control

ED: Eating Disorders

EDI-3: Eating Disorders Inventory-3

EDI- BD: Eating Disorders Inventory_ Body Dissatisfaction subscale

EWRP: Eating and Weight Related Problems

LPA: Light Physical Activity

MVPA: Moderate-vigorous Physical Activity

SATAQ-3 : Socio-Cultural Attitudes Towards Appearance Questionnaire-3

TPA: Total Physical Activity

WHO : World Health Organization

GENERAL INTRODUCTION

Adolescence represents a critical period of development during which important physical and psychological changes occur. During this period, eating and weight-related problems (EWRP)[1], such as body dissatisfaction, unhealthy weight-control behaviors, overweight and obesity become quite prevalent. The high prevalence of these behaviors, combined with severe physical and psychological consequences represent an important public health problem. Physical activity, a modifiable lifestyle factor associated with the prevention of chronic diseases, decreases markedly during this period. The aim of this thesis is to investigate the interrelationship of physical activity in early adolescence with body dissatisfaction, screen time and weight status in a less researched sample of Spanish adolescents.

This thesis is presented as a compendium of two articles, Study1 is currently under revision and Study 2 is published in the Journal of Heath Psychology, Volume 23, Issue 1, 36-47 (JCR indexed journal).

The overall structure of the thesis takes the form of five chapters. Given that this thesis is centered around physical activity during adolescence, Chapter 1, begins by describing adolescents according to the biological, psychological and social characteristics that influence their decision making and behavior in relationship to their physical activity. Then, it focuses on defining physical activity, its measurement instruments, and describing the patterns of physical activity overtime in adolescence. Chapter 2 reviews the concept of EWRP and its implications; the relationship between physical activity and key concepts to be developed in depth in the studies: weight, body dissatisfaction and screen-time. Chapter 3, describes objectives and studies design. Chapter 4, describes the sample and methods common to both studies. Chapter 5, describes the empirical research studies.

Study 1, titled "Longitudinal study of physical activity in Spanish young adolescents: weight status and gender differences" aimed to set a picture of physical activity prevalence and to

[1] Dianne Newmark-Sztainer introduced the concept of Eating and Weight Related Disorders in 2005. From this original conceptualization, the term has evolved and currently the term "Problems" is preferred over "Disorders".

investigate longitudinally changes (drops/ increments) in levels and intensities (moderate-vigorous vs. light) of physical activity throughout early adolescence.

Study 2, titled "Body image dissatisfaction, physical activity and screen time in Spanish adolescents" is a cross-sectional analysis that investigated whether high levels of body dissatisfaction may be a barrier to engage in moderate-to-vigorous physical activity (MVPA).

Detailed description of the characteristics of each sample, the measures used in each study as well as the procedures and statistical analyses followed can be found in the correspondent papers. The thesis concludes with a general discussion of the main findings. Clinical implications of the findings, limitations and directions for future research are also outlined. Finally, the main contributions of this thesis are presented in the conclusion section at the end of the thesis.

INTRODUCCIÓN GENERAL

La adolescencia representa un período crítico de desarrollo durante el cual ocurren cambios físicos y psicológicos importantes. Durante este período, los problemas relacionados con la alimentación y el peso (PRAP), como la insatisfacción corporal (IC), los comportamientos poco saludables de control de peso, el sobrepeso y la obesidad se vuelven bastante frecuentes. La alta prevalencia de estos comportamientos, combinada con graves consecuencias físicas y psicológicas representa un importante problema de salud pública. La actividad física, un factor de estilo de vida modificable asociado con la prevención de enfermedades crónicas, disminuye marcadamente durante este período. El objetivo de esta tesis es investigar la interrelación de la actividad física en la adolescencia temprana con insatisfacción corporal, tiempo de pantalla y estado nutricional en una muestra de adolescentes españoles.

Esta tesis se presenta como un compendio de dos artículos, el Estudio1 se encuentra actualmente en revisión y el Estudio 2 se publicó en el Journal of Health Psychology, Volumen 23, Número 1, 36-47.

La estructura general de la tesis toma la forma de cinco capítulos. Dado que esta tesis se centra en AF durante la adolescencia, el Capítulo 1 comienza describiendo a los adolescentes de acuerdo con las características biológicas, psicológicas y sociales que influyen en su toma de decisiones y comportamiento en relación con su actividad física. Luego, se enfoca en definir la AF, discutir sus instrumentos de medición y describir los patrones de actividad física a lo largo de la adolescencia. El Capítulo 2 revisa el concepto de PRAP y sus implicaciones; la relación entre AF y los conceptos clave que se desarrollarán en profundidad en los estudios: peso, insatisfacción corporal y tiempo de pantalla. El Capítulo 3, describe el diseño de objetivos y estudios. El Capítulo 4 describe la muestra y los métodos comunes a ambos estudios. El Capítulo 5, describe los estudios de investigación empírica.

Estudio 1, titulado "Estudio longitudinal de la actividad física en jóvenes adolescentes españoles: estado de peso y diferencias de género" con el objetivo de establecer una imagen de

la prevalencia de actividad física e investigar cambios longitudinales (incrementos / decrementos) en niveles e intensidades (vigoroso, moderada, leve) de actividad física a lo largo de la adolescencia temprana.

El estudio 2, titulado "Insatisfacción con la imagen corporal, actividad física y tiempo de pantalla en adolescentes españoles" es un análisis transversal que investigó si los altos niveles de insatisfacción corporal pueden ser una barrera para participar en actividades físicas moderadas-vigorosas.

La descripción detallada de las características de cada muestra, las medidas utilizadas en cada estudio, así como los procedimientos y análisis estadísticos seguidos se pueden encontrar en los documentos correspondientes. La tesis concluye con una discusión general de los principales hallazgos. También se describen las implicaciones clínicas de los hallazgos, las limitaciones y las sugerencias para futuras investigaciones. Finalmente, las principales contribuciones de esta tesis se presentan en la sección de conclusiones.

CHAPTER 1_ PHYSICAL ACTIVITY AND ADOLESCENTS

1.1 Adolescence: an overview

Adolescence is one of the most rapid phases of human development. It is sometimes defined as a transitional phase of growth and development between childhood and adulthood (Sawyer, Azzopardi, Wickremarathne, & Patton, 2018). The World Health Organization (WHO) defines an adolescent as a person between ages 10 and 19 (World Health Organization, n.d.-a). Age is, however, only a marker as there is a lot variation across individuals. It can thus be understood as a period of maturation and it is possible to identify two major areas of change during this phase (Sawyer et al., 2018).

a) Physical and physiological: there is a rapid increase in height, weight and a modification of body composition as well as the development and maturation of sexual characteristics.

b) Psychological: is characterized by egocentrism, adolescents feel the urge to be more independent from their families. Often, friends replace parents as a source of advice, although family support is important to help them build a strong sense of self. There are cognitive developments that help to define their sense of self-concept and build their identity.

These changes impact in adolescents' habits such as physical activity. Given the autonomy of the adolescents, they may put their health at risk if their decisions are not adequate. This is an important reason that justifies research in physical activity within this age group.

1.2 Physical activity definition, benefits and recommendations

Physical activity is defined as "any bodily movement produced by skeletal muscles that require energy expenditure" (Caspersen, Powell, & Christenson, 1985). This term is commonly used as an abbreviation for health-enhancing physical activity. Physical activity can either be classified as structured or incidental (Caspersen et al., 1985). Structured physical

activity or *exercise,* is planned and it involves repetitive bodily movement with the intent of improving or maintaining health and fitness benefits. Exercise can be accomplished through activities such as cycling, dancing, walking, swimming, yoga, working out at the gym, or running, just to name a few. Incidental physical activity is not planned and usually is the result of daily activities at work, at home, or during transport (e.g., walking to and from work, taking the stairs instead of elevators and escalators, gardening, and doing household chores). For the purpose of this thesis dissertation I will be using the term physical activity in a broad way to include everyday activities such as going from-and-to school or work, to structured exercise and physical leisure activities.

There are four dimensions of physical activity generally considered: type of activity, frequency, duration and intensity (Strath et al., 2013).

Type: Considering ultimate health benefits, the literature typically classifies different activities in the context of physiological and biomechanical demands/types (e.g., aerobic versus anaerobic activity, resistance or strength training, balance and stability training).

Frequency: It refers to the number of sessions per day or per week.

Duration: Time (minutes or hours) of the activity bout during a specified time frame (e.g., day, week, year, past month).

Intensity: It refers to the rate of energy expenditure or the magnitude of the effort required to perform an activity or exercise. It can be measured with physiological measures (e.g., in terms of the percentage of oxygen used, i.e., VO_2; by measuring the heart rate and using that value as an index of the strain of exertion); in terms of the energy costs (i.e., metabolic equivalent; METs) based upon the amount of energy used by the body while doing the activity. It can be subjectively assessed by perceptual characteristics (e.g., rating of perceived exertion, walk-and-talk test), or quantified by body movement (e.g., stepping rate, 3-dimensional body accelerations).

This latter type of dimension is the most commonly reviewed in the literature and physical activity can be classified as light physical activity (LPA), moderate-vigorous physical activity (MVPA) or vigorous physical activity, from less intense to more intense (Ainsworth et al., 2011). MVPA, one of the most common measures of interest from a physical activity assessment is simply the amount of time an individual spends in a specified physical activity intensity threshold range. For example, studies frequently aim to determine whether an individual is meeting the physical activity guidelines of a cumulative 150 minutes per week of moderate-intensity physical activity or 75 minutes per week of vigorous-intensity physical activity (Strath et al., 2013).

According to the WHO definition "Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity" (World Health Organization, 1946). In this thesis, physical activity is studied with this overarching vision, accounting not only by the strictly medical benefits, but also taking into account the psychological benefits.

Physical activity is an important modifiable behavior. It can have a positive impact on physical and psychological health. It helps to control weight, improves cardiovascular health, some cancers, reduce risks of diabetes and metabolic syndrome (Hallal, Victora, Azevedo, & Wells, 2006; Strong et al., 2005). Furthermore, there are associated psychological benefits, as it improves mood, sociability and cognitive ability (Booth, Roberts, & Laye, 2014). Physical activity has been shown to have beneficial effects on mental health in adolescents, particularly on depression (i.e., fewer depressive symptoms) and self-esteem. Physical activity may decrease depressive symptoms due to an increased release of β-endorphins, which are related to a positive mood and an overall enhanced sense of well-being. In addition, physical activity may indirectly increase self-esteem by creating the perception of physical competence and an improved level of fitness. Moreover, some evidences suggest that involvement in regular MVPA can produce meaningful improvements in academic achievement in childhood and adolescence (Booth et al., 2014; Davis et al., 2007; Donnelly & Lambourne, 2011). Lack of physical activity is globally the fourth most important risk factor associated with mortality (World Health Organization, n.d.-b). There is substantial amount of evidence that physical activity influences health during childhood and adolescence (Timmons et al., 2012).

The first public health recommendations for physical activity in the United States were released in 1995 (Pate et al., 1995) and these were followed by additional and updated recommendations in 1996 (US Department of Health and Human Services, 1996) and 2007 (Haskell et al., 2007; Nelson et al., 2007). In 2008 the body of evidence culminated in the first-ever federal guidelines for physical activity (US Department of Health and Human Services., 2008). These guidelines simplified the message for the general public concerning health-enhancing levels of physical activity and included the following recommendations: (1) adults should avoid inactivity (i.e., some physical activity is better than none); (2) substantial health benefits are obtained from accumulating, in bouts of ≥10 minutes, 150 minutes per week of moderate-intensity or 75 minutes per week of vigorous-intensity aerobic activity, or an equivalent combination of both; (3) additional and more extensive health benefits are obtained by increasing aerobic physical activity to 300 minutes per week at moderate intensity or 150 minutes per week at vigorous intensity or an equivalent combination of both; and (4) muscle-strengthening activities of moderate to high intensity should be performed ≥2 days per week.

The WHO developed the "Global Recommendations on Physical Activity for Health" (World Health Organization, 2010) with the overall aim of providing national and regional level policy makers with guidance on the dose-response relationship between the frequency, duration, intensity, type and total amount of physical activity needed for the prevention of non-communicable diseases. It also sets similar recommendations, suggesting that children and youth aged 5–17 should accumulate at least 60-minutes of moderate- to vigorous-intensity physical activity daily. Different international health institutions have made recommendations about the amount of physical activity that needs to be performed to observe a positive impact on an individual´s health. The recommendations vary per age group and although they may vary a little bit between recommending bodies, generally it is agreed that children and adolescents should do at least 60-minutes per day of MVPA (Centers for Disease Control and Prevention, 2015).

1.3 Physical activity prevalence and trends in adolescence

Worldwide estimates indicate that almost 80% of youths do not achieve the Centers for Disease Control (CDC) recommendation of accumulating at least 60-minutes of MVPA per-day (Hallal, Andersen, Bull, Guthold, & Haskell, 2012). Specific to Spain, data from the Spanish National Health Survey (Ministerio de Sanidad, 2014) revealed that 45.28% of over 15 years old performed weekly MVPA, whereas unpublished data from the WHO-Health Behavior in School-Aged Children report for Spain from the 2013/2014 round, showed that of only 24.4% of adolescents reach the recommended physical activity levels for health, with significantly more boys being active than girls (31.7% and 17.3%, respectively) (World Health Organization, 2016).

It is well established that during adolescence, there is a decline in MVPA. This is of concern as it has been shown that levels of physical activity in adolescence track into adulthood. According to a 2011 review literature of 26 studies conducted between 1998 and 2009, on average the mean percentage physical activity change per year, across all studies, was -7.0% (95% confidence interval: -8.8 to -5.2) (Dumith, Gigante, Domingues, & Kohl III, 2011). In this review, overall, declines in physical activity were higher in boys. However, taking into account age groups, it was found that the decline among girls was higher in younger ages (9–12 years), and higher in older ages (13–16 years) among boys. Some studies have suggested that declines are higher in boys, for vigorous physical activity and in non-organized sports (Sallis, Prochaska, & Taylor, 2000). Specific to Spain, the WHO-Health Behavior in School-Aged Children report (Currie et al., 2012) showed that the proportion of adolescents fulfilling the physical activity recommendation fell from 27 % in 11-year-old boys and 15 % in girls, to 25 % in 15-year-old boys and 8 % in girls.

Although the decline in physical activity levels is consistent in the literature, it is not clear yet what are the factors related to this change. Moreover it is difficult to compare across studies because there is large variation in age groups, instruments used, type of physical activity measured, etc. For example, in one study, the authors attributed the decline to the number of physical activities, rather than the time spent in each physical activity (Aaron, Storti,

Robertson, Kriska, & Laporte, 2002). In fact, the number of physical activities was the measure that presented the highest decline.

Another potential explanation for decrements in physical activity may be positively associated with its baseline level, although a possible effect of regression-to-the-mean phenomenon may not be ruled out. That is, those starting with high levels of baseline physical activity can potentially present a large decrease in physical activity levels, compared with those who start with lower physical activity levels. Other researchers have reported that vigorous physical activity may increase during adolescence, even in the presence of an overall decline in physical activity (Telama & Yang, 2000).

In sum, the data highlights that there is no a simple and straightforward description of how, when or in which group the change in physical activity occurs. Moreover, the view that there are marked declines in physical activity during adolescence is supported mostly by cross-sectional, self-reported studies, by and large from US samples, and by studies that did not include samples which crossed over the transition between childhood and adolescence (Dumith et al., 2011; Sallis et al., 2000). Similarly, there is recent evidence from longitudinal studies, showing non-significant or negligible changes in MVPA (Collings et al., 2013; Cooper et al., 2015; Harding, Page, Falconer, & Cooper, 2015; Mitchell et al., 2012). In this line, physical activity intensity (i.e., MVPA vs LPA) is another inherent component that deserves further investigation, because its definition and instruments varies widely across studies. It is unclear what kind of physical activity intensity has the greatest variability during adolescence.

1.4 Measurement of physical activity

There are two broad categories of methods available to assess physical activity: subjective methods and objective methods. Subjective methodologies rely on the individual either to record activities as they occur or to recall previous activities. Objective methodologies include all wearable monitors that directly measure one or more bio-signals, such as acceleration,

heart rate, or some other indicator of physical activity or energy expenditure, as they occur. There are different methods to measure physical activity, amongst the most frequently used are: devices (pedometer, accelerometers, and heart-rate monitors), questionnaires, direct observation, and self-report diaries. All of these have their advantages and disadvantages which are summarized in Table 1 taken from (Strath et al., 2013).

Table 1 strengths and limitations to objective and subjective methodologies

Characteristics	Questionnaire	Diaries/Logs	Observation	Indirect Calorimetry	DLW	HR	Accelerometer	Pedometer	Multisensing Units
Strengths	• Low cost • Low burden • Convenient/ easy • Applicable to large numbers of individuals • Single time point assessment • Valid to assess structured physical activity • Can successfully rank into high/low categories • Can assess different dimensions and domains	• Low cost • Detailed information on dimension and domains • Not subjected to memory or recall as much as other subjective methods • Provides a good subjective measure of physical activity and energy expenditure	• No recall necessary • Provides excellent contextual information • Provides detailed information on dimensions and domains	• Highly accurate and reliable measure of physical activity and energy expenditure • Suitable criterion measure of physical activity and energy expenditure	• "Gold standard" measure for total daily energy expenditure in free-living individuals • Low burden to patients or participants	• Low burden for short periods • Relatively inexpensive • Relationships strong with moderate to vigorous intensity	• Concurrent measure of movement • Provides detailed intensity, frequency, and duration data • Can store data for weeks at a time • Low burden • Relatively inexpensive	• Low cost • Low burden • Easy data processing • Applicable to large numbers of individuals • Can also be used to motivate people	• Accuracy improved compared with single sensing assessments
Weaknesses	• Recall and social desirability bias can occur • Needs to be population and culture specific • Low validity for assessing incidental or lifestyle physical activity	• Very high burden on patients and participants • Complex and time-consuming data reduction and analysis • Similar to questionnaires, they should be population and culture specific	• High burden on the observer • Training essential to successfully administer this technique • Can alter individual behavior of the one being assessed	• Expensive • High degree of technical expertise required • Short time assessment only permissible	• Expensive • Technical equipment and trained personnel required • Measures of resting metabolic rate and thermic effect of food required to derive PAEE • Unable to discern dimensions or domains	• Affected by nonactivity stimuli (emotion, medication, caffeine) • Weak relationship at low end of intensity realm • Subject to interference with signal	• Cannot account for all activities, such as cycling, stair use, or activities that require lifting a load • Upper-body activities neglected with hip or lower-back wear • Data reduction, transformation, and processing take time	• Simple pedometers cannot measure intensity/ duration • Cannot measure mode/type • Not accurate for energy expenditure • Depending on device, false steps can be recorded • Some brands require user to write steps down	• Higher cost • Increased burden of wear for some devices • Depending on device, technical expertise is essential

DLW indicates doubly labeled water; HR, heart rate; and PAEE, physical activity–related energy expenditure.

One of the main challenges for epidemiological studies, like the ones reported here is to find a valid and suitable method to measure quantity and quality of physical activity (Welk, Corbin, & Dale, 2000). One of the most common measurement tools used in epidemiological studies to measure physical activity is the questionnaire (Sallis & Saelens, 2000; Sylvia, Berstein, Hubbard, Keating, & Anderson, 2014). There are plenty of questionnaires that vary according to what they measure (e.g., duration or frequency of physical activity), what is reported (e.g., activity types, time, calories), the quality of the data (e.g., measures of intensity, habitual vs. recent activities, structured vs non-leisure activities), and how data is gathered (e.g., paper and pencil, computerized questionnaire or interview). Physical activity questionnaires can be classified into three categories: global, recall, and quantitative history (Sylvia et al., 2014). Overall, validation studies of questionnaires show strong correlations and agreement with other measures for vigorous-intensity physical activity, but they are generally less robust for light- to moderate-intensity activities (Ainsworth, Richardson, David, Leon, & Sternfeld, 1999; Jacobs, Ainsworth, Hartman, & Leon, 1993; Strath, Bassett, & Swartz, 2004). Discriminant validation studies have demonstrated that questionnaires are able to classify individuals according to activity level in rank order so, in other words, they are able to discern who is less or more physically active within a given sample (Wareham & Rennie, 1998). Even though questionnaires have their limitations, they have many advantages for large samples in terms of the ease in administration, time and costs (Vanhees et al., 2005). In the present thesis, this is one reason that justified its use as well as the relationship between physical activity assessed with questionnaires and other psychological constructs in similar epidemiological studies.

There is a significant number of questionnaires assessing physical activity, depending on which dimensions of physical activity one is interested in, the specific target population, the sample size, its logistics and other constrains that determined the selection of the specific questionnaire. In the present thesis, physical activity was assessed along with other variables as it was part of a program in the prevention of EWRP. Hence, the length of questionnaires was also considered at the time of choosing the instrument. We used the Leisure Time Exercise Questionnaire (Godin & Shephard, 1997) adapted by Neumark-Sztainer and colleagues (Neumark-Sztainer, Goeden, Story, & Wall, 2004), which is a global recall- type of

questionnaire that in fact is one of the most widely used in the EWRP field. A description of the questionnaire can be found in Chapter 4.

1.5 Summary of Chapter 1

Chapter 1, described adolescents according to the biological, psychological and social characteristics to provide a framework to understand their decision making and behavior in relationship to their physical activity. Then, it defined physical activity, discussed recommendations according to international consensus, presented prevalence rates of physical activity in adolescence and described trends of physical activity over this developmental period. Finally, it tried to summarize the most common forms of physical activity measurement with its advantages and disadvantages.

CHAPTER 2 _ EATING AND WEIGHT-RELATED PROBLEMS: PHYSICAL ACTIVITY AND BODY IMAGE

2.1 Eating and Weight Related Problems

Both obesity and eating disorders (ED) are problems with substantial health consequences and they are highly resistant to treatment (Agras, 2001; Brownell, 2010; Fairburn, Cooper, Doll, Norman, & Connor, 2000; Haines & Neumark-Sztainer, 2006; Pi-Sunyer, 2002; Strauss, 2000). Once obesity is established it is difficult to revert, and it is now recognized as a chronic non-communicable disease (World Health Organization, 2018). The increase in obesity rates in recent years has placed a considerable economic burden on health-care systems (Tremmel, Gerdtham, Nilsson, & Saha, 2017). ED are serious mental disorders, with a clear chronic tendency and high co-morbidity with other mental disorders, highly resistant to treatment and associated with adverse medical conditions (Arcelus, Mitchell, Wales, & Nielsen, 2011; Fairburn et al., 2000; Treasure, Claudino, & Zucker, 2010).

In view of the serious consequences of obesity, ED and disordered eating, the difficulties encountered in treatment and the high prevalence of these conditions, efforts aimed at their prevention are crucial. A prevention approach that addresses a broad range of EWRP may be the best solution. Historically, research in the two fields has followed quite separate paths, but for some years now, researchers in the areas of ED and obesity prevention recognize the benefits of collaborative efforts aimed at the spectrum of eating and weight-related problems, which include anorexia nervosa, bulimia nervosa, anorexic and bulimic behaviors (such as fasting, vomiting and the use of laxatives, diet pills or diuretics), unhealthy dieting practices, body dissatisfaction, binge-eating disorder, overweight and obesity (Neumark-Sztainer, 2005; Oda-Montecinos, Saldaña, & Andrés, 2013; Sánchez-Carracedo, Neumark-Sztainer, & López-Guimerà, 2012; Shaw, Ng, & Stice, 2007). There are several empirically supported reasons and practical considerations for seeing these problems as part of a continuum and for developing interventions aimed at preventing a broad spectrum of eating and weight related concerns. Neumark-Sztainer (Neumark-Sztainer, 2005a) is a pioneer study in proposing this

holistic approach that includes five different dimensions: weight control practices, physical activity behaviors, body image, eating behaviors, and weight status (see Figure 1, adapted from (Neumark-Sztainer, 2005a)). For each of these dimensions, she proposed that an adolescent may range from healthy to problematic. Thinking of these dimensions as in a continuum helps to consider a variety of concerns and domains so that focus is not in just one problem. Often times, an individual may have a problem in one domain, whilst being healthy in another domain. For instance, an overweight person can be physically active and avoid unhealthful weight control behaviors.

Figure 1 A spectrum of eating, activity and weight-related concerns

	Healthy →	→	→	**Problematic**
Weight Control Practices	Healthy Eating	Dieting	Unhealthy Weight Control Behaviors	Anorexia or Bulimia Nervosa
Physical Activity Behaviors	Moderate Physical Activity	Minimal or Excessive Physical Activity	Lack of or Obsessive Physical Activity	"Athletic Anorexia"
Body Image	Body Acceptance	Mild Body Dissatisfaction	Moderate Body Dissatisfaction	Severe Body Dissatisfaction
Eating Behaviors	Regular Eating Patterns	Erratic Eating Behaviors	Binge Eating	Binge Eating Disorder
Weight Status	Healthy Body Weight	Mildly Over or Underweight	Overweight or Underweight	Severe Overweight or Underweight
	Healthy →	→	→	**Problematic**

There is research supporting this model and three important conclusions have been drawn in this regard. First, weight-related problems can co-occur, and individuals can cross over from one problem to another. Second, rather minor unhealthful behaviors can turn into more severe or problematic behaviors. Third, behaviors such as dieting, often times perceived as the solution to a problem like obesity, may aggravate or lead to other problems, such as more weight gain, disordered eating, and ED (Neumark-Sztainer, 2005).

2.2 Physical activity and two - ends of a continuum

As noted in Figure 1 physical activity is one dimension within the spectrum. It can be problematic in two ways: at one end of the continuum representing minimal or lack of physical activity; at the opposite end, excessive/obsessive amounts of activity.

2.2.1 Low levels of physical activity and obesity

Rates of obesity have increased over the last three decades and this phenomenon is observable in developed and developing countries (Stankov, Olds, & Cargo, 2012). Minimal or lack of physical activity plays an important role in developing overweight and obesity (Anderson & Butcher, 2006). Unlike other behaviors associated with eating disorders, exercise is healthy and is encouraged in different ways. In fact, exercise is a key factor in the prevention and treatment of obesity, helping in some cases to produce necessary weight loss and contributing to weight maintenance (Blair & Holder, 2002; Carels et al., 2008). Furthermore, it is now recognized that the benefits of performing physical activity go beyond controlling weight, but help in the control of several comorbidities of overweight and obesity such as cholesterol, diabetes and cardiovascular disease (Booth et al., 2014).

Experiencing obesity during adolescence can have a profound impact on psychosocial development, in part because it is a critical period for psychosocial development marked by increasing separation from parents, peer acceptance and identity formation (Coleman, 1980). Compared to normal weight adolescents, those who are overweight/obese are regularly

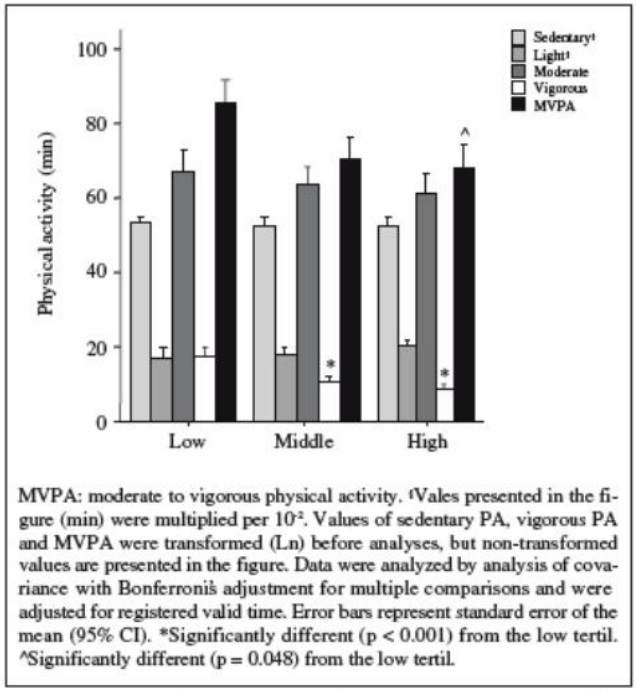
victimized by peers and more often experience higher rates of low self-esteem and sadness, than peers in the normal weight range (Neumark-Sztainer, Story, & Faibisch, 1998; Puhl & Heuer, 2010; Strauss, 2000). Among these overweight/obese adolescents, in particular girls, it has been reported that some may suffer depressive symptoms, body dissatisfaction, disordered eating (Bucchianeri et al., 2013; Needham & Crosnoe, 2005; Pearl & Puhl, 2018) and they may be more likely to experience suicidal thoughts if they are victim of weight-based teasing (Eisenberg, Neumark-Sztainer, & Story, 2003). Furthermore, in a recent longitudinal study it has been shown that weight- based stigmatization in adolescence predicts obesity and unhealthy eating behaviors into adulthood (Puhl et al., 2017).

Excessive body consciousness has been identified as a unique barrier to physical activity for overweight youth as compared to non-overweight youth (Zabinski, Saelens, Stein, Hayden-Wade, & Wilfley, 2003). Moreover, overweight youth tend to perceive a greater number of barriers to sports participation, including feeling insecure about their appearance (Needham & Crosnoe, 2005). Peer stigmatization can inhibit participation in exercise (Needham & Crosnoe, 2005). Indeed, some studies have documented that physical activity is less prevalent among obese and overweight men and women than among people of normal weight (Adams, Der Ananian, DuBose, Kirtland, & Ainsworth, 2003; Martínez-Gómez et al., 2009). Page and colleagues (Page et al., 2005) analyzed physical activity patterns of 11 years old using accelerometers and arrived to similar results, with obese children being significantly less physically active overall, and in moderate or greater intensity activities than their non-obese counterparts. Interestingly, they also showed a tendency of obese children to be less active than non-obese children at times when activity was more likely to be determined by free choice, particularly outside of school time.

Likewise, adolescents from the Healthy Lifestyle in Europe by Nutrition in Adolescence (HELENA) study showed that adolescents who performed less than 60 minutes of MVPA in comparison to more active ones, had higher percentage of total and abdominal fat (Moliner-Urdiales et al., 2009). Specifically to Spain, in the cohort of the European Youth Heart Study (EYHS), an international study that addresses the multi-dimensional issues of CVD risk factors, the risk of developing overweight/obesity was nearly four-times more likely in

children who practiced less than 60 minutes of MVPA per day than their more active counterparts (Laguna, Ruiz, Lara, & Aznar, 2013). In the AFINOS study, it has also been shown that there are differences in the intensity of physical activity performed by adolescents, categorized based on the different sum of skinfolds (Martínez-Gómez et al., 2009). As illustrated in Figure 2, it is interesting that the three groups have similar levels of sedentarism, LPA and moderate physical activity, but there is an observable difference in levels of vigorous and MVPA when comparing those in the high category against to those in the low category of sum of skinfolds.

Figure 2 Mean values of physical activity intensities divided in tertiles (low, middle, and high) by the sum of 6 skinfolds of the sample (n = 214)



MVPA: moderate to vigorous physical activity. †Vales presented in the figure (min) were multiplied per 10^{-2}. Values of sedentary PA, vigorous PA and MVPA were transformed (Ln) before analyses, but non-transformed values are presented in the figure. Data were analyzed by analysis of covariance with Bonferroni's adjustment for multiple comparisons and were adjusted for registered valid time. Error bars represent standard error of the mean (95% CI). *Significantly different ($p < 0.001$) from the low tertil. ^Significantly different ($p = 0.048$) from the low tertil.

Fig. 2.—Mean values of physical activity intensities divided in tertiles (low, middle, and high) by the sum of 6 skinfolds of the sample (n = 214)†.

Given the increasing rates of overweight- obesity, and the considerably low prevalence of physical activity, investigating the factors that can help in breaking this vicious cycle of increased weight and greater barriers for involving in physical activity for people with overweight or obese are necessary.

2.2.2 Excessive levels of physical activity and eating disorders

The prevalence of eating disorder for anorexia and bulimia is estimated to be 0.3% and 1.0% among adolescent and young women, respectively. Prevalence rates of anorexia and bulimia appear to increase during the transition from adolescence to young adulthood (Hoek, 2007).

The exercise activities of those struggling with an eating disorder are often unhealthy in terms of excessive behavioral components, and obsessive psychological qualities. Indeed, exercise as a means to control weight is common among those with eating disorders, especially those with anorexia nervosa (Meyer, Taranis, & Touyz, 2008), and "excessive exercise" as an inappropriate compensatory behavior is included as a diagnostic criterion for bulimia nervosa (American Psychiatric Association, 2013).

It is estimated that approximately 80% of patients with anorexia nervosa and 55% of patients with bulimia nervosa engage in unhealthy exercise patterns (Davis et al., 1997). Even though, physical activity as a diagnostic criteria is not sufficiently emphasized in current diagnostic guides, it has been noted that especially compulsive exercise is present in patients with ED (Jáuregui Lobera, Estébanez Humanes, & Santiago Fernández, 2008). For example, around 90-95% of college students diagnosed with an eating disorder also belong to a fitness facility. An estimated 3% of gym-goers have a destructive relationship with exercise (Berczik et al., 2012) and a 2008 Paris study found that up to 42% of gym-goers have a destructive relationship with exercise (Lejoyeux, Avril, Richoux, Embouazza, & Nivoli, 2008). Between 40% and 80% of anorexia nervosa patients are prone to excessive exercise in their efforts to avoid putting on weight. Ideally, those recovering from an ED would return to not only healthy eating, such as intuitive eating, but also healthy exercise, such as more mindful physical activity free of obsessive qualities (Greenleaf, 2018)

Until recently, physical activity was not the first one to be considered in health promoting interventions dealing with EWRP, but more and more there is recognition of the value of including physical activity as a central component in health promotion and prevention of EWRP (Neumark-Sztainer et al., 2010).

2.3 Body Image: from acceptance to dissatisfaction

As noted earlier, when we introduced the concept of EWRP and the model proposed by Newmark-Stzainer (2005a), body image is also considered a dimension or concern within the EWRP paradigm (see Figure 1). It can range from acceptance to severe dissatisfaction.

Body image is a multidimensional concept that comprises perceptions, cognitions, and feelings in general, as well as an individual's behavior towards his/her own body (Cash, Fleming, Alindogan, Steadman, & Whitehead, 2002). There is scientific consensus that body image includes both perceptual and cognitive–affective components (Bully, Elosua, & López-Jáuregui, 2012; Muth & Cash, 1997; Thompson, Heinberg, Altabe, & Tantleff-Dunn, 1999). While the perceptual component affects the accuracy of size estimations and perceptual distortions, the cognitive–affective component refers to evaluations and feelings of satisfaction or dissatisfaction with one's body size (Gardner, 1996; Gardner & Brown, 2010; Wood, Becker, & Thompson, 1996). Moreover, we can think in terms of body image evaluation and body image investment. The first one denotes individuals' evaluative thoughts and beliefs about their physical appearance. The second one refers to the behaviors that individuals perform to manage or enhance the way they look (Cash & Szymanski, 2010). Cash goes further in defining body image as a multifaceted experience of embodiment, moving beyond body appearance and dissatisfaction to include body functionality and positive body image (Cash & Pruzinsky, 2002). Body image is a complex phenomenon, including many components with gender, ethnic, and sociocultural influences (Cash, & Pruzinsky, 2002; Cash & Smolak, 2011)

Body dissatisfaction is one aspect of body image. It may be affected by the perceptual component and may result from perceptual distortions. However, body dissatisfaction can also occur in individuals whose perception skills are undistorted and accurate if the individual's actual body does not correspond to his/her own ideal (Gardner, 2001; Schneider, Weiß, & Thiel, 2013).

Although, body dissatisfaction does not cause ED alone, it is quite common in young women in Western culture, and it is considered a major risk factor responsible for initiating and then sustaining extreme weight controlling behaviors seen in eating disorders. Overall, the current state of research shows that body dissatisfaction represents one of the main risk factors for body change strategies such as skipping meals, dieting during adolescence, taking laxatives and diuretics, and exercising excessively (Andrés & Saldaña, 2014). These strategies may not only endanger an individual's physical health but also cause depressive symptoms and ED (Goldfield et al., 2010; Helfert & Warschburger, 2011; López-Guimerà et al., 2013).

Several studies have demonstrated that adolescence is an especially crucial time for the development of body dissatisfaction (Cheung et al., 2011; Gardner, 2001). This is not surprising since adolescence involves considerable physical and psychological changes. Changes in body proportions —such as the development of secondary sexual characteristics and rapid longitudinal growth— experienced during puberty can lead to feelings of body dissatisfaction (Sypeck et al., 2006). Adolescent girls are especially at risk of body dissatisfaction as they are particularly exposed to the ideal of extreme slimness portrayed in the mass media.

Although there are many theories about the dynamics of developing body dissatisfaction, most models would agree that it is connected to a culturally defined standard of beauty or ideal of beauty. There are three constructs that seem to be frequently implicated in the development of body image dissatisfaction: awareness of a thin ideal, internalization of a thin ideal, and perceived pressures to be thin. Central to these models is the construct of internalization, which is defined as the extent to which individuals buy into, incorporate, and accept the value of culturally endorsed ideals of beauty, to the point that it affects body image or personal behavior (Flament et al., 2012;Thompson & Stice, 2001; Thompson et al., 1999). Internalization of the thin beauty ideal is detrimental to one's mental and physical health (Karazsia, van Dulmen, Wong, & Crowther, 2013). Indeed, the thin ideal has been linked to restrained and external eating (Flament et al., 2012; Huxley, Halliwell, & Clarke, 2015), bulimic symptoms (Moradi, Dirks, & Matteson, 2005), compulsive exercise (Homan, 2010), body image disturbance (Durkin & Paxton, 2002; Kristin Homan, 2010), and higher levels of

thin-ideal internalization have been found in eating disordered samples compared to non-eating disordered samples (Calogero, Davis, & Thompson, 2004). Thus, it is not surprising that thin-ideal internalization and appearance pressures have been identified as some of the most important risk factors in the development of body image dissatisfaction and eating pathology (Cafri, Yamamiya, Brannick, & Thompson, 2005; Dittmar, Halliwell, & Stirling, 2009; Stice & Shaw, 2002; Thompson & Stice, 2001). As it will be discussed in the next section, mass media play a crucial role in delivering and fomenting the thin-ideal internalization.

2.4 Development of body image dissatisfaction: the role of the mass media

Given the overwhelming impact of the mass-media on people living within Western societies, and especially on adolescents, it is inevitable to include the mass media within the research questions.

Sociocultural models of ED highlight the role of the media in the development and maintenance of body image problems (Cafri et al., 2005; Keery, Van den Berg, & Thompson, 2004; van den Berg, Thompson, & Obremski-Brandon, Coovert, 2002). That is, even though sociocultural factors linked to body image are associated to different socialization agents (i.e., family, friends, and peers), there is consensus that the mass media plays a crucial role in female body objectification. This happens through the exposure to consistent, reiterative, and persuasive thin-ideal images (Calado, Lameiras, Sepulveda, Rodriguez, & Carrera, 2011). As previously noted, during adolescence, screen-time exposure increases, and in this line, it has been identified as an important risk factor for ED (Jordan, Kramer-Golinkoff, & Strasburger, 2008; Thorp, Owen, Neuhaus, & Dunstan, 2011; Tremblay et al., 2011; Vaughan & Fouts, 2003).

According to sociocultural models of eating disorders, mass-media messages pressure individuals to conform to the cultural ideals of beauty (Dittmar et al., 2009; Levine & Murnen, 2009; López-Guimerà, Levine, Sánchez-Carracedo, & Fauquet, 2010). Internalization of these ideals results in body dissatisfaction because attaining these ideals is generally very difficult

for most people (Thompson & Stice, 2001). Then, body dissatisfaction could lead to negative affect and disordered eating, which can lead to eating disorders. Cross-sectional studies have found positive associations among media use (TV and magazines), and body dissatisfaction and disordered eating behavior among adolescents (López-Guimerà et al., 2010; Vaughan & Fouts, 2003). Likewise, experimental studies have shown that exposure to thin-ideal images causes an increase in body dissatisfaction (Levine & Murnen, 2009; López-Guimerà et al., 2010).

Until recently, most of the research about the impact of the media on body dissatisfaction has been centered on television and magazines. Undoubtedly, since the advent of the internet and the rapid growth of different types of social media such as Instagram, Facebook, as well as the rapid change in media from computers to mobile phones, tablets, highlights the importance of researching the impact on body dissatisfaction of these "new" types of media (Fardouly, Diedrichs, Vartanian, & Halliwell, 2015; Fardouly & Vartanian, 2015; Holland & Tiggermann, 2016; Marika. Tiggemann & Slater, 2013). Researchers, primarily in the U.S. UK and Australia have commenced studying how these may be affecting body image concerns. Although there ae distinctive attributes of social media (Perloff, 2014), Williams & Ricciardelli (2014) have listed several mechanisms (e.g., exposure to unrealistic body images; modelling; pressure to conform; gender-typed socialization; objectification of the body; internalization of appearance ideals, etc.) that seem to be no different between how social media and traditional forms of media (i.e. TV and magazines) may influence people`s body image. Nonetheless, there is no doubt that more research is needed.

2.5 Measurement of body image dissatisfaction

There are mainly two approaches to the measurement of body image: perceptual (i.e., estimation of body and shape) and attitudinal (i.e., evaluative judgments about the body). Perceptual measures focus on size perception accuracy of entire or parts of the body. Attitudinal measures, entails global subjective satisfaction; affective distress relating to appearance; cognitive aspects & behavioral aspects of appearance. There are many body

dissatisfaction measures that can be grouped broadly in figure drawings and self-report questionnaires.

Typically, when using figure drawings, a participant is presented with a series of drawings of body shape and asked to identify their 'ideal' body shape or the body shape that they feel best reflects their actual body shape. A low score using this measure would indicate inaccurate body perception or low levels of body satisfaction. Although there is more than a dozen of these type of scales (e.g., Figural Rating scale [Stunkard, Sorensen, & Schulsinger, 1983]; Body Image Assessment Scale [Gardner, Jappe, & Gardner, 2009]), all of them have shortcomings, as pointed out in a review by Gardner and Brown (2010). Nonetheless, they still have some advantages such as ease of administration and ability to collect group data Besides, this methods has evolved from paper drawings to now more realistic computerized drawings (Mutale et al., 2016)

Within the self-reported questionnaires there is a wealth of instruments (only some examples: Multidimensional Body-Self Relations Questionnaire [Cash, 2000]; Body Image Disturbance questionnaire [Cash, Phillips, Santos, & Hrabosky, 2004]; Body Appreciation Scale [Avalos, Tylka, & Wood-Barcalow, 2005]). They are designed to assess different aspects of the body image construct, for different populations (e.g., cross-cultural, race/ethnic related), age groups, and research questions (e.g., body size/shape, global body image, specific body parts, appearance, fitness, health, disordered eating). Furthermore, over the last decade there has been a burgeoning interest in the study of body image, shifting the focus from a focus on negative aspects to a broader body image concept including body appreciation, an aspect of positive body image (Avalos et al., 2005; Halliwell, Jarman, Tylka, & Slater, 2017; Tylka & Wood-Barcalow, 2015). For the present thesis, framed within an EWRP prevention perspective, we used the Body Dissatisfaction subscale of the Eating Disorders Inventory-3 (EDI-3)(Garner, 2004), in it is Spanish validated version (Elosua, López-Jáuregui, & Sánchez-Sánchez, 2010). It consists of 10 items that assess discontentment with the overall shape and with the size of those regions of the body of extraordinary concern to those with ED (i.e., stomach, hips, thighs, buttocks). A more detailed description of this scale is detailed in Chapter 4.

2.6 Body Image Dissatisfaction and Physical activity

As previously discussed, during adolescence, concern with body image becomes important for a great proportion of teenagers. Physical activity and body dissatisfaction becomes relevant in two ways. In one hand, some teenagers may shy away from physical activity because of their body image dissatisfaction. On the other hand, others may engage in excessive amounts of physical activity with the intention of modifying their body image.

In line with the first scenario of avoiding physical activity, qualitative research investigating adolescent girls' experiences in physical education classes (Olafson, 2002), and in swimming pools (James, 2000) showed that dissatisfaction with how they felt about their bodies was identified as a major barrier to engaging in physical activity and consequently affected the frequency and the quality of their participation. Likewise, cross-sectional studies suggest that lower levels of body satisfaction are associated with lower levels of physical activity (Douthitt, 1994; Neumark-Sztainer et al., 2004; Zakarian, Hovell, Hofstetter, Sallis, & Keating, 1994). Similarly, a five year longitudinal study with adolescents showed that lower levels of body image satisfaction are predictive of lower levels of physical activity among both male and female adolescents, after controlling for baseline level of physical activity and demographic variables (Neumark-Sztainer, Paxton, Hannan, Haines, & Story, 2006). Likewise, Jensen and colleagues (2009) showed that preadolescent girls who reported high levels of weight criticism during physical activity and high levels of body dissatisfaction participated in fewer physical activities than girls with lower levels.

Body image can also impact the type of physical activity adolescents feel comfortable participating in and the level of enjoyment. Individuals who are self-conscious and anxious about their appearance tend to prefer to exercise alone and have lower levels of enjoyment. For example, Tiggermann and colleagues (Tiggemann, Gardiner, & Slater, 2000) used focus groups to explore participation in sports and they found that girls raised the issue of not being 'cool' or feminine for them to play sport. Considering the well-known benefits of an active lifestyle and from an obesity prevention point of view it is certainly important to identify the impact of body dissatisfaction on physical activity.

In line with the second scenario, where individuals may engage in excessive amounts of physical activity with the intention of modifying their body image, the concept of "fitspiration" has recently been introduced in the literature (Boepple & Thompson, 2016; Tiggermann & Zaccardo, 2018). It refers to the combined internalization of the thin and muscular ideals. In other words, individuals, currently, may be striving to reach a thin body but also a toned one. This amalgamated female body type is becoming known as the 'fit' ideal and refers to a body ideal that is very lean, highly toned, and apparently, highly desirable. In support of this view, longitudinal research of magazine content, has found an emphasis on appearance-related reasons for exercise and that promoting dieting as a means of achieving thinness is now less common than the promotion of diet in conjunction with exercise, as a means of losing weight and improving 'tone' (Luff & Gray, 2009; Willis & Knobloch-Westerwick, 2013).

Therefore, it could be argued that because the fit ideal is comprised of both the thin and muscular aesthetics, women who internalize this ideal would be even more likely to engage in compulsive exercise. Indeed, there is some evidence to suggest that compared to their peers, women who desire thinness and muscularity concurrently are more likely to exercise compulsively (Kelley, Neufeld, & Musher-Eizenman, 2010) and to use supplements and steroids for weight loss and/or muscle development (Field et al., 2005).

Recent studies analyzing the content of fitspiration messages in the media have suggested that components of these images, such as the focus on appearance, the presence of objectifying features, the emphasis on appearance-related reasons for exercise, and on weight management behaviors, are likely to have negative effects for body image (Boepple & Thompson, 2016; Carrotte, Prichard, & Lim, 2017; Simpson & Mazzeo, 2016).

Going back to the beginning of the chapter and the concept of EWRP, from the literature reviewed it easy to observe how both dimensions noted in the model proposed by Neumark-Stzanier (2005), body image and physical activity can move along a continuum, and also they interact in different kinds of combinations from obesity to eating disorders, from excessive to

lack of physical activity, from improvement to utter dissatisfaction with one´s own body image.

2.7 Summary of Chapter 2

The overarching theme of the present thesis lies within physical activity and EWRP. Chapter 2 started by defining a rather novel approach that proposes the treatment of problems associated to eating and weight as a continuum, ranging from ED in one extreme, to overweight and obesity in the other extreme. Within these endpoints, the EWRP approach considers an array of unhealthy behaviors such as physical activity and body dissatisfaction, among others. Within the EWRP, physical activity is one health behavior that can go from one end (excessive physical activity levels; linked to eating disorders) till the other end (low levels or lack of physical activity; linked to overweight/obesity). Chapter 2, then provides examples in the literature on the relationship between physical activity and ED and overweight/obesity.

Body Image is another concept within the EWRP, going from acceptation to dissatisfaction, the latter linked to ED and overweight/obesity. Chapter 2, briefly defines the concept of body dissatisfaction, the development of body dissatisfaction and the role of the mass media in its development as well as a brief description of ways to measure body dissatisfaction. After this, Chapter 2 provides research examples of the relationship between body dissatisfaction, physical activity, ED and overweight/obesity.

CHAPTER 3: OBJECTIVES AND DESIGN

3.1 Study 1 & 2 objectives and hypothesis

Objectives Study 1

Past research indicates that there are marked declines in physical activity during adolescence. Recent studies are offering new insights into this view. Study 1 aimed to:

- Set a picture of physical activity prevalence in a sample of Spanish adolescents
- To longitudinally investigate changes (increments/decrements) in total physical activity
- To longitudinally investigate changes (increments/decrements) in intensities of physical activity (moderate-to-vigorous vs. light)
- To further investigate these associations, discriminating by gender and weight status.

Hypothesis Study 1

- During early adolescence we will observe minimal to no-significant decrements in total physical activity
- Discriminating by gender we expect to observe increments in MVPA in boys, but not in girls; we expect to observe increments in light physical activity in both genders.
- Discriminating by weight-status we expect to observe decrements to no-changes in physical activity for underweight adolescents; increments or no-changes in normal-weight adolescents and decrements or no-changes in overweight-obese adolescent

Objectives Study 2

There is a wealth of evidence showing that regular engagement in physical activity is beneficial for improving body satisfaction. However, evidence on whether high levels of body dissatisfaction may be a barrier to engage in MVPA or not, is mixed. Study 2 aimed to:

- To investigate the relationship between physical activity and body dissatisfaction in a large sample of Spanish adolescents.
- To add to the existing literature on the impact of TV and magazines on body dissatisfaction, by investigating the association of computer time exposure and body dissatisfaction.

Hypothesis Study 2

- Medium to high levels of body dissatisfaction will be associated to low levels of physical activity
- High screen-time levels will be associated to high levels of body dissatisfaction

3.2 Study 1 & 2 Design

Data for Studies 1 and 2 were drawn from the MABIC project, a study on the prevention of EWRP conducted in the Barcelona area, Spain. This was a multi-center non-randomized controlled trial with an intervention and a control group. The intervention group was assessed at baseline, post-intervention and one-year later, The control group, was assessed at baseline, post-intervention, and one, two and four years later (Sanchez-Carracedo et al., 2016).

Study 1, is a longitudinal study. The sample was constituted by students that after baseline assessemnts where in the control group and were further followed-up at one and two- years later.

Study 2, is a a cross-sectional study. The sample was constituted by students that provided baseline assessments before being assigned to the intervention or control group.

CHAPTER 4: METHODS

4.1 Participants

For both studies, participants were comprised by students attending 11 secondary schools (10 public with a total of 35 classes, and one grant-aided with a total of two classes), from the area of Badia de Valles, Cerdanyola del Valles, Ripollet and Rubi.

For study 1, a cohort of participants in the control group of the MABIC project [Time1, May 2011, n=846] who at baseline were *M*=13.9, *SD*= 0.58 years old, was followed- up a year [Time 2, March 2012, n=703, *M*=14.9, *SD*=0.51] and two years later [Time 3, March 2013, n=523, *M*=16, *SD*=0.48]. This was the sample employed in Study 1.

For Study 2, the sample was compromised by 1,501 adolescents from the MABIC project Mean participant age was 14.2 years (SD= 1.1; range 13-17 years); and participants were roughly equally distributed across genders (47.6% girls) and grades. The self-reported origin of participants was as follows: 71.7% Spanish, 12.8% Latin-American, 2.2% from other European countries, 5.6% African and 8.0% of mixed or unknown origin. Socioeconomic status (SES), according to parents' educational level and occupational status (Hollingshead, 1975), was predominantly middle-class (medium low=38.5%; medium=26.5%; medium-high= 16.3%). This sample became the study sample for Study2.

Both studies were conducted according to the Declaration of Helsinki and all procedures were approved by the Animal & Human Experimentation Ethics Committee of the Universitat Autònoma de Barcelona and the Clinical Research Ethics Committee of the Corporació Sanitari Parc Taulí. Parental consent and participant assent were obtained. The confidentiality of participating adolescents was protected with coded data, and the data processing was anonymous.

4.2 Measures and Procedures

Data collection in both studies was conducted in the same way. Participants completed a paper and pencil booklet with a battery of validated questionnaires that included measures on body image, physical activity, screen-time exposure, and demographic and sociocultural variables identified in the literature to affect physical activity, body dissatisfaction and screen-time. Factors that have been shown to predict declines in physical activity are being female, increasing age during adolescence, being of low SES and from non-Caucasian ethnicity (Bauman et al., 2009). Factors associated with higher body dissatisfaction are being female, having a higher BMI, having a high internalization of the beauty ideal and being susceptible to sociocultural pressures (Smolak, 2009; Thompson & Stice, 2001; Williams & Ricciardelli, 2014). Factors that have been found to correlate with increased levels of screen-time exposure in adolescence are less conclusive, but gender, SES and BMI are generally controlled for in the literature (Dumith et al., 2011).

The booklet was completed individually during regular class time, whilst height and weight were taken by trained researchers following a standardized procedure, in a private room near the area of booklet administration (Sánchez-Carracedo et al., 2013). Completion of the questionnaires coupled with anthropometric assessments lasted approximately 60 minutes.

Below, a description of the instruments used in Study1 (variables a, b, c) and Study 2 (variables a, b, c, d, e and f).

a) **Physical activity** was assessed with a version of the Leisure Time Exercise Questionnaire adapted by Neumark-Sztainer and colleagues (2004), and similar to surveys used in national surveillance systems. For each participant, the average weekly time spent performing a light (little effort), moderate (not exhausting) and vigorous (heart beats rapidly) physical activity was assessed. Each type of activity was exemplified with a list of activities to aid comprehension. Responses were on a scale ranging from "0 hours to 7 or more hours", and later recoded for analyses following Graham and colleagues (Graham, Wall, Larson, & Neumark-Sztainer, 2014), and employed in several publications (Neumark-Sztainer et al., 2007; Neumark-Sztainer et al., 2004, 2006). For each subject the '*Total Physical Activity" (TPA)* was generated as

an aggregate of the three individual measures. In addition, a *MVPA* score was generated as the sum of moderate and vigorous items, and a "*Light Physical activity" (LPA)* score considering simply that response. The MVPA score was created in line with the public health recommendation for adolescents that suggests attaining at least 60 minutes per day of moderate-to-vigorous physical activity (Centers for Disease Control and Prevention, 2015). In addition, for Study 1, a dichotomic variable to calculate the percentage of adolescents meeting the CDC recommendation for adolescents was created. Those reporting at least 7 hours per week of MVPA were classified as meeting the CDC recommendation.

b) Socio-demographic variables. Adolescents provided information regarding age, parental origin, parental education and employment. An index of socio-economic status was derived following Hollingshead formulae (Hollingshead, 1975), which combines parental education and employment. Regarding their parental origin, due to small numbers in certain origins, responses were categorized in Spanish/European background vs other.

c) Body Mass Index (BMI). Researchers measured participant's body weight in light clothing and no shoes to the nearest 0.1 kg using digital scales (SECA- model 872; 0-200 kg; accuracy range .1 kg; precision ± 0.15%), and height to the nearest 0.1 cm with a wall-mounted stadiometer (Seca-model 214; 20-207cm; accuracy range of 0.1 cm). Weight values were later corrected by subtracting 0.9 kg from the boys and 0.7 kg from the girls, which are average values estimated after weighing several sets of clothes similar to those worn at the time of assessment. BMI z-scores accounting for age and gender were calculated with the WHO growth reference data for 5-19 years old (De Onis, Onyango, Borghi, Siyam, & Siekmann, 2007), and later on classified into underweight, normal weight, overweight or obese following the WHO criteria. For analyses, we collapsed the overweight and obese categories.

d) Body image dissatisfaction was assessed with the Body Dissatisfaction subscale of the Eating Disorders Inventory-3 (EDI-3) (Garner, 2004), in its Spanish validated

version (Elosua et al., 2010). This is a ten-item scale that measures satisfaction with different parts of the body with response options on a six-point Likert scale from "0= Never" to "5= Always". Higher scores on the scale indicate greater dissatisfaction with one's body. The EDI-3 is well validated in female populations and its validity in male populations has also been reported in a sample of adolescents' boys (Spillane, Boerner, Anderson, & Smith, 2004). In the present study, the internal consistency of the EDI-body dissatisfaction subscale was found to be acceptable for both genders (Cronbach's alpha=0.85 for girls and 0.81 for boys).

e) **Screen-time exposure.** It was assessed with six questions from the EAT Project Inventory (Neumark-Sztainer et al., 2012) and similar to questions employed in national surveillance surveys. The questions asked participants to report the number of hours on a typical school-day (Monday- Friday) that they watch TV; use a computer for doing homework (computer-homework), and use a computer for leisure (computer-leisure). Participants were also asked to report the number of hours spent on these three activities (i.e., TV, computer-homework, computer-leisure) on a typical day of the weekend (Saturday –Sunday). Response options were on a 7-point scale ranging from "0, 0.5, 1, 2, 3, 4 to "5 hours or more". To facilitate interpretation of results, for the analyses, we re-coded responses to correspond to hours. The response "5 hours or more" was coded simply as 5 hours (Dianne Neumark-Sztainer et al., 2004).

f) **Sociocultural pressures and internalization of the beauty ideal.** They were assessed with the Sociocultural Attitudes Towards Appearance Questionnaire-3 (SATAQ-3) (Thompson, Van Den Berg, Roehrig, Guarda, & Heinberg, 2004), in its Spanish validated version (Sánchez-Carracedo, Barrada, et al., 2012). It consists of four subscales: "Internalization-General" to evaluate the internalization of the general beauty ideal transmitted by TV and magazines; "Internalization-Athlete" that assesses the internalization of athletic models; "Information" which assesses the belief that the mass media is an important source of information about appearance, and "Pressures" which assesses feelings of pressure from media messages to modify one's appearance. Participants respond on a 5- point Likert scale from "completely disagree" to

"completely agree". In the current study the reliability estimates for the four subscales were 0.93, 0.83, 0.91 and 0.93, respectively.

4.3 Data analyses

Data analyses for study 1 were performed with SPSS 21.0 (IBM Corp, 2012) and STATA 13 (StataCorp.2013, 2013). Initially exploratory analyses were performed to clean the data, analyze distributions, and recodification of new variables. Being a longitudinal study, the data matrix was restructured "from long to short", or "from multiples variables for one case to a group of related variables for the same case". With the new data restructure, linear regressions with random intercepts and accounting for clustering by school were regressed on physical activity, to investigate changes over time and by weight status, adjusting for control variables (age, gender, SES).

Data analyses for study 2 were performed with SPSS 21.0 (IBM Corp, 2012) and STATA 13 (StataCorp.2013, 2013) First the distribution of primary and secondary variables was performed to evaluate if a transformation or use of non-parametric test was recommended. Multiple-hierarchical regressions adjusting for socio-demographic variables (age, gender, origin, socio-economic status) standardized BMI and SATAQ-3 variables to investigate the relative contribution of physical activity on body dissatisfaction. In addition, to account for clustering of participants at school level, regressions were ran with random intercepts.

CHAPTER 5: RESULTS

5.1 Study1_ Longitudinal study of physical activity in Spanish young adolescents: weight status and gender differences

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Abstract

Purpose: Past research indicates there are marked declines in physical activity during adolescence. Recent studies are offering new insights into this view. The aim of this study is to longitudinally investigate changes in intensities of physical activity (moderate-to-vigorous vs. light), in a sample of Spanish early-adolescents. And to further investigate these associations, discriminating by gender and weight status.

Methods: Students on average 13.9 years-old (N=846), were followed- up a year and two years later. Self-reported physical activity was recorded. Mixed model effects accounting for control variables and adjusting for cluster at school level were conducted.

Results: Overall physical activity prevalence is low, although, overtime, we observed slight increments. Girls showed higher increments in moderate-to-vigorous physical activity (MVPA), whilst boys showed higher increments in light physical activity (LPA). Investigating by weight-status, normal weight boys showed increments over time in LPA; no changes observed for normal-weight girls. Overweight/obese girls increased their total physical activity (TPA) and MVPA; overweight/obese boys increased their LPA. Underweight boys and girls decreased their TPA.

Conclusion: Although slight increments overtime were observed, physical activity prevalence is still low. Interventions targeting specific intensities of physical activity may be beneficial for different groups based on their gender and weight status.

Keywords: adolescents, weight-status, longitudinal, physical activity intensity

Introduction

Evidence suggests that modifiable lifestyle factors such as physical activity play a key role in the development of chronic diseases. Being physically active is associated with a lower risk of developing serious illnesses such as cardiovascular disease, some cancers, diabetes mellitus as well as a crucial aspect in maintaining a healthy weight status and improved psychological wellbeing (Booth, Roberts, & Laye, 2014). The Centers for Disease Control and Preventions (CDC), recommends that children and adolescents should do at least 60 minutes per day of physical activity (Centers for Disease Control and Prevention, 2015). Worldwide estimates indicate that almost 80% of youths do not achieve this public health recommendation (Hallal, Andersen, Bull, Guthold, & Haskell, 2012).

There is a widespread and strong belief that there is a marked decline in moderate-to-vigorous physical activity (MVPA) during adolescence. This view is supported mostly by cross-sectional, self-reported studies, by and large from US samples, and by studies that did not include samples which crossed over the transition between childhood and adolescence (Dumith, Gigante, Domingues, & Kohl III, 2011; Sallis, 2000). In fact, new evidence from longitudinal studies using accelerometers, an objective measure of physical activity, is challenging this widespread view showing non-significant or negligible changes in MVPA (Collings et al., 2013; Cooper et al., 2015; Harding, Page, Falconer, & Cooper, 2015; Mitchell et al., 2012). Likewise, data from the International Children's Accelerometry Database (which standardizes and pools accelerometer data on MVPA from over 20,000 individuals in different countries) has supported the view that the decline in physical activity begins around the time of school entry in both sexes, with no evident declines in MVPA during adolescence (Cooper et al., 2015; Reilly, 2016). In sum, there is no conclusive evidence that there are marked declines in physical activity during adolescence.

Over the last years there has been many works carried out aimed at documenting the prevalence of physical activity in the Spanish population. Nearly 70% of a representative

sample of 13-16 years-old from the region of Madrid met the 60 minutes per day recommendation, (Martínez-Gómez, Welk, Calle, Marcos, & Veiga, 2009). In a representative study of over 1500 adults from Catalonia, found that 77% engaged in health enhancing physical activity (Pardo et al., 2014). However, analyzing data at the national level, the Spanish National Health Survey (Ministerio de Sanidad, 2014) revealed that only 45.28% of over 15 years old performed weekly MVPA. More recently, in a nationally representative sample of the Spanish population it was found that only 38% of all adolescents surveyed achieved the 60-minute physical activity recommendation (Mielgo-Ayuso et al., 2016). Thus, from the available literature it seems that certain areas of Spain are closer to meet the physical activity recommendation, but in nationally representative samples, the percentage drops substantially. Nonetheless, studies carried out in the Spanish population have similar limitations to those conducted in the USA: most of them are cross- sectional, carried on with adults, and importantly, they mostly focus on prevalence. Likewise, there are few studies looking at changes in intensity of physical activity throughout the lifespan (Caspersen, Pereira, & Curran, 2000). Therefore, our first aim was to explore if there were changes (declines/increments) in physical activity levels during early adolescence in a Spanish sample.

In addition, it is often reported that males have higher levels of physical activity than females (Azevedo et al., 2007; Owen, Nightingale, Rudnicka, & Cook, 2009; Rangul et al., 2011). However, there is less research on changes in intensity levels by gender. Furthermore, overweight/obese youth have frequently been reported to be less active than their normal weight counterparts (Cooper et al., 2015; Martínez-Gómez et al., 2009; Raudsepp & Viira, 2008) and to our knowledge there are not studies looking at changes over time in physical activity levels in adolescents with overweight. Hence, our second aim is to investigate whether there would be changes (increments/decrements) in physical activity intensity levels by gender and weight status.

Participants and Procedures

Data for the present study was drawn from baseline assessments of the MABIC project, a school-based intervention study on the prevention of eating and weight- related problems

conducted in the Barcelona area, Spain (Sanchez-Carracedo et al., 2016). A cohort of participants in the control group who at baseline [Time1 (T1), May 2011, n=846] were *M*=13. 9, *SD*= 0.58 years old, were followed- up a year [Time 2 (T2), March 2012, n=703, *M*=14.9, *SD*=.51] and two years later [Time 3 (T3), March 2013, n=523, *M*=16, *SD*=.48]. Table1 presents sample characteristics at baseline.

Of the original study population, most participants were lost primarily due to absenteeism on the assessment day or change from school (T2= 141; T3=194); no consent (T2=0; T3=21), or to unwillingness to participate/medical condition/lack of understanding (T2=2; T3=108). The final study population who provided complete data at the three-time points, consisted of 474 students, representing a 55.9% of the initial sample. There were no significant differences between those who remained in the study and those who dropped out in baseline total physical activity (TPA) levels (T1-T2: p=.39; T1-T2-T3: p=.18). The study was conducted according to the Declaration of Helsinki and all procedures were approved by the Animal & Human Experimentation Ethics Committee of the Universität Autónoma de Barcelona and the Clinical Research Ethics Committee of the Parc Taulí Medical Center. Parental consent and participant assent were obtained. The confidentiality of participating adolescents was protected with coded data, and the data processing was anonymous.

Participants completed a paper and pencil booklet with a battery of validated questionnaires that included among others, measures on physical activity and sociodemographic variables (age, gender, parental education and employment, parental origin). The booklet was completed individually during regular class time, whilst height and weight were taken by trained researchers following a standardized procedure, in a private room near the area of booklet administration (Sánchez-Carracedo et al., 2013).

[Insert Table 1 around here]

Measures

Physical activity was assessed with a version of the Leisure Time Exercise Questionnaire adapted by Neumark-Sztainer et al., (Neumark-Sztainer, Goeden, Story, & Wall, 2004). For each participant, the average weekly time spent performing a light (little effort), moderate (not

exhausting) and vigorous (heart beats rapidly) physical activity was recorded. Each type of activity was exemplified with a list of activities to aid comprehension. Responses were on a scale ranging from "0 hours to 7 or more hours", and later recoded for analyses following Neumark-Sztainer et al's (Neumark-Sztainer et al., 2004). For each subject the '*Total Physical Activity" (TPA)* was generated as an aggregate of the three individual measures. In addition, a *MVPA* score was generated as the sum of moderate and vigorous items, and a "*Light Physical activity" (LPA)* score considering simply that response. In addition, we computed a dichotomic variable to calculate the percentage of adolescents meeting the CDC recommendation for adolescents. Those reporting at least 7 hours per week of MVPA were classified as meeting the CDC recommendation.

Socio-demographic variables. Adolescents provided information regarding age, parental origin, parental education and employment. An index of socio-economic status was derived following Hollingshead formulae (1975), which combines parental education and employment. Regarding their parental origin, due to small numbers in certain origins, responses were categorized in Spanish/European background vs other.

Body Mass Index (BMI). Researchers measured participant's body weight in light clothing and no shoes to the nearest 0.1 kg using digital scales (SECA- model 872; 0-200 kg; accuracy range .1 kg; precision ± 0.15%), and height to the nearest 0.1 cm with a wall-mounted stadiometer (Seca-model 214; 20-207cm; accuracy range of 0.1 cm). Weight values were later corrected by subtracting 0.9 kg from the boys and 0.7 kg from the girls, which are average values estimated after weighing several sets of clothes similar to those worn at the time of assessment. BMI z-scores accounting for age and gender were calculated with the WHO growth reference data for 5-19 years old (De Onis, Onyango, Borghi, Siyam, & Siekmann, 2007), and later on classified into underweight, normal weight, overweight or obese following the WHO criteria. For analyses, we collapsed the overweight and obese categories.

Statistical analyses

Changes in physical activity levels in adolescence may differ by gender, age, weight, and it has been suggested that youth form lower SES and minorities have fewer opportunities to engage in physical activity (Gonzalo-Almorox & Urbanos-Garrido, 2016; Owen et al., 2009). Analyses controlled for these factors as they may play a role in explaining different patterns in physical activity. All analyses were performed with STATA13 (StataCorp.2013, 2013) with alpha set at ≤0.05. Quantitative variables were expressed as means and standard deviations, and categorical variables as frequencies (percentages); we used chi-square and t-test statistics to determine statistical differences by gender. Multiple comparisons between weight status groups were conducted to check for statically significant differences in levels of physical activity. We ran linear mixed-models effects (LME) accounting for the clustering of participants within schools. To test for changes over time in physical activity levels, controlling for covariates, we ran a model with TPA score, and then repeated them separating MVPA from LPA as we wanted to investigate potential differences in changes across time in intensities of physical activity. We further explored differences in changes over time in physical activity (TPA, MVPA and LPA) across weight status categories. When testing changes over time, the reference category for the variable of interest was always T1. We stratified all analyses a priori, and present gender specific estimates for all analyses given the differences between boys and girls reported in the literature on physical activity levels.

Results

Mean number of TPA, MVPA, LPA hours per week and percentage of adolescents meeting the CDC recommendation at baseline and at the two follow-ups are depicted on Table 2. At all time-points, boys engaged in significantly greater amounts of MVPA compared to girls (all p <0.001), and a higher proportion of males met the 60-minute MVPA recommendation (T1: $X^2_{(845)}=16.95, p<0.001$, T2: $X^2_{(702)}=25.11, p<0.001$;T3: $X^2_{(522)}=16.69, p<0.001$). Furthermore, TPA at T1 was associated with TPA at T2 (boys: r= 0.39, girls: r=0.58, both p <0.001) and at T3 (boys: r=0.35, girls: r=0.43, both p <0.001) in both genders. Across all time points, boys engaged in significantly greater amounts of MVPA and intense physical activity than girls (all

p <0.001), but there were non-significant differences between genders for the other intensity levels (see Table1). Exploring differences by weight, we observed in boys, statistically significant differences in TPA ($F_{(5, 254)}$=3.85, p<0.05) and MVPA ($F_{(5, 254)}$=5.68, p<0.05) at T3, with normal weight boys being significantly more active than boys in the overweight/obese category. For girls, we observed a significant difference in TPA at T3 ($F_{(5,257)}$=4.79, p<0.05) with normal weight girls being more active than underweight girls.

[Insert Table 2 around here]

First objective: Comparison of changes overtime in TPA, MVPA and LPA

Mean number of hours and changes over time in TPA, MVPA and LPA levels and controlling for age, origin, weight status and SES at baseline are illustrated in Table 3. For boys, in terms of TPA, we found statistically non-significant changes over time. Separating MVPA from LPA, we observed statistically non- significant changes in MVPA across time, but a significant increase in LPA from T1 to T2 and T3. There were no statistically significant effects of SES, origin, weight status or age for boys in any of the three models ran (i.e., TPA, MVPA, LPA). For girls, in terms of TPA levels, we observed a significant increase from T1 to T2. Discriminating between MVPA and LPA, we observed only a statistically significant increase from T1 to T2 in MVPA. There were no statistically significant effects of SES, origin, or age for girls in any of the three models ran (i.e., TPA, MVPA, LPA).

[Insert Table 3 around here]

Second objective

Exploring changes in intensity of physical activity over time by weight status and gender are illustrated in Table 4. We observed that, for normal weight boys and girls no changes over

time in TPA were observed in this weight status category in any gender group. Looking at the intensity level, though, we observed a gradual and statistically significant increase in LPA from T1 to T2 & T3 for normal weight boys, but no statistically significant changes were observed in normal-weight girls. Within the underweight category, we observed statistically significant decrements in TPA for boys and girls. Considering the intensity levels, we observed only in girls, a significant drop in MVPA from T1 to T2 & T3 and a gentler decrease in LPA from T1 to T3. Within the overweight/obese category, we observed in boys, statistically significant increases in LPA from T1-T2 & T3. For overweight/obese girls we observed significant increases in TPA and MVPA fromT1-T2 and T3.

[Insert Table 4 around here]

Discussion

Worldwide levels of MVPA among adolescents are typically much lower than recommended: as few as 20% of 13-15 years old globally appear to meet the MVPA recommendation (Hallal et al., 2012). At baseline, in our sample, we found similar percentages with only 22 % meeting the MVPA recommendation. This figure is similar to the latest Health Behavior in School-aged Children (HBSC) study showing for Spain, that only 24.4% of adolescents reach the recommended physical activity levels for health (according to the WHO recommendations) (World Health Organization, 2016). In line with worldwide estimates, we also found in our sample that the percentage of boys regularly engaging in physical activity is significantly higher that the percentage of girls. Interestingly, following our sample, we found that two years later, the percentage meeting the recommendation increased substantially to 29.4%. Although a significant increase, the prevalence of physical activity uptake in our sample and especially for girls is quite low and it highlights the need of interventions aimed at promoting physical activity for healthy benefits.

There is a common belief that there is a marked decline in MVPA during adolescence. One of the main goals of this study was to investigate whether we observed drops in physical activity levels in a sample of non-Anglo-Saxon adolescents. In line with recent studies challenging the

view of a marked decline in physical activity during adolescence, we found overall, no statistically significant drops from 13 to 15 years old. Even more, we found increments in LPA for boys, and in MVPA and TPA for girls from 13-15 years old. These results are in line with those reported for a sample of Finnish students for whom leisure physical activity slightly increased on average between 9 and 17 years-old, and was stable from 13 to 17 years-old (Pahkala et al., 2013). Likewise, a recent longitudinal study with measurements at 7, 9,12 and 15 years of age, found that for boys and girls, there were no initial high levels of total of physical activity followed by sharp drops during adolescence. In fact, drops were steadily from age 7, but between 12 and 15 years of age (which would be comparable to our sample), MVPA levels remained stable in both gender groups (Farooq et al., 2017). In sum, our study does not support the view that there is a marked decline during adolescence in physical activity in fact in our sample we observed increments.

There are several potential explanations for our findings. First, it has been argued that declines in physical activity may take place already between ages 7 and 9 years (Basterfield et al., 2011). Data on Spanish young people has indicated that the age at which physical activity begins to plateau or decrease may be around 11 years of age (Lasheras, Aznar, Merino, & EG, 2001). In this study, we take on board 13 years old adolescents, that have relatively low physical activity levels, and therefore there may be a floor effect (Reilly, 2016). Besides, there are also social and environmental explanations for these differences. For example, active travel to school or to non-school places can be substantial contributors to overall physical activity (Southward, Page, Wheeler, & Cooper, 2012). According to a report from the European Commission, the Spanish population tends to exercise on the way to-and-from work/school/shops (TNS Opinion & Social, 2010). This contrasts with other samples from Anglo-Saxon cultures, where travelling is most often done with cars. In our sample we may not be observing drops, thanks to minutes of physical activity accumulated in this unstructured way. Another explanation is the weather conditions may contribute to more active lifestyle, for instance, it has been shown that physical activity levels tend to decrease during winter and when adverse weather conditions occur (e.g., snowfall) (Bélanger, Gray-Donald, O'Loughlin, Paradis, & Hanley, 2009). In Catalonia there is a gentle weather throughout the year that could work as motivator and not as barrier for outdoor activities.

Another goal of the study was to explore changes in physical activity intensities by gender and weight status. Results from our study confirm previous and consistent findings in the literature reporting differences in physical activity levels by gender. Overall, we found that boys are more active than girls, and in line with previous studies, we found that boys engaged in significant greater amounts of MVPA. (Martínez-Gómez et al., 2009; Nader, Bradley, Houts, Mcritchie, & Brien, 2008) interestingly, when we explored changes in intensity of physical activity from 13 to 15 years of age, in our sample, we observed that girls, on average, increased their levels of MVPA whereas boys increased their levels of LPA. We could hypothesize that this may be an effect of ceiling effects, whereas we observe changes were there is room to be observed. Literature is scarce and it highlights the need for future research on this topic given the importance of the intensity and not only the amount of physical activity.

Overweight/obese youth have frequently been reported to be less active than normal weight adolescents (Raudsepp & Viira, 2008). In our sample there was no conclusive evidence that overweight/obese adolescents were less active than their normal weight counterparts. Nevertheless, we wondered if throughout adolescence there would be changes in the frequency and intensity of physical activity. We observed in overweight/obese boys, increments in LPA whereas in overweight/obese girls, we observed increments in MVPA and TPA. We did not ask participants for their reasons for engaging in physical activity, therefore we can only hypothesize that a degree of body dissatisfaction, which is quite common in adolescence, may be a reason to increase their physical activity to lose weight/ shape-up their body (M. P. McCabe, Ricciardelli, & Banfield, 2001; M. McCabe & Ricciardelli, 2003). Nonetheless, it is important to highlight that for this age group, body dissatisfaction it is not an efficient motivator to lose weight nor to increase physical activity (Añez et al., 2016). Another explanation for our finding may reflect adherence to medical recommendations among other reasons. To our knowledge studies researching these issues are scarce and more research certainly is needed.

This study has strengths and limitations. The use of accelerometers for objectively assessing physical activity would have been preferred, but it was not feasible in our sample. Nonetheless, the questions used in the present study to assess duration and intensity have been shown to be reliable in the adult population (Jacobs, Ainsworth, Hartman, & Leon, 1993). Social desirability and self-report bias, whereby participants possibly over/underreported their amount of physical activity it is a potential limitation. Nonetheless, to limit social desirability researchers explained participants that there was no right or wrong answers. As with many longitudinal studies, we lost participants during follow-ups. We compared physical activity levels at baseline between those who provided data at all three times, against those who did not, and we found no statistical significant differences. Although, a longitudinal study which crossed over childhood and adolescence would have been preferable, it is worth highlighting that this it is one of the few studies from a non-Anglo-Saxon culture and that includes more than the standard two-time points common in the literature to date. There are further strengths to the study. Cluster by school was considered; weight status was determined from objective measure; we surveyed a large Spanish sample, it is one of the first studies investigating changes in intensity of physical activity through early adolescence, and in addition, that it has looked at these issues by weight status.

In conclusion, the present study investigated in a less researched sample of non-Anglo- Saxon adolescents two main areas. On one hand, it aimed to investigate the well-established idea that there are marked declines in physical activity during this period of life. Interestingly and in line with more recent studies, it was found that during early adolescence there are no big drops, but that it remains rather constant and even it can increase slightly. Nonetheless, the findings of this study along with others, highlight that only a very small percentage of young adolescents meet the CDC physical activity recommendation and that interventions to increase participation are needed. The second area of research of this study focused in a less researched question: if there are changes in the amount of physical activity during early adolescence, are these different across different intensities? It was very interesting to find that when we analyzed total physical activity no changes were observed in boys but when we discriminated between two levels of intensity, MVPA vs LPA, there were significant increments in LPA.

Likewise, for girls, we observed increments in TPA, but when discriminating it was MVPA the type of physical activity driving the increment. This information is valuable for future interventions: understanding which kind of intensities need to be targeted more heavily and/or which ones may be easier to invite adolescents to practice. Finally, the study provided a rather novel approach to the study of the relationship between physical activity and weight status, by also analyzing if there were changes across time in young adolescence, and whether there would be differences in the type of physical activity. Certainly, more studies in this area are warranted to further shed light on these differences.

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Table 1 Sample characteristics at baseline by gender group

		Boys (N=433)	Girls (N= 413)	*p*
Age M (SD)		13.99 (0.6)	13.87 (0.5)	**0.04**
Origin n (%)				
	Spanish/European	317 (74.1)	280 (67.8)	**0.05**
	Other Ethnicity	111 (25.9)	133 (32.2)	
SES n (%)				0.57
	Low	41 (9.6)	51 (12.4)	
	Medium-low	165 (38.6)	152 (37.0)	
	Medium-low	107 (25.0)	111 (27.0)	
	Medium-high	72 (16.8)	62 (15.1)	
	High	43 (10.0)	35 (8.5)	
Weight Status n (%)				**0.01**
	Underweight	19 (4.4)	5 (1.2)	
	Normal weight	274 (63.7)	284 (68.8)	
	Overweight/Obese	137 (31.9)	124 (30.0)	
TPA M (SD)		8.28 (5.0)	6.85 (4.6)	0.14
MVPA M (SD)		5.71 (3.7)	4.14 (3.3)	**0.01**
LPA M (SD)		2.56 (2.6)	2.71 (2.4)	0.09

Note: SES= Socio-economic status; MVPA=moderate-vigorous physical activity; LPA= light physical activity

p-values in bold indicate significant gender differences

Table 2 Mean (SD) number of MVPA hours per week and proportion of adolescents meeting the CDC physical activity recommendation at three-time points

	Males			Females			TOTAL	
	N	Mean hours	% meet CDC recommendation	N	Mean	% meet CDC recommendation	Mean hours	% meet CDC recommendation
T1 MVPA	427	5.71 (3.7)	28.1	406	4.14 (3.2)†	16.3‡	4.95 (3.6)	22.2
T2 MVPA	364	6.39 (3.5)	37.4	337	4.91 (3.3)†	20.2‡	5.68 (3.5)	28.8
T3 MVPA	261	6.73 (3.8)	37.5	259	4.84 (3.3)†	21.2‡	5.79 (3.7)	29.4

†Gender difference in mean number of MVPA hours per week is significant at $p<0.001$

‡Gender difference in the proportion meeting the CDC MVPA recommendation is significant at $p<0.001$

Table 3 Changes in TPA, MVPA and LPA across time by gender group

	MALES							FEMALES						
	M (SD)	B	SE B	z	*p*	CI		M (SD)	B	SE B	z	*p*	CI	
							TPA							
T1	8.28 (5.0)	-	-	-	**-**	-	-	6.85 (3.3)	-	-	-	**-**	-	-
T2	9.73 (4.9)	1.57	1.04	1.51	0.13	-0.47	3.61	8.64 (3.3)	1.46	0.57	2.57	**0.01**	0.35	2.58
T3	10.12 (5.2)	2.26	1.76	1.28	0.20	-1.19	5.71	8.38 (3.4)	1.03	1.08	0.95	0.34	-1.09	3.15
							MVPA							
T1	5.71 (3.7)	-	-	-	-	-	-	4.14 (4.6)	-	-	-	-	-	-
T2	6.39 (3.5)	0.37	0.71	0.52	0.60	-1.02	1.76	4.91 (4.5)	0.81	0.35	2.34	**0.02**	0.13	1.49
T3	6.73 (3.8)	0.38	1.08	0.35	0.73	-1.73	2.48	4.84 (4.6)	0.76	0.80	0.95	0.34	-0.81	2.33
							LPA							
T1	2.56 (2.6)	-	-	-	-	-	-	2.71 (2.4)	-	-	-	-	-	-
T2	3.36 (2.6)	1.16	0.43	2.67	**0.01**	0.31	2.01	3.72 (2.5)	0.63	0.47	1.35	0.18	-0.29	1.55
T3	3.39 (2.7)	1.79	0.87	2.05	**0.04**	0.08	3.50	3.54 (2.5)	0.22	0.79	0.28	0.78	-1.33	1.76

Note: TPA=total physical activity; MVPA=moderate-vigorous physical activity; LPA=light physical activity. Model adjusted for socioeconomic status. origin. age and weight status. The reference category is Time 1. *p*- values in bold indicate significant gender differences
Mean and SD are unadjusted raw scores

Table 4 Changes overtime in TPA, MVPA, LPA by gender and weight status

		Males																			
		TPA							MVPA							LPA						
		M (SD)	B	SE	z	*p*	CI		M (SD)	B	SE	z	*p*	CI		M (SD)	B	SE	z	*p*	CI	
Underweight	T1	8.82 (5.3)	-	-	-	-	-	-	6.02 (4.2)	-	-	-	-	-	-	2.79 (3.1)	-	-	-	-	-	-
	T2	7.61 (4.5)	9.00	4.51	2.00	**0.05**	0.16	17.83	4.27 (2.4)	3.78	3.07	1.23	0.22	-2.24	9.79	3.33 (2.9)	5.22	3.17	1.65	0.10	-1.00	11.44
	T3	8.77 (7.0)	9.91	7.88	1.26	0.21	-5.52	25.35	6.07 (4.9)	1.84	5.25	0.35	0.73	-8.46	12.13	2.7 (2.6)	8.08	5.73	1.41	0.16	-3.15	19.30
Normalweight	T1	8.34 (5.2)	-	-	-	-	-	-	5.87 (3.8)	-	-	-	-	-	-	2.46 (2.6)	-	-	-	-	-	-
	T2	10.02 (5.1)	1.67	1.15	1.45	0.15	-0.58	3.92	6.69 (3.6)	0.73	0.84	0.87	0.38	-0.92	2.39	3.33 (2.6)	0.94	0.44	2.11	**0.04**	0.07	1.81
	T3	10.77 (5.3)	2.73	1.72	1.59	0.11	-0.63	6.10	7.29 (3.9)	1.16	1.23	0.95	0.34	-1.24	3.57	3.48 (2.7)	1.57	0.81	1.94	**0.05**	-0.02	3.16
Overweight/ Obese	T1	8.10 (4.6)	-	-	-	-	-	-	5.39 (3.4)	-	-	-	-	-	-	2.71 (2.6)	-	-	-	-	-	-
	T2	9.48 (4.5)	1.57	1.59	0.99	0.32	-1.55	4.70	6.07 (3.2)	-0.11	1.48	-0.08	0.94	-3.01	2.79	3.45 (2.6)	1.73	0.26	6.62	**0.001**	1.22	2.24
	T3	9.02 (4.3)	1.23	2.94	0.42	0.68	-4.54	6.99	5.67 (3.2)	-0.94	2.40	-0.39	0.70	-5.64	3.77	3.36 (2.7)	2.24	0.84	2.65	**0.01**	0.58	3.89
		Females																			
		TPA							MVPA							LPA						
		M (SD)	B	SE	z	*p*	CI		M (SD)	B	SE	z	*p*	CI		M (SD)	B	SE	z	*p*	CI	
Underweight	T1	5.2 (4.7)	-	-	-	-	-	-	3.02 (1.9)	-	-	-	-	-	-	2.18 (3.3)	-	-	-	-	-	-
	T2	5.0 (1.6)	-11.09	1.31	-8.44	**0.001**	-13.66	-8.52	3.20 (1.6)	-5.60	2.45	-2.28	**0.02**	-10.41	-0.79	1.80 (1.0)	-5.49	3.52	-1.56	0.12	-12.39	1.40
	T3	3.5 (2.1)	-20.27	2.16	-9.38	**0.001**	-24.51	-16.04	1.45 (0.2)	-12.19	2.83	-4.31	**0.001**	-17.73	-6.65	2.05 (2.2)	-8.08	3.47	-2.33	**0.02**	-14.88	-1.28
Normalweight	T1	6.94 (4.6)	-	-	-	-	-	-	4.28 (3.4)	-	-	-	-	-	-	2.66 (2.4)	-	-	-	-	-	-
	T2	8.93 (4.4)	0.58	0.99	0.59	0.56	-1.37	2.53	5.10 (3.4)	0.07	0.73	0.10	0.92	-1.35	1.49	3.83 (2.4)	0.50	0.48	1.05	0.30	-0.44	1.43
	T3	8.87 (4.6)	-1.05	1.85	-0.57	0.57	-4.67	2.58	5.17 (3.4)	-0.86	1.48	-0.58	0.56	-3.77	2.04	3.70 (2.5)	-0.25	0.91	-0.27	0.79	-2.03	1.54
Overweight/ Obese	T1	6.70 (4.7)	-	-	-	-	-	-	3.86 (3.1)	-	-	-	-	-	-	2.83 (2.5)	-	-	-	-	-	-
	T2	8.06 (4.6)	3.98	0.75	5.28	**0.001**	2.50	5.46	4.52 (3.2)	2.80	0.67	4.16	**0.001**	1.48	4.12	3.52 (2.7)	1.14	0.75	1.52	0.13	-0.33	2.61
	T3	7.56 (4.4)	6.52	1.18	5.53	**0.001**	4.21	8.84	4.30 (3.2)	4.93	0.98	5.02	**0.001**	3.01	6.86	3.26 (2.4)	1.56	1.30	1.20	0.23	-0.98	4.10

TPA= total physical activity; MVPA= moderate-vigorous physical activity; LPA= light physical activity; T2=time 2; T3= time 3.The reference category is Time1.M= Mean number of hours; standard deviations in brackets.Mean and SD are unadjusted raw scores

Significant p-values in bold. Models adjusted for age. ethnicity. SES.

5.2: Study 2_ Body image dissatisfaction, physical activity and screen time in Spanish adolescents

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Abstract

This cross-sectional study contributes to the literature on whether body dissatisfaction is a barrier/ facilitator to engaging in physical activity, and to investigate the impact of mass-media messages via computer-time on body dissatisfaction. High-school students (N=1501), reported their physical activity, computer-time (homework/leisure), and body dissatisfaction. Researchers measured students'weight and height. Analyses revealed that body dissatisfaction was negatively associated with physical activity, on both genders; whereas computer-time was associated only with girls' body dissatisfaction. Specifically, as computer-homework increased, body dissatisfaction decreased; as computer-leisure increased, body dissatisfaction increased. Weight-related interventions should improve body image and physical activity simultaneously, whilst critical consumption of mass-media interventions should include a computer component.

Keywords: sedentary behavior; body image; physical activity; adolescents; social media

Introduction

Eating disorders and unhealthy weight control behaviors are major issues of public health concern (Hudson et al., 2007; WHO, 2005). Worldwide prevalence rates of eating disorders are relatively low (1-5%) (Treasure et al., 2010), but they are associated with severe physical and psychosocial consequences (Herpertz-Dahlmann, 2015). One of the strongest predictors of developing an eating disorder is body image dissatisfaction (Stice, 2002). In a sample of Spanish 12- 17 years old, more than 50% of girls and nearly 50% of boys reported dissatisfaction with their body image (Valverde et al., 2010). Importantly, body image dissatisfaction represents a risk factor for the adoption of unhealthy weight control behaviors that are more common than eating disorders. For instance, it has been shown that adolescents with higher levels of body dissatisfaction engage more frequently in dieting, unhealthy weight control behaviors and binge eating (Neumark-Sztainer et al., 2006). The Homeostatic Theory of Obesity and its Circle of Discontent, a system of feedback loops between body dissatisfaction, negative affect, energy consumption and weight gain, offer an interactive framework to study this issue (Diclemente and Delahanty, 2016; Marks, 2015, 2016; Rosenbaum and White, 2016). According to this novel theory, for most people and on most occassions, the reciprocal relationship between these factors are in equilibrium. However, if any of these factors were to increase (i.e., high levels of dissatisfaction, negative affect, energy consumption or body weight), the reciprocity between them forms a vicious circle; a disturbance from equilibrium maintaining problematic eating behaviors and obesity.

During adolescence many of these problems emerge because teenagers experience important physical and psychological changes, strongly influenced by a society focused on body appearance (Smolak, 2009). Moreover, there are two health-related behaviors that are relevant during this life period. Whilst physical activity levels decline drastically during adolescence, rates of screen-time exposure increase considerably (Currie et al., 2012; Sallis, 2000). Worldwide estimates indicate that almost 80% of youths do not achieve the public health recommendation of at least 60 minutes per day of moderate-to-vigorous physical activity (Hallal et al., 2012). Specific to Spain, the WHO-Health Behavior in School- Aged Children report (WHO-HBSC) (Currie et al., 2012), showed that the proportion of adolescents fulfilling the physical activity recommendation fell from 27% in 11- years- old boys and 15 % in girls,

to 25 % in 15- years- old boys and 8% in girls, respectively. Furthermore, during adolescence it has been observed a rise on exposure time to TV, computers and other types of screens, collectively known as screen-time According to the WHO-HSBC report, the proportion of Spanish adolescents watching TV more than 2 hours daily, increased from 60% in11- years-old boys and 54% in girls, to 65% in 15 years-old boys and 63% in girls, respectively.

Aside from the well-known health- related physical benefits of regularly engaging in physical activity such as improved cardiovascular health, reduced risks of diabetes and metabolic syndrome (Hallal et al., 2006; Strong et al., 2005), there are also associated psychological benefits. A recent literature review of works investigating the relationship between exercise and body image concluded that regular exercise has a positive effect on body image (Hausenblas and Fallon, 2006). Interestingly, reversing the direction of the association, it has been argued by Heinberg and colleagues (2001), that a certain degree of body image dissatisfaction may be beneficial to motivate physical activity adherence. This last premise should be taken with caution because there are several studies showing that low body satisfaction may be a barrier to engaging in physical activity (Kopcakova et al., 2014; Neumark-Sztainer et al., 2004; Schuler et al., 2004). For example, it has been reported that people with high social physique anxiety may find wearing sporting clothes or "exposing" their body in front of other people in a gym, to be quite intimidating (Crawford and Eklund, 1994; Spink, 1992). Furthermore, it has been reported that among body dissatisfied, at- risk-for-overweight and obesity children and adolescents, peer victimization represented a barrier to engaging in physical activity (Storch et al., 2007); and among overweight adults, feeling too fat (and having body image concerns), also represented a common barrier to exercise (Ball et al., 2000). From an eating disorders and obesity prevention point of view it is certainly important to provide further evidence on whether a certain degree of body dissatisfaction might be a barrier or facilitator to engaging in physical activity. To date, there are no studies looking at this issue in non-Anglo-Saxon, large samples. This fact limits the generalizability of previous findings in other cultures. Thus, the first aim of this study, is to investigate if body dissatisfaction represents a barrier to engaging in physical activity in a large sample of adolescents from Catalonia, Spain

As previously noted, during adolescence, screen-time exposure increases and this is of concern as it has been identified as an important risk factor for physical and psychological poor health. For example, it has been linked to weight gain/obesity risk in adulthood, reduced self-worth, reduced academic achievement, depression and as a potential risk factor for eating disorders (Jordan et al., 2008; Thorp et al., 2011; Tremblay et al., 2011; Vaughan and Fouts, 2003). According to sociocultural models of eating disorders, mass media messages pressure individuals to conform to the cultural ideals of beauty (Levine and Murnen, 2009; López-Guimerà et al., 2010). Internalization of these ideals results in body dissatisfaction because attaining these ideals is generally very difficult for most people (Thompson and Stice, 2001). Then, body dissatisfaction could lead to negative affect and disordered eating, which can lead to eating disorders. Cross-sectional studies have found positive associations between media use (TV and magazines), body dissatisfaction and disordered eating behavior among adolescents (López-Guimerà et al., 2010; Vaughan and Fouts, 2003). Likewise, experimental studies have shown that exposure to thin-ideal images causes an increase in body dissatisfaction (Levine and Murnen, 2009; López-Guimerà et al., 2010). However, the majority of these studies have focused on the impact of the TV and magazines, and in spite of a growing interest during the past years on investigating the impact of being exposed to the Internet (mainly social networks, such as Facebook), little is known about the broader role of computers on body dissatisfaction (Bair et al., 2012; Fardouly and Vartanian, 2015; Fardouly et al., 2015; Mabe et al., 2014; Meier and Grey, 2014; Tiggemann and Miller, 2010; Tiggemann and Slater, 2013a, 2013b; Williams and Ricciardelli, 2014). According to the 2011 Survey on Information and Communication Technology more than half of the individuals in the European Union use Internet every day or almost every day (Seybert and States, 2012). In 2014, in Spain, nearly 75% of households reported having Internet access and at least one computer (Instituto Nacional de Estadisticas, 2014). Interestingly, in a recent study of adolescents from several countries of the European Union, Spanish adolescents between 14 and 17 years-old are the group with the highest percentage of daily use of social networks in Europe (91.6%) and 39.2% recognized spending more than two hours in these websites, daily (Tsitsika et al., 2013). The growth in recent years in accessibility to this technology highlights the importance of researching the relationship between computer-use and body dissatisfaction. Thus, the second aim of this study is to add to the existing literature on the impact of TV and

magazines on body dissatisfaction, by investigating the association of computer time exposure and body dissatisfaction.

Method

Participants

Data for the present study was drawn from baseline assessments of the MABIC project, a study on the prevention of eating and weight-related problems conducted in the Barcelona area, Spain (Sánchez-Carracedo et al., 2016). The study sample was compromised by 1,501 adolescents attending 11 secondary schools. Mean participant age was 14.2 years (SD= 1.1; range 13-17 years); and participants were roughly equally distributed across genders (47.6% girls) and grades. The self-reported racial/ethnic background of participants was as follows: 71.7% Spanish, 12.8% Latin-American, 2.2% from other European countries, 5.6% African and 8.0% of mixed or unknown origin. Socioeconomic status (SES), according to parents' educational level and occupational status (Hollingshead, 1975), was predominantly middle-class (medium low=38.5%; medium=26.5%; medium-high= 16.3%). The study was approved by the Animal & Human Experimentation Ethics Committee of the Universitat Autonòma de Barcelona. Parents were informed about the study via the school administration and could opt out if they disagreed with participation of their child. Participation rate was high (85.5%), whilst main reasons for lack of participation were: absenteeism at the assessment day (10.1%), no parental consent (3.6%) and unwillingness to participate/medical conditions (0.8%).

Measures and Procedures

Participants completed a paper and pencil booklet with a battery of validated questionnaires that included measures on body image, physical activity, screen-time exposure, and demographic and sociocultural identified in the literature to affect physical activity, body dissatisfaction and screen-time. Factors that have been shown to predict declines in physical activity are being female, increasing age during adolescence, being of low SES and from non-Caucasian ethnicity (Bauman et al., 2012). Factors associated with higher body dissatisfaction are being female, having a higher BMI, having a high internalization of the beauty ideal and

being susceptible to sociocultural pressures (Smolak, 2009; Thompson and Stice, 2001; Williams and Ricciardelli, 2014). Factors that have been found to correlate with increased levels of screen-time exposure in adolescence are less conclusive, but gender, SES and BMI are generally controlled for in the literature (Dumith et al., 2012; Van der Horst et al., 2007).

The booklet was completed individually during regular class time, whilst height and weight were taken in a private room near the area of booklet administration. Completion of the questionnaires coupled with anthropometric assessments lasted approximately 60 minutes. Assessments took place between January and March 2011.

Body image dissatisfaction. It was assessed with the body dissatisfaction subscale of the Eating Disorders inventory-3 (EDI-3) (Garner, 2004), in its Spanish validated version (Elosua et al., 2010). This is a ten-item scale that measures satisfaction with different parts of the body with response options on a six-point Likert scale from "0= Never" to "5= Always". Higher scores on the scale indicate greater dissatisfaction with one's body. The EDI-3 is well validated in female populations and its validity in male populations has also been reported in a sample of adolescent boys (Spillane et al., 2004). In the present study, the internal consistency of the EDI- BD subscale was found to be acceptable for both genders (Cronbach's alpha=.85 for girls and.81 for boys).

Moderate-to- vigorous physical activity (MVPA). It was assessed with two items that asked participants to report the number of hours on a typical week (7 days) that they spent on vigorous physical activities ('heart beats rapidly') and moderate physical activities ('not exhausting'), separately. Each type of activity was exemplified with a list of activities to aid comprehension. Examples of vigorous physical activities were intense cycling, running, swimming, aerobic dancing, skating, footbal, basketball; examples of moderate physical activites were fast walking, light cycling, weight lifitng, dancing, volleyball). These items were taken from the EAT Project Inventory (Neumark-Sztainer et al., 2012). Responses were on a 9-point scale ranging from "0 hours to 7 or more hours". For the analyses first, we re-coded responses to correspond to number of hours; the response "7 hours or more" was coded simply as 7 hours; and then created a score by adding up responses to the moderate and vigorous scores to form a total time score spent in MVPA (score range=0-14). This score was

created in line with the public health recommendation for adolescents that suggests attaining at least 60 minutes per day of moderate-to-vigorous physical activity (Hallal et al., 2012).

Screen-time exposure. It was assessed with six questions from the EAT Project Inventory (Neumark-Sztainer et al., 2012) that asked participants to report the number of hours on a typical school-day (Monday- Friday) that they watch TV; use a computer for doing homework (computer-homework), and use a computer for leisure (computer-leisure). Participants were also asked to report the number of hours spent on these three activities (i.e., TV, computer-homework, computer-leisure) on a typical day of the weekend (Saturday – Sunday). Response options were on a 7-point scale ranging from "0, 0.5, 1, 2, 3, 4 to "5 hours or more". To facilitate interpretation of results, for the analyses, we re-coded responses to correspond to hours. The response "5 hours or more" was coded simply as 5 hours (Neumark-Sztainer et al., 2004).

Sociocultural pressures and internalization of the beauty ideal. They were assessed with the Sociocultural Attitudes Towards Appearance Questionnaire-3 (SATAQ-3) (Thompson et al., 2004), in its Spanish validated version (Sánchez-Carracedo et al., 2012). It consists of4 subscales: "Internalization-General" to evaluate the internalization of the general beauty ideal transmitted by TV and magazines; "Internalization-Athlete" that assesses the internalization of athletic models; "Information" which assesses the belief that the mass media is an important source of information about appearance, and "Pressures" which assesses feelings of pressure from media messages to modify one's appearance. Participants respond on a 5- point Likert scale from "completely disagree" to "completely agree". In the current study the reliability estimates for the four subscales were .93, .83, .91 and .93, respectively.

Body Mass Index (BMI). Researchers measured participant's body weight in light clothing and no shoes to the nearest 0.1 kg using digital scales (SECA- model 872), and height to the nearest 0.1 cm with a wall-mounted stadiometer (Seca-model214). Weight values were later corrected by subtracting 0.9 kg from the boys and 0.7 kg from the girls, which are average values estimated after weighing several sets of clothes similar to those worn at the

time of assessment. BMIz scores were calculated using WHO 2007 growth reference criteria (Onis et al., 2007).

Statistical Analyses

Statistical analyses were performed with STATA13 (StataCorp.2013, 2013) and the level of significance was set at 0.05. There are well established gender differences in body satisfaction and physical activity (both higher in boys than in girls, especially in adolescents) (Grunbaum et al., 2002; Neumark-Sztainer et al., 2002) hence to facilitate interpretation of results all analyses were conducted separately for boys and girls. Independent t-tests were performed to compare main variables included in the analyses across gender groups. To assess the association between body dissatisfaction and physical activity on one hand, and screen-time variables and body dissatisfaction on the other hand, linear mixed effects (LME) regression models with random intercepts were used. The LME model was used since adolescents within the same schools are likely to display similar correlated values in several variables, so that school was used as a cluster variable in the model. In the first model, body dissatisfaction was treated as the independent variable and MVPA as the dependent variable; in the second model, body dissatisfaction was treated as the dependent variable and all six screen-time variables as independent variables. Both LME regression models were adjusted, with sociodemographic variables (ethnicity, age, BMI z scores and SES) and sociocultural variables (SATAQ-3 variables).

Results

Table 1 summarizes descriptive statistics and results of independent t-tests to compare main variables included in the regression models between gender groups. Noteworthy, only 1.9% of adolescents met the screen-time recommendation (a maximum of 2 hours of total screen-time, daily) and only 22.1% reached the physical activity guidelines. For informative purposes, in the Supplementary Files section (available at: http://hpq.sagepub.com/), we provide a table of correlations between body dissatisfaction and the six screen-time-related variables and MVPA by gender group.

[Insert Table 1 here]

Body Dissatisfaction and Physical Activity

LME regression model examining the associations between body dissatisfaction and MVPA after adjusting for control variables were significant for girls (total explained variance=9.49%, Wald χ^2 (9) =56.307, p<0.001) and boys (total explained variance= 11.10%, Wald χ^2 (9) = 60.69, p<0.001). School was not a significant factor affecting the relation between body dissatisfaction and MVPA on any gender group (girls: p= 0.802; boys: p=0.889). In particular, body dissatisfaction was significantly associated with lower rates of MVPA in girls: B=-.04, *SE*=0.02, p=0.011, 95% CI [-0.08, -0.01] and boys: B=-.07, *SE*=0.02, p<0.001, 95% CI [-0.10, -0.03].

Screen-time and Body Dissatisfaction

Table 2 illustrates the LME regression model results of the association between the screen-time variables and body dissatisfaction after adjusting for control variables. School was a significant factor for the model ran for boys (p=0.009), but not for girls (p= 0.889). The models were statistically significant in both gender groups, (girls: total variance explained= 45.08%, Wald χ^2 (14) = 563.99, p<0.001; boys; total variance explained=43.83%, Wald χ^2 (14) =99.65, p<0.001), but we observed significant associations of certain screen-time variables and body dissatisfaction only in girls. Specifically, body dissatisfaction decreased as the number of computer-homework hours increased (B=-.70, p=0.003), and body dissatisfaction increased as the number of computer-leisure hours increased (B=.56, p=0.01). There were no statistically significant associations between body dissatisfaction and TV hours in any gender group.

[Insert Table 2 here]

Discussion

In line with global trends, our findings in a large sample of Spanish adolescents showed that a large proportion of adolescents are generally inactive (77.9%), have a screen-time exposure way above the recommended levels (98.9%), and express some degree of dissatisfaction with their body image (65.9%). All these variables are of concern and put them at higher risk of developing physical and psychological distress. Particularly, the present study explored first,

whether a certain degree of body dissatisfaction was negatively associated to regularly engaging in physical activity and second, whether screen-time exposure was associated to body dissatisfaction.

There is a wealth of evidence showing that regular engagement in physical activity is beneficial for improving body satisfaction (Hausenblas and Fallon, 2006). However, evidence on whether high levels of body dissatisfaction may be a barrier to engaging in MVPA or not, is mixed. It has been proposed that certain degree of body dissatisfaction may motivate individuals to engage in physical activity (Heinberg et al., 2001). On the other hand, past research, has found that social physique anxiety, weight-related peer victimization, feelings of being "too fat" and high levels of body dissatisfaction can represent a barrier to physical activity engagement, both in girls and boys (Ball et al., 2000; Crawford and Eklund, 1994; Focht and Hausenblas, 2004; Kopcakova et al., 2014; Neumark-Sztainer et al., 2004, 2006; Schuler et al., 2004; Spink, 1992; Storch et al., 2007). Our data seem to support this last premise, although the cross- sectional nature of our study does not allow us to establish the exact direction of the relationship between body dissatisfaction and physical activity. Nonetheless, this finding is important for future interventions in eating and weigh-related problems, which should aim to improve body image and physical activity levels together, and do not rely on that body dissatisfaction will motivate people to increase physical activity.

In the last few years, there has been a burgeoning interest in study in the relation between computer use and body image. Most them focus on the use of the Internet, more specifically on social network sites (e.g., Facebook), on computer-based publicity, and on the impact of pro-anorexia-web pages (Bair et al., 2012; Fardouly and Vartanian, 2015; Fardouly et al., 2015; Holland and Tiggemann, 2016; Mabe et al., 2014; Meier and Grey, 2014; Tiggemann and Miller, 2010; Tiggemann and Slater, 2013a, 2013b). Importantly, the vast majority of these studies investigated the relationship in girls only. To our knowledge this study is one of the few evaluating the impact of computer time on adolescent girls' and boys' body dissatisfaction. First, we found a significant association for girls but not for boys. We found that a greater number of hours of computer use for leisure were associated with higher scores of body dissatisfaction, but that greater number of hours of computer use for doing homework was associated with lower scores of body dissatisfaction. Without information about the

content of the material viewed, it is difficult to interpret the findings, and so the differences between boys and girls. However, there is evidence that the influence of media on body dissatisfaction seems to be higher for girls than for boys (Calado et al., 2011; Swami et al., 2010). Internalization of the thin beauty ideal (extensively promoted by Western media) is thought to directly promote body dissatisfaction because it is unattainable for most women (Homan, 2010). Hence, we may hypothesize that when girls use computers for surfing the Internet or social networking in their leisure time, they are exposed to messages around the beauty ideal, which in consequence negatively affect their body image. This finding is in line with the predictions of sociocultural models and previous studies that have demonstrated the mediating role of internalization of the thin-beauty ideal, in the relation between body dissatisfaction and the use of Internet-based social network sites such as Facebook (Tiggemann and Miller, 2010; Tiggemann and Slater, 2013a, 2013b).

An original aspect of the present study is that it not only focused on computer time during adolescents' leisure time, but also explored the relationship between computer time for doing homework and body image. Specifically, we found that girls who spend more hours with computers doing homework have a more positive body image, possibly, because they are not being exposed to beauty ideal messages. In addition, they may derive a positive self-evaluation from attributes of their personality other than their physical appearance (e.g., cognitive abilities, school achievement) (Booth and Gerard, 2013; Marsh et al., 2005)**.** For example, in a correlational study, undergraduate girls with higher academic achievement reported lower concern with their physical appearance (Miles, 2009). Certainly, this is an issue worth investigating in the future. More research is granted to investigate why this connection may exist.

Several studies have shown the negative impact that TV exposure has on body image (Levine and Murnen, 2009; López-Guimerà et al., 2010). In our study the number of raw hours exposed to TV was not statistically significantly associated to body dissatisfaction. Our measure was quite crude and did not ask about the type of programs or content. This global measure may not be sufficient to capture the well-documented impact of TV on body dissatisfaction. Another possible explanation may be related to a change in screen "types" usage. When we compare in our sample, the number of hours that adolescents spend watching

TV or using computers for leisure activities, the latter is higher. This is consistent with trends in developed countries. In 2015, US adolescents between 12-17 years-old was the age group with the least weekly TV hours and noteworthy, in the space of 4 years, almost one-third of this age group's traditional TV viewing time has migrated to other activities (Marketing Charts, 2015). In Catalonia, trends are similar with people between 15 and 29 years old, being the age group with the lowest percentage of average TV time (after the 65+ age group) (Institut d' Estadistica de Catalunya, 2006). It seems that in the past TV has been a big source of information, but with the advent of Internet and new technologies, the focus has shifted to other type of media (i.e., computers, tablets, Smartphones, Facebook, Instagram, Tweeter, etc.). This is a valuable finding for future interventions oriented to the critical consumption of mass media pointing out the necessity of including this new media component in addition to TV and magazines.

We acknowledge a number of limitations. Self-reported measures were used to report physical activity and screen-time. Objective measures such as the use of accelerometers would have been preferable. However, the use of these tools was not feasible in a sample of this scale. Notwithstanding, all the measures used have been previously validated. In addition, there are biological factors, especially relevant during adolescence such as biological maturity, which may influence physical activity adherence (Machado Rodrigues et al., 2010). Particularly to adolescent girls, there is evidence of a negative association between levels of physical activity and biological maturity, being mediated by self-concept (Cumming et al., 2011). In future studies investigating the impact of body dissatisfaction on physical activity engagement, it may be worth including a measure of biological maturity, to shed further light on this relationship. Another limitation is that at the time of doing data collection the use of tablets and Smartphones was not as widespread as it is today in Spain. It is possible that if we had included some questions about these types of technologies, we would have found stronger effects on body image. The most important limitation is that because of the cross- sectional design of this study, we are unable to establish causal relationships between physical activity, computer-time and body dissatisfaction.

The current study has also a number of important strengths. The large and diverse sample in terms of ethnicity and socioeconomic status increase the generalizability of the findings. Importantly, we contributed to the literature in the field within a Spanish sample. This is of great value because much of studies examining this theme have been conducted in Anglo-Saxon cultures, mainly USA. Even though Spain shares many characteristics of Western culture such as the general ideal of beauty and unhealthy messages of weight control strategies, Spain, along with other European countries has its own cultural traditions and eating patterns, which may be protective from developing disordered eating behaviors. For example, Spain involves the Mediterranean diet, seen as one of the healthiest; in the Spanish society, family meals are still common; and although in recent years there has been an increase in the number of fast food restaurants, they still are poorly frequented compared to the more traditional establishments, where the cuisine is similar to the Mediterranean diet (Davidson and Gauthier, 2010; López-Guimerà et al., 2013; Marin-Guerrero et al., 2008). Moreover, the instruments used to measure key variables were all validated measures within Spanish samples and the objective assessment of height and weight reduced any self-report bias. Noteworthy, we investigated the role of computer-use on body dissatisfaction, an area which certainly in the near future will grow considerably. Future research may explore the quality of programs/ messages that are transmitted in TV versus computers, tablets, Smartphones, as well as the impact of new technologies on body dissatisfaction and physical activity. Future studies on body image may explore the impact of specific uses of new technologies (i.e., mainly for email; mainly social networking; mainly for work; computer gaming, downloading movies, music videos, etc.).

Conclusions

The present study showed within a large sample of Spanish adolescents that body dissatisfaction can work as a barrier and not a motivator to physical activity adherence. Importantly, it was found that the use of computers during leisure time was negatively associated with girls' body image. Findings of the present study along with previous research findings have implications for the development of programs aimed at preventing the broad spectrum of weight related disorders with a focus on improving body satisfaction and physical

activity simultaneously, as well as the critical consumption of messages delivered via new technologies.

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Table 1 Descriptive and test statistics of variables included in analyses by gender group

	Females		**Males**		95% CI of the difference	*t*	*p*
	Mean	SD	Mean	SD			
Age	14.05	1.03	14.18	1.1	(-0.23. -0.02)	-2.28	**0.04**
BMI	21.22	3.65	20.93	4.01	(-0.10. 0.68)	1.45	**0.02**
SES	6.13	1.46	6.29	1.49	(-0.31. -0.01)	-2.05	0.46
STQIG	18.91	9.82	14.41	6.89	(3.64. 5.37)	10.24	**<.001**
STQIA	7.61	4.01	9.24	4.54	(-2.07. -1.20)	-7.31	**<.001**
STQP	12.21	6.55	9.93	4.83	(1.69. 2.86)	7.61	**<.001**
STQI	21.4	9.7	18.01	8.6	(2.46. 4.33)	7.13	**<.001**
WDTV	1.98	1.4	2.09	1.4	(-0.26. 0.03)	-1.58	0.96
WDC-H	2.04	1.29	1.59	1.22	(0.32. 0.57)	6.84	0.59
WDC-L	2.43	1.61	2.28	1.61	(-0.01. 0.31)	1.82	0.31
WETV	2.51	1.49	2.5	1.46	(-0.14.0.16)	0.13	0.43
WEC-H	1.87	1.25	1.43	1.11	(0.33. 0.57)	7.28	**0.01**
WEC-L	2.97	1.62	2.85	1.65	(-0.04. 0.29)	1.44	0.47
BD	12.34	9.19	7.89	7.27	(3.61. 5.30)	10.34	**<.001**
MVPA	4.12	3.08	5.88	3.49	(-2.06. -1.40)	-10.23	**<.001**

Note, CI, confidence interval; SD, standard deviation; BMI= Body Mass Index; SES=Socio economic Status; STQIG= Internalization-General; STQIA= Internalization Athletic Ideal; STQP= Pressures; STQI= Information; WDTV= weekday TV; WDC-H= weekday computer-homework; WDC-L= weekday computer-leisure; WETV=weekend TV; WEC-H= weekend computer-homework; WEC-L=weekend computer-leisure; BD= Body Dissatisfaction; MVPA= moderate-to-vigorous activity. Significant p-values in bold. N for females were between 696 and 713; N for males were between 765 and 784

Table 2 LME regression model of the association between body dissatisfaction and screen-time variables by gender group

	Females				Males			
Variables	B	SE	*p*	95%CI	B	SE	*p*	95%CI
WDTV	-0.04	0.25	0.886	(-0.53, 0.46)	-0.07	0.21	0.748	(-0.50, 0.36)
WDC-H	-0.69	0.26	**0.009**	(-1.21, -0.18)	-0.06	0.23	0.781	(-0.52, 0.39)
WDC-L	-0.04	0.22	0.872	(-0.49, 0.41)	-0.16	0.2	0.431	(-0.56, 0.24)
WETV	0.11	0.24	0.658	(-0.36, 0.57)	-0.18	0.21	0.385	(-0.60, 0.23)
WEC-H	0.34	0.26	0.196	(-0.18, 0.86)	0.09	0.24	0.705	(-0.39, 0.57)
WEC-L	0.57	0.23	**0.013**	(0.12, 1.02)	0.05	0.19	0.78	(-0.33, 0.44)
Random effect								
School	3.06e-11	2.13e-10	0.889	(3.53e-17; 2.65e-5)	0.91	0.35	**0.009**	(0.43,1.92)

Note, LME, linear mixed effects; SE, standard error; WDTV= weekday TV; WDC-H= weekday computer-homework; WDC-L= weekday computer-leisure; WETV=weekend TV; WEC-H= weekend computer-homework; WEC-L=weekend computer-leisure.

Model adjusted for Age, Ethnicity, SES, BMI z-score, Internalization-General, Internalization-athlete, Pressures and Information. Significant p-values in bold

Supplementary File. Bivariate correlations between body dissatisfaction, screen-time variables and MVPA by gender group

		BD	WDTV	WDC-H	WDC-L	WETV	WEC-H	WEC-L
Females	**BD**	-						
	WDTV	.017	-					
	WDC-H	-.075*	.164**	-				
	WDC-L	.130**	.308**	-.009	-			
	WETV	.024	.659**	.135**	.163**	-		
	WEC-H	-.047	.075*	.654**	-.086*	.193**	-	
	WEC-L	.149**	.205**	-.007	.707**	.252**	.023	-
	MVPA	-.037	.019	.220**	.093*	.050	.176**	.097**
Males	**BD**	-						
	WDTV	-.040	-					
	WDC-H	-.011	.144**	-				
	WDC-L	-.011	.265**	.067	-			
	WETV	-.052	.583**	.090*	.051	-		
	WEC-H	-.029	.027	.580**	-.063	.173**	-	
	WEC-L	-.049	.153**	.060	.661**	.218**	.079*	-
	MVPA	-.135**	.048	.097**	.029	.071*	.112**	.030

Note, BD= Body Dissatisfaction; WDTV= weekday TV; WDC-H= weekday computer-homework; WDC-L= weekday computer-leisure; WETV=weekend TV; WEC-H= weekend computer-homework; WEC-L=weekend computer-leisure; MVPA= moderate to vigorous physical activity.

*p<.05 **p<.01

CHAPTER 6, DISCUSSION

6.1 Overall Discussion

Worldwide levels of MVPA among adolescents are typically much lower than recommended; as few as 20% of 13-15 years old globally appear to meet the MVPA recommendation (Hallal et al., 2012). This is worrying since lack of physical activity is considered the fourth risk factor of mortality, and habits established in adolescence track later in adulthood (World Health Organization, n.d.-a). This is a particular developmental period in which the gained autonomy means adolescents will make decisions over their health than can impact in their future. The studies in the present thesis contribute to the understanding of this topic by investigating the relationship between intensity of physical activity, body dissatisfaction, and computer use, in a sample of Spanish adolescents.

The present thesis, intended to set out a picture of physical activity prevalence in a Spanish sample of adolescents. Moreover, it investigated a less common researched area: physical activity intensities according to weight and gender, and potential changes (increments/decrements) over time in the different types of physical activity intensities. In addition, this thesis aimed to investigate the relationship between physical activity, body dissatisfaction and screen time in a sample of Spanish adolescents at the same time of trying to fill in some gaps in the literature in this field (e.g., computer use for homework).

Some of reasons why the present thesis has been carried out are summarized below,

- There is a common belief that there is a marked decline in MVPA during adolescence. This view is being challenged by more recent studies using objective measures.
- There are few longitudinal studies with more than one measurement point in a non-Anglo-Saxon population.
- There are not many studies investigating, longitudinally, changes (increments/decrements) in different types of intensities of physical activity (i.e.; vigorous, moderate, light).

- In different areas of psychological treatment, it is more common to observe successful tailored interventions rather than umbrella interventions. Recognizing that different intensities of physical activities may be less threatening to different groups of teenagers based on their gender and weight status may result in more successful interventions aimed at sustaining or improving adherence to regular physical activity.
- The interrelationship of physical activity and body image dissatisfaction and screen time has been long researched, however more research is needed for the specific Spanish population.
- There are several studies looking at body dissatisfaction and mass-media influences but the bulk of work has been conducted in TV and printed media (magazines, newspapers). With the rapid advent of the internet, the messages available via computers become important media to be considered as well.

Overall the key contributions of both studies are summarized below,

Study1

Prevalence rates of physical activity in our sample were in line with global trends showing low adherence, with only 22 % meeting the MVPA recommendation. This figure is similar to the latest Health Behavior in School-aged Children (HBSC) study showing for Spain, that only 24.4% of adolescents reach the recommended physical activity levels for health (according to the WHO recommendations) (World Health Organization, 2016). In line with worldwide estimates, we also found in our sample that the percentage of boys regularly engaging in physical activity is significantly higher that the percentage of girls. Interestingly, following our sample statistics, we found that two years later, the percentage meeting the recommendation increased substantially to 29.4%. Although a significant increase, the prevalence of physical activity uptake in our sample and especially for girls is quite low and it highlights the need of interventions aimed at promoting physical activity for healthy benefits.

There is a common belief that there is a marked decline in MVPA during adolescence. One of the main goals of this study was to investigate whether we observed drops in physical activity levels in a sample of non-Anglo-Saxon adolescents. In line with recent studies challenging the

view of a marked decline in physical activity during adolescence, we found overall, no statistically significant drops from 13 to 15 years-old. Even more, we found increments in LPA for boys, and in MVPA and TPA for girls from 13-15 years old. In our study, data does not support the view that there is a marked decline during adolescence in physical activity; in fact, in our sample we observed increments. Potential explanations for this finding are, floor effects; active travel and weather conditions. For the first explanation, it has been documented that declines begin during childhood, between 7-9 years-old. In our sample, we take on 13 years old, already with low levels of physical activity and therefore there may not be much more room to observe decrements (Reilly, 2016). In addition, factors that may explain increments are associated to high rates of active travel in the Spanish population, when compared to other Western societies such us USA, UK or Australia, where most of the research showing decrements in physical activity has been conducted (Southward, Page, Wheeler, & Cooper, 2012; TNS Opinion & Social, 2010). And finally, it has also been pointed out that good weather conditions promote an active lifestyle (Bélanger, Gray-Donald, O'Loughlin, Paradis, & Hanley, 2009), and in Catalonia, where we conducted the study has a gentle weather throughout the year.

Another goal of the study was to explore changes in physical activity intensities by gender and weight status. Results from our study confirmed previous and consistent findings in the literature reporting differences in physical activity levels by gender. Overall we found that boys are more active than girls, and in line with previous studies, we found that boys engaged in significant greater amounts of MVPA (Martínez-Gómez et al., 2009; Nader, Bradley, Houts, Mcritchie, & Brien, 2008). Interestingly, when we explored changes in intensity of physical activity from 13 to 15 years of age, in our sample, we observed that girls, on average, increased their levels of MVPA whereas boys increased their levels of LPA. Literature is scarce and it highlights the need for future research on this topic given the importance of the intensity and not only the amount of physical activity.

Overweight/obese youth have frequently been reported to be less active than normal weight adolescents (Raudsepp & Viira, 2008). In our sample there was no conclusive evidence that overweight/obese adolescents were less active than their normal-weight counterparts. Nevertheless, we wondered if throughout adolescence there would be changes in the

frequency and intensity of physical activity. We observed for overweight/obese boys increments in LPA whereas in overweight/obese girls, we observed increments in MVPA and TPA. To our knowledge studies researching these issues are scarce and more research certainly is needed.

In conclusion, the present study investigated in a less researched sample of non-Anglo- Saxon adolescents two main areas. On one hand, it aimed to investigate the well-established idea that there are marked declines in physical activity during this period of life. Interestingly and in line with more recent studies, it was found that during early adolescence there are no big drops, but that it remains rather constant and even it can increase slightly. Nonetheless, the findings of this study along with others, highlight that only a very small percentage of young adolescents meet the CDC physical activity recommendation and that interventions to increase participation are needed. The second area of research of this study focused in a less researched question: if there are changes in the amount of physical activity during early adolescence, are these different across different intensities? It was very interesting to find that when we analyzed total physical activity no changes were observed in boys but when we discriminated between two levels of intensity, MVPA vs LPA, there were significant increments in LPA. Likewise, for girls, we observed increments in TPA, but when discriminating it was MVPA the type of physical activity driving the increment. This information is valuable for future interventions, understanding which kind of intensities need to be targeted more heavily and/or which ones may be easier to invite adolescents to practice. Finally, the study provided a rather novel approach to the study of the relationship between physical activity and weight status, by also analyzing if there were changes across time in young adolescence, and whether there would be differences in the type of physical activity. Certainly, more studies in this area are warranted to further shed light on these differences.

Study 2

This cross-sectional study contributes to the literature on whether body dissatisfaction is a barrier/facilitator to engaging in physical activity and to investigate the impact of mass-media messages via computer-time on body dissatisfaction.

There is a wealth of evidence showing that regular engagement in physical activity is beneficial for improving body satisfaction (Hausenblas & Fallon, 2006). In contrast, evidence on whether high levels of body dissatisfaction may be a barrier to engaging in MVPA or not, is mixed. On one hand, some researchers have hypothesized that a certain degree of body image dissatisfaction may conceivably be beneficial for individuals with average or above-average BMI values because it may be a motivating factor to engage in healthy weight management behaviors (Heinberg, 2001). On the other hand, past research, has found that social physique anxiety, weight-related peer victimization, feelings of being "too fat" and high levels of body dissatisfaction can represent a barrier to physical activity engagement, both in girls and boys (Ball, Crawford, & Owen, 2000; Crawford & Eklund, 1994; Focht & Hausenblas, 2004; Kopcakova, Veselska, Geckova, van Dijk, & Reijneveld, 2014; Neumark-Sztainer et al., 2004, 2006; Schuler et al., 2004; Spink, 1992; Storch et al., 2018).

In our sample, analyses revealed that body dissatisfaction was negatively associated with physical activity on both genders. So, our data seem to support this last premise, although the cross- sectional nature of our study does not allow us to establish the exact direction of the relationship between body dissatisfaction and physical activity. Nonetheless, this finding is important for future interventions in eating and weigh-related problems, which should aim to improve body image and physical activity levels together, and do not rely on that body dissatisfaction will motivate people to increase physical activity.

Another aim of this study was to investigate the impact of screen time on body dissatisfaction. Several studies have shown the negative impact that TV exposure has on body image (Levine & Murnen, 2009; López-Guimerà et al., 2010). In our study the number of raw hours exposed to TV was not statistically significantly associated to body dissatisfaction. It may be that our measure was quite crude and not sufficient to capture the well-documented impact of TV on body dissatisfaction. Nonetheless, another possible explanation may be related to a change in screen "types" usage. When we compared in our sample, the number of hours that adolescents spent watching TV or using computers for leisure activities, the latter is higher. It seems that in the past TV has been a big source of information, but with the advent of Internet and new technologies, the focus has shifted to other type of media (i.e., computers, tablets, Smartphones, Facebook, Instagram, Tweeter, etc.). It is worth re-iterating, that the MABIC

project was designed and data collected, before the explosive expansion of the Internet, and devices. At the time, 2011, it was novel the inclusion of a computer-based component in addition to TVs and magazines. However, recent reports have shown that the Internet as a communication and information platform has become the preferred medium among adolescents, with 99% of Spanish adolescents reporting acceding Internet on a daily basis and principally from their smartphone (Ditrendia, 2017; IAB, 2015). This is a valuable finding for future interventions oriented to the critical consumption of mass media pointing to the necessity of including these new media components in addition to TV and magazines.

In consonance with this trend of higher amounts of time spent with computers than with TV, we set out to investigate the impact of media messages delivered via computers on body image. In our study, we evaluated the impact of computer time on adolescent girls' and boys' body dissatisfaction. First, we found a significant association for girls but not for boys. In particular we found that a greater number of hours of computer use for leisure were associated with higher scores of body dissatisfaction, but that greater number of hours of computer use for doing homework was associated with lower scores of body dissatisfaction. This finding is in line with the predictions of sociocultural models and previous studies that have demonstrated the mediating role of internalization of the thin-beauty ideal, in the relation between body dissatisfaction and the use of Internet-based social network sites such as Facebook (Tiggemann & Slater, 2013a; Tiggemann & Slater, 2013b)

An original aspect of study 2 was that it not only focused on computer time during adolescents' leisure time, but also explored the relationship between computer time for doing homework and body image. Specifically, we found that girls who spent more hours with computers doing homework have a more positive body image, possibly, because they are not being exposed to beauty ideal messages. In addition, they may derive a positive self-evaluation from attributes of their personality other than their physical appearance (e.g., cognitive abilities, school achievement) (Booth & Gerard, 2013; Marsh, Trautwein, & Lu, 2005). Certainly, this is an issue worth investigating in the future. More research is granted to investigate why this connection may exist.

In sum, the results from the second study suggest that weight-related interventions should improve body image and physical activity simultaneously, while critical consumption of mass-media interventions should be extended beyond traditional TV and magazine components, to include the role of computers and devices that facilitate easy access to the Internet, and social networks such as tablets & smartphones, primordially.

6.2 Limitations and Strengths

- Participants and generalizability. The samples employed in both studies were convenience samples and there was not a possibility to randomly select schools. Nonetheless, the large and diverse sample in terms of origin and socioeconomic status increase the generalizability of the findings.

- Self-report measures. The use of accelerometers for objectively assessing physical activity would have been preferred, but it was not feasible in our sample. Notwithstanding, all the measures used have been previously validated.

- Participant attrition. As with many longitudinal studies, we lost participants during follow-ups. We compared physical activity levels at baseline between those who provided data at all three times, against those who did not, and we found no statistical significant differences.

- Another limitation relates to the assessment instruments that are centered on female body dissatisfaction and weight concern. Although the one used in Study2 has been validated in male populations, body concerns and sociocultural pressure are not the same for men as for women. Moreover, as discussed in Chapter 2, there is now research showing that women are also internalizing the athletic ideal. Therefore, it may be enriching to include other factors such as drive for muscularity, in the study of female and male body dissatisfaction (Hatoum & Belle, 2004; McCabe & Ricciardelli, 2004).

- An important limitation is that the questionnaires used did not consider new technologies such as internet websites. Our own questionnaire has focused primarily on

television and computers, as does much of the existing research (Grabe, Ward, & Hyde, 2008; Groesz, Levine, & Murnen, 2002). Television may not be the most important medium for many adolescents, and just recently we are starting to see studies considering the extent, degree and nature of internet, which has given adolescents much more control over when and where they will use them. Furthermore, the internet allows immediate access to specific content, such as music videos or the sharing of common social network sites, such as YouTube, Instagram, Facebook or Twitter, where adolescents can upload, alter, compare, and receive/ give feedback about images of themselves (Hatoum & Belle, 2004; Hogan & Strasburger, 2008)

- The current studies have also important strengths. Importantly, we contributed to the literature in the field within a Spanish sample. This is of great value because most of studies examining these themes have been conducted in Anglo-Saxon cultures. Even though Spain shares several characteristics of Western culture such as the general ideal of beauty and unhealthy messages of weight control strategies, Spain, along with other European countries has its own cultural traditions and eating patterns, which may be protective from developing disordered eating behaviors. For example, in the Spanish society, family meals are still common; and although in recent years there has been an increase in the number of fast food restaurants, they still are poorly frequented compared to the more traditional establishments (Davidson & Gauthier, 2010; López-Guimerà et al., 2013; Marin-Guerrero, et al., 2008).

- The instruments used to measure key variables were all validated measures within Spanish samples and the objective assessment of height and weight reduced any self-report bias.

6.3 Directions for future research

Considering the low levels of physical activity, and its relationship with body dissatisfaction, ED and overweight/obesity, the difficulties encountered in treatment and the high prevalence of these conditions are important reasons to develop efforts aimed at their prevention. The

implementation of integrated interventions aimed at preventing risk factors for both obesity and ED and working with physical activity as vector, constitutes a very exciting development.

Below I include a list of future research topics that derive from the literature reviewed and thoughts worked through this doctorate.

- Qualitative research to assess teenagers' preferences for different types of physical activity intensities, according to their weight, gender and baseline level of physical activity.
- Research employing objective measures such as accelerometers to investigate the correlates of different types of physical activity intensities.
- More research on which kinds of activities/ environments will motivate adolescents to increase their exercise behavior.
- In connection with the rather novel concept of fitspiration, more research is needed to investigate whether this "fitness inspiration" motivates some type of "healthy" physical activity adherence
- We have not approached the research from the point of view of positive body image. It is also important to include more expansive conceptualizations such as body appreciation and body acceptance, and models of body image and embodiment (Avalos et al., 2005; Halliwell, 2015; Halliwell et al., 2017; Tylka & Wood-Barcalow, 2015).
- More research on body-image based bullying and physical activity participation
- Social media is the main form of mass media being used by the youth of today, and researchers in the United States, UK and Australia have started studying how these may be affecting body image concerns. We need more studies to investigate if social networking sites and other forms of social media are more detrimental to one's body image than traditional forms of media (e.g., TV, magazines).

- We need qualitative research to explore the quality of programs/ messages that are transmitted in TV versus computers, tablets, Smartphones, as well as the impact of new technologies on body dissatisfaction and physical activity.
- Future studies on body image may explore the impact of specific uses of new technologies (i.e., mainly for email; mainly social networking; mainly for work; computer gaming, downloading movies, music videos, etc.).
- More research on factors (e.g., interventions targeting body appreciation, Halliwell et al., 2016) that may protect against the internalization of body ideals transmitted via mass media
- Investigate on protective factors such as being assertive, being a member of a family where there is a low focus on weight and attractiveness, and social acceptance of diverse range of body shapes, and close relationships with friends or romantic partners who are relatively unconcerned with weight (Shisslak & Crago, 2001).
- Traditionally research on body dissatisfaction and physical activity has been conducted primarily on females. More recently there has been research on males, but more research is needed.

6.4 Applied research implications and conclusions

The present thesis contributes to the analysis of issues that are relevant for public health interventions as these issues have important physical and psychological consequences. Moreover, it considers a sample of Spanish adolescents, which contributes to the understanding of this phenomena according to the cultural characteristics of this population, which although part of Western society has its own customs and values.

The findings of this thesis add to the literature and highlight that only a very small percentage of young adolescents meet the physical activity recommendation and that interventions to increase participation are needed. Results of this thesis suggest that interventions targeting specific intensities of physical activity for different groups based on their gender and weight

status may be beneficial. Moreover, how people feel about their body can influence their physical activity participation. Individuals who feel better about their bodies (i.e., have positive body image) are more likely to engage in physical activity than those who have negative body image. Therefore seeking out supportive and welcoming physical activity environments in which individuals feel comfortable is important (Boixadós, Cruz, Torregrosa, & Valiente, 2004). Finally, given the rapid change over the last decades in media platforms (i.e., computer based technologies over TV and printed media), and with the crucial appearance of internet it is evident that the focus of critical mass-media interventions should include a computer and social-media component.

Findings of the present study along with previous research findings have implications for the development of programs aimed at preventing the broad spectrum of weight related disorders with a focus on improving body satisfaction and physical activity simultaneously, as well as the critical consumption of messages delivered via new technologies.

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8. ANNEXES

8.1 MABIC Questionnaire , Physical Activity Questionnaire

A lo largo de una semana habitual (7 días), ¿cuántas horas realizas las siguientes actividades?

Ejercicio intenso (el corazón late rápidamente). Ej: ciclismo intenso, baile aeróbico, correr, nadar, patinar, jugar a tenis, esquí de fondo, jugar a fútbol, jugar a baloncesto.
Ejercicio moderado (no extenuante). Ej: caminar rápido, bailar, jugar a béisbol, gimnasia, ciclismo ligero, jugar a voleibol, hacer pesas en el gimnasio.
Ejercicio suave (poco esfuerzo). Ej: caminar lentamente, jugar a bolos, yoga, estiramientos, tareas del hogar.

	Ninguna	Menos de ½ h	½ h - 1 h	1½ - 2h	2½ - 3h	3½ - 4h	4½ - 5h	5½ - 6½h	7h o más
Ej. intenso	☐	☐	☐	☐	☐	☐	☐	☐	☐
Ej. moderado	☐	☐	☐	☐	☐	☐	☐	☐	☐
Ej. suave	☐	☐	☐	☐	☐	☐	☐	☐	☐

8.2 MABIC Questionnaire , Screen Time Questionnaire

En tu tiempo libre, en un día habitual de la semana escolar (de lunes a viernes) cuántas horas pasas...

	0	½h	1h	2h	3h	4h	5h o más
...mirando la TV / Vídeos / DVDs?	☐	☐	☐	☐	☐	☐	☐
...leyendo o haciendo los deberes?	☐	☐	☐	☐	☐	☐	☐
...utilizando el ordenador? (no para hacer los deberes)	☐	☐	☐	☐	☐	☐	☐
...utilizando la tableta?	☐	☐	☐	☐	☐	☐	☐
...utilizando juegos de consola?	☐	☐	☐	☐	☐	☐	☐

En tu tiempo libre, en un día habitual del fin de semana (sábado y domingo) cuántas horas pasas...

	0	½h	1h	2h	3h	4h	5h o más
...mirando la TV / Vídeos / DVDs?	☐	☐	☐	☐	☐	☐	☐
...leyendo o haciendo los deberes?	☐	☐	☐	☐	☐	☐	☐
...utilizando el ordenador? (no para hacer los deberes)	☐	☐	☐	☐	☐	☐	☐
...utilizando la tableta?	☐	☐	☐	☐	☐	☐	☐
...utilizando juegos de consola?	☐	☐	☐	☐	☐	☐	☐

8.3 MABIC Questionnaire, EDI- 3 (BD & DT)

Debes contestar a las frases que se te proponen. Algunas se refieren a la comida y otras a los sentimientos o actitudes que experimentas. En cada frase contesta con una señal (X) si lo que se dice te ocurre. Es importante que contestes a todas las frases con sinceridad

EDI-3	Nunca	Pocas veces	A veces	A menudo	Casi siempre	Siempre
1. Como dulces e hidratos de carbono sin preocuparme						
2. Creo que mi estómago es demasiado grande						
3. Pienso en ponerme a dieta						
4. Pienso que mis muslos son demasiado gruesos						
5. Me siento muy culpable cuando como en exceso						
6. Creo que mi estómago tiene el tamaño adecuado						
7. Me aterroriza la idea de engordar						
8. Me siento satisfecha con mi figura						
9. Exagero o doy demasiada importancia al peso						
10. Me gusta la forma de mi trasero						
11. Estoy preocupada porque querría ser una persona más delgada						
12. Creo que mis caderas son demasiado anchas						
13. Me siento hinchada después de una comida normal						
14. Si engordo un kilo, me preocupa que pueda seguir ganando peso						
15. Creo que el tamaño de mis muslos es adecuado						
16. Creo que mi trasero es demasiado grande						
17. Creo que mis caderas tienen el tamaño adecuado						

8.4 MABIC Questionnaire, Socio-economic status questioannaire

- De acuerdo a la siguiente escala, escribe dentro del recuadro qué número se corresponde con los estudios y ocupación de tus padres:

1. Primarios o sin estudios	☐ Padre		1. En paro	Padre ☐	
2. EGB o ESO finalizados			2. Jubilados, pensionistas		
3. Bachillerato o FP finalizados	☐ Madre		3. Labores domésticas propias del hogar	Madre ☐	
4. Título universitario (finalizado)			4. Trabajo a tiempo parcial		
			5. Trabajo a tiempo completo		

- ¿Cuál es el país de origen de tus padres? (caso de orígenes diferentes del padre y la madre, señala "Mixto")

Español – Catalán ☐ Europeo ☐ Hispanoamericano ☐ Norte Africano ☐
Subsahariano ☐ Mixto ☐ Otros (especificar) _____ ☐

8.5 MABIC Questionnaire, SATAQ-3

Por favor, lee cada uno de las siguientes frases y rodea con un círculo el número que mejor refleja tu acuerdo con cada una de ellas

Completamente en desacuerdo		Ni de acuerdo ni en desacuerdo		Completamente de acuerdo
1	2	3	4	5

1.	Los programas de televisión son una fuente importante de información sobre moda y sobre cómo ser atractiva.	1	2	3	4	5
2.	Me he sentido presionada por la televisión o las revistas para perder peso.	1	2	3	4	5
3.	Me importa si mi cuerpo se parece o no al de la gente que sale en la televisión.	1	2	3	4	5
4.	Comparo mi cuerpo con el de la gente que aparece en la televisión.	1	2	3	4	5
5.	Los anuncios de televisión son una fuente importante de información sobre moda y sobre cómo ser atractiva.	1	2	3	4	5
6.	Me siento presionada por la televisión o las revistas para estar guapa.	1	2	3	4	5
7.	Me gustaría que mi cuerpo se pareciese al de las modelos que aparecen en las revistas.	1	2	3	4	5
8.	Comparo mi apariencia física con la de las estrellas de la televisión y del cine.	1	2	3	4	5
9.	Los vídeos musicales de la televisión son una fuente importante de información sobre moda y sobre cómo ser atractiva.	1	2	3	4	5
10.	Me he sentido presionada por la televisión y las revistas para ser delgada.	1	2	3	4	5
11.	Me gustaría que mi cuerpo se pareciese al de la gente que aparece en las películas.	1	2	3	4	5
12.	Comparo mi cuerpo con el de la gente que aparece en las revistas.	1	2	3	4	5
13.	Los artículos de las revistas son una fuente importante de información sobre moda y sobre cómo ser atractiva.	1	2	3	4	5
14.	Me he sentido presionada por la televisión o las revistas para tener un cuerpo perfecto.	1	2	3	4	5
15.	Me gustaría parecerme a las modelos que aparecen en los vídeos musicales.	1	2	3	4	5
16.	Comparo mi apariencia física con la de la gente que aparece en las revistas.	1	2	3	4	5
17.	Los anuncios en las revistas son una fuente importante de información sobre moda y sobre cómo ser atractiva.	1	2	3	4	5
18.	Me he sentido presionada por la televisión o las revistas a hacer dieta.	1	2	3	4	5
19.	Deseo estar tan atlética como la gente que aparece en las revistas.	1	2	3	4	5
20.	Comparo mi cuerpo con el de la gente que está en buena forma.	1	2	3	4	5
21.	Las fotos de las revistas son una fuente importante de información sobre moda y sobre cómo ser atractiva.	1	2	3	4	5
22.	Me he sentido presionada por la televisión o las revistas a hacer ejercicio físico.	1	2	3	4	5
23.	Desearía estar tan atlética como las estrellas del deporte.	1	2	3	4	5
24.	Comparo mi cuerpo con el de la gente que tiene un cuerpo atlético.	1	2	3	4	5
25.	Las películas son una fuente importante de información sobre moda y sobre cómo ser atractiva.	1	2	3	4	5
26.	Me he sentido presionada por la televisión o las revistas a cambiar mi apariencia física.	1	2	3	4	5
27.	Intento parecerme a la gente que sale en la televisión.	1	2	3	4	5
28.	Las estrellas de las películas son una fuente importante de información sobre moda y sobre cómo ser atractiva.	1	2	3	4	5
29.	La gente famosa es una fuente importante de información sobre moda y sobre cómo ser atractiva.	1	2	3	4	5
30.	Intento parecerme a las deportistas.	1	2	3	4	5

8.6 Letter of acceptance to publish Study 2

Journal of Health Psychology <onbehalfof+editorjhp+gmail.com@manuscriptcentral.com> 12/7/16

para mí

12-Jul-2016

Dear Ms. Añez:

It is a pleasure to accept your manuscript entitled "Body Image Dissatisfaction, Physical Activity and Screen-Time in Spanish Adolescents" in its current form for publication in the Journal of Health Psychology.

If you would like your article to be freely available online immediately upon publication (as some funding bodies now require), you can opt for it to be published under the SAGE Choice Scheme on payment of a publication fee. Please simply follow the link to the Contributor Agreement form in the next email and you will be able to access instructions and further information about this option within the online form.

The phenomenal rise over the last five years of online social media has affected the journals market profoundly, as users place a premium on active engagement with the scholarly community. For ideas on how you can use social media tools to help promote your article, please read our guide on Using Social Media to Promote Your Article [https://uk.sagepub.com/en-gb/eur/promote-your-article] or refer to the Journal Author Gateway [https://uk.sagepub.com/en-gb/eur/page/journal-author-gateway] for more ideas.

To give you a couple of examples, you could record a video abstract to give interested parties a short taster about your article. Here is an example of a good video abstract [http://aut.sagepub.com/content/early/2015/02/24/1362361314568899/suppl/DC1]
lasting no longer than 3 minutes. If you are interested in producing a video abstract, please see the attached document for more details. Or why not write for The Conversation [http://theconversation.com/uk]? SAGE has recently partnered with The Conversation, an independent source of news and views, sourced from the academic and research community and delivered direct to the public. It's getting increasingly referenced in the mainstream media and is a good way of raising your profile, beyond the confines of your immediate institution. The Conversation Editors are always looking for new authors, so if you wanted to pitch [http://theconversation.com/pitches/new] them any public interest article ideas on health psychology issues, please feel free to get in touch with them directly.

Thank you for your fine contribution. On behalf of the Editorial Board of the Journal of Health Psychology, we look forward to your continued contributions to the Journal.

With best wishes,

David F Marks PhD
Editor
Journal of Health Psychology