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Department of Clinical and Health Psychology
PhD in Clinical and Health Psychology

Doctoral Thesis

**Food insecurity in Spanish adolescents: assessment and
associations with psychological wellbeing, body image
and disordered eating**

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List of Acronyms

ANOVA: Analysis of Variance
MANCOVA: Multiple Analysis of Covariance
BMI: Body Mass Index
BSQ: Body Shape Questionnaire
CFA: Confirmatory Factor Analysis
CFI: Comparative Fit Index
CFSSM: Child Food Security Survey Module
CFSSM-S: Spanish Child Food Security Survey Module
CIDI: Composite International Diagnostic Interview
EDDS-5: Eating Disorder Diagnostic Scale
EDE-Q: Eating Disorder Examination Questionnaire
EDI3: Eating Disorder Inventory (DT: Drive for Thinness; BD: Body Dissatisfaction)
EFA: Exploratory Factor Analysis
ELCSA: Escala Latinoamericana y Caribeña de Seguridad Alimentaria
EU: European Union
FAO: Food and Agriculture Organisation of the United Nations
FASIII: Family Affluence Scale
FIES: Food Insecurity Experience Scale
GAD7: Generalised Anxiety Disorder
GHQ12: General Health Questionnaire
HFSSM: Household Food Security Survey Module
IFAD: International Fund for Agricultural Development
PANASN: Positive and Negative Affect Schedule for children and adolescents
PEDSQL: Pediatric Quality of Life Initiative
PHQ8: Patient Health Questionnaire
PSWQ: Penn State Worry Questionnaire
RCFIM: Radimer-Cornell Food Insecurity Measure
RMSEA: Root-Mean-Square Error of Approximation
RSES: Rosenberg Self-Esteem Scale
SD: Standard Deviation
SES: Socioeconomic Status
SPSS: Statistical Package for Social Sciences
TLI: Tucker Lewis Index
UK: United Kingdom
UNICEF: The United Nations Children's Fund
US: United States
US-FSSM: United State's Household Food Security Survey Module
USDA: United States Department of Agriculture
WFP: World Food Program
WHO: World Health Organisation
WSLMV: Weighted Least-Squares Means and Variance
WSSQ: Weight Self-Stigma Questionnaire
YAQ: Youth Adolescent Questionnaire

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GENERAL INTRODUCTION

The overall study focuses on food insecurity and its effects on variables related to psychological wellbeing, disordered eating and body image. There has been more focus on food insecurity in the field of research in recent years especially due to rise in food insecurity rates post economic crisis in 2008. It is important to examine the impact of food insecurity on adolescents. Adolescence represents a critical period of growth and development whereby negative factors such as food insecurity could affect physical health and psychological wellbeing. However, there has not been sufficient research about food insecurity in Spain nor has there been previously validated Spanish child food security questionnaires. Further, the effects of food insecurity on different variables in Spanish adolescents have not been examined before in previous research. Hence, the overall aims of this thesis are the validation of the Spanish Child Food Security Survey Module (CFSSM-S) and to examine the effects of food insecurity on psychological wellbeing, disordered eating, body image and dietary habits of Spanish adolescents.

This thesis comprises of two related studies. Study 1 focuses on the Spanish adaptation and validation of the Child Food Security Survey Module (CFSSM-S). Study 2 examines the associations between food insecurity and psychological wellbeing, disordered eating, body image and dietary habits in Spanish adolescents. The results of Study 1 have been published in the journal *Public Health Nutrition* (Shankar-Krishnan, Penelo, Fornieles-Deu and Sánchez-Carracedo, 2018) (see first page in Annex 9.8). The results of Study 2 have been submitted to a journal.

There are seven chapters in this thesis. The first three chapters provide an in-depth introduction to food insecurity. Chapter 1 provides a general overview of food insecurity, which includes its definition and ranges. It examines its consequences due to the economic crisis, its association with poverty and its prevalence rates in different countries of the world. Chapter 2 provides information about the measurement of food insecurity and the various methods of assessing food insecurity. It focuses on previous instruments commonly used to measure food insecurity including the English original version of the Child Food Security Survey Module (CFSSM). Chapter 3 examines the association of food insecurity with different variables. It focuses on its overall impact on general health and

wellbeing in adolescence. Further, focusing specifically on psychological wellbeing, body image and eating behaviour and their effects on adolescents. Finally, examining its associations with age, gender, weight status, socioeconomic class, family affluence and ethnicity.

Chapter 4 provides the objectives and design for study 1 and 2. Study 1 focuses on the adaptation and validation of the instrument, Spanish Child Food Security Survey Module (CFSSM-S). It examines the internal structure of the CFSSM-S, mean differences of external variables such as gender, grade (age), weight status, socio-economic status (SES and family affluence), as well as invariance and the relationship with these external variables. Study 2 examines the associations between food insecurity and psychological wellbeing, body image, disordered eating and dietary habits in Spanish adolescents. It determines if food insecurity is associated with poor psychological wellbeing, body dissatisfaction, disordered eating and poor dietary habits in Spanish adolescents. It also provides the prevalence rates of food secure and food insecure adolescents in the study.

Chapter 5 focuses on the common method used in both studies. It explains in detail about the cross-sectional study such as participants, measures used in both studies including the CFSSM-S and the common procedure employed in both studies. It also explains the data analysis for the two studies.

Chapter 6 provides a discussion of both studies, which includes the strengths and limitations ending with a brief conclusion and research implications of the study.

CHAPTER 1: FOOD INSECURITY: AN OVERVIEW

1:1 Definition and ranges

Food security and food insecurity have several definitions and some of which have been changed over the years. During the 1996 World Food Summit in Rome, leaders of 186 countries pledged to tackle and reduce the number of hungry individuals in the world [Food and Agriculture Organisation of the United Nations (FAO), 2000]. The state of hunger and food insecurity in the world gave rise to a more refined definition of ‘food security’ as ‘a situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life’ (FAO, 2003a). The FAO also went on to define ‘food insecurity’ as “a situation that exists when people lack secure access to sufficient amounts of safe and nutritious food for normal growth and development and an active and healthy life.” (FAO, 2000; FAO, 2003a).

However, Anderson’s (1990) definition of food insecurity has been commonly used in research articles and is defined as “the limited or uncertain availability of nutritionally adequate and safe foods or limited or uncertain ability to acquire acceptable foods in socially acceptable ways”. The United States Department of Agriculture (USDA, 2018a) has also adopted and used this definition in their research website.

Though the definitions provided by both the FAO and the USDA unanimously focus on the lack or the limitation of food resources, the FAO concentrates more on the physical, social and economic aspects of food insecurity and food preferences while the USDA focuses more on acceptable foods and the nutritional needs at an individual level (Gibson, 2012). In addition, food insecurity in the western world has been extensively studied through reports, national household surveys etc. in the United States when compared to other countries in Europe. Also, the USDA has conducted elaborate research and provides a wider range of food insecurity instruments including shorter versions of household surveys and a food insecurity instrument specifically for adolescents (as discussed in Chapter 2).

The USDA (2018a) initially labelled the ranges of food insecurity as ‘food insecurity without hunger’ and ‘food insecurity with hunger’. However, the term ‘hunger’ refers to a state of discomfort, pain, weakness or illness caused by the prolonged, involuntary lack of food which is often difficult to measure and would require elaborate information of the physiological experiences of the food insecure individual (USDA, 2018a). As a result, the USDA decided to avoid using the term ‘hunger’ when defining ranges of food insecurity. Instead, they labelled the ranges of food insecurity as ‘low food security’ and ‘very low food security’. Low food security has been described as ‘reports of reduced quality, variety, or desirability of diet. Little or no indication of reduced food intake.’ Very low food security includes ‘reports of multiple indications of disrupted eating patterns and reduced food intake.’

1.2 Impact due to economic crisis and association with poverty

Food insecurity is a term more common and predominant in economically disadvantaged regions of the world. Even though ‘malnutrition’ and ‘poverty’ are terms commonly known to the western world, ‘food insecurity’ still remains obscure to many. However, since the economic crisis of 2008, food insecurity has become a huge public health burden in the world, especially Europe (Loopstra, Reeves & Stuckler, 2015; Loopstra, Reeves, McKee & Stuckler, 2016). The crisis led to large-scale unemployment and poverty affecting food affordability thus resulting in malnutrition in developed countries such as Spain (Ortiz-Miranda, Perez & Alegre, 2016). The reductions and cessations in social benefits and school meal subsidies greatly affected the wellbeing of the Spanish population especially children (Frazer & Marlier, 2014).

Despite food insecurity being more common in poorer and developing countries of the world, its increase in developed countries since the economic crisis has reiterated its association with poverty. Higher rates of food insecurity are observed in individuals living near or below the poverty line (Nord, Andrews & Carlson, 2008). High food prices and low income are the main reasons why food insecure individuals find it difficult to afford healthy food prepared under sanitary conditions (Barrett, 2010; Kirkpatrick and Tarasuk, 2003). However, despite the association between poverty and food insecurity, it is important to note that not all food insecure households experience poverty nor is it necessary that all households living in poverty are food insecure (Coleman-Jensen, Rabbitt,

Gregory & Singh, 2017). For example, in a household survey conducted in the US, two thirds of all households with income below the national poverty line were found to be food secure (FAO, 2003a). Also, data from the 2009 December Supplement of the Current Population survey indicated three major factors examining the associations between food insecurity and poverty. The first factor is that food insecurity is inversely associated with income; second factor included that poverty is different from food insecurity and the third factor that households earning more than the stipulated poverty line are food insecure (Gundersen, 2013). As a result, this shows that specific associations between both poverty and food insecurity often vary depending on the definition of poverty (Wight, Kaushal, Waldfogel & Garfinkel, 2014). As pointed out by the FAO, IFAD, UNICEF, WFP and WHO, (2018), reductions in poverty does not necessarily guarantee better nutrition as some of the food insecure people do not belong to the poorest strata of society. While significant improvements are noticeable in alleviating poverty, poor quality of food and unhealthy diets are still major health deterrents worldwide (FAO et al, 2018).

1.3 Prevalence and relevance in different countries

According to the FAO et al, (2018), one out of nine persons in the world are undernourished. Food insecurity is mostly prevalent in poor countries of Asia, Africa and South America. As per the FAO, (2018) report, 19 million people (14.3 million adults and 4.7 million children) suffer from food insecurity in Europe and Central Asia. Although, severe food insecurity seems to be increasing especially in Africa and South America, undernourishment rates are stabilizing in Asia (FAO, et al, 2018).

The United States has documented its prevalence rates of food insecurity systematically through the years and has carried out extensive research in this area. According to the USDA, (2018b), 9.3 million and 5.8 million households in the United States experienced low food security and very low food security respectively. Despite children being protected by adults in their households, 7.7% still experienced food insecurity (USDA, 2018b).

The Eurostat 2015 data indicates considerable variation in food insecurity rates in countries in the European Union since the post economic crisis in 2008 (European Union, 2018). This data has also been confirmed in the UNICEF Innocenti report in 2017 (Pereira, Handa & Holmqvist, 2017), which provides the prevalence rates of households

experiencing food insecurity with children under 15 years of age in Europe (see Table 1). This report consists of a total of 289,933 respondents from 147 countries, a part of the Gallup World Poll in which a common methodology was applied; participants were randomly selected from households and the 8-item Food Insecurity Experience Scale (FIES) was employed. This report indicates that even though food insecurity rates are considerably less in countries like Norway, Sweden, Germany and France, it is much higher in Ireland and some of the Mediterranean countries like Portugal, Greece, Cyprus and Spain. However, as noted in this report, food insecurity rates in the United Kingdom (UK) are astonishingly higher in comparison to other EU nations.

Table 1: UNICEF Innocenti report, 2017 (Pereira et al, 2017)

COUNTRY/REGION	No of respondents	Share of children <15 years living in households with food insecurity
	N	%
Cyprus	664	17.57
France	486	6.02
Germany	418	4.91
Greece	446	15.74
Ireland	601	17.94
Norway	480	5.15
Portugal	793	18.15
Spain	585	12.01
Sweden	514	4.05
United Kingdom	354	19.46

There have been countries such as Germany, which immediately addressed the food insecurity issue during the post economic crisis by adopting suitable measures including soup kitchens, free meals and food banks even in small towns in order to reduce the number of hungry residents in their country (Pettoello-Mantovani, Ehrich, Sacco, Ferrara, Giardino & Pop 2018). This is indicative in their lower child food insecurity rate of 4.91

(Table 1). However, in other countries such as the UK, food insecurity continues to be a major issue as low income is one of the reasons cited by UK's largest food banks, Trussell Trust which has witnessed an enormous increase in the number of food bank users in 2018 (The Trussell Trust, 2018) indicating an increase in food insecurity rates. The UNICEF Innocenti report, 2017 (Pereira et al, 2017) (Table 1) has indicated that around 19% of children in the UK under the age of 15 years have been affected by food insecurity while another UNICEF report conducted in the same year 2017 also indicates 10% of children in the United Kingdom have been affected by severe food insecurity (UNICEF, 2017).

Food insecurity in Europe has been largely related to inequalities in social and environmental determinants of health and the inability to generate suitable public policies including public health interventions has resulted in a larger number of individuals becoming food insecure (Pettoello-Mantovani et al, 2018). This has been evident in countries such as Spain, which has witnessed budget cuts and increase in social inequalities and unemployment since the economic crisis of 2008 (Ortiz-Miranda et al, 2016). As a result, the gap between the upper and lower social classes have widened and child poverty rates are much higher than the rich world average (UNICEF, 2017). Twenty percent of the population in Catalonia (Spain) are living under the poverty line (Generalitat de Catalunya, 2017). There has also been an increase of 23% in child poverty in 2017 in Catalonia with 261,970 children experiencing severe poverty (Save the Children, España, 2017). The UNICEF Innocenti report, 2017 (Pereira et al, 2017) indicates 12% food insecurity rate in Spain. However, this report includes children under 15 years of age and food insecurity has been reported to be higher in older children (Fram et al, 2011). As a result, considering the insufficient data and lack of research studies about prevalence rates of food insecurity across a wider range of adolescents, further research studies are required in order to confirm the prevalence rates in adolescents in Spain.

CHAPTER 2: MEASUREMENT OF FOOD INSECURITY

2.1 Instruments to measure food insecurity

Food insecurity can be measured in a number of ways. There are three separate components to be considered while measuring food insecurity, which includes: uncertainty, insufficiency and hunger (National Research Council, 2005). As explained in Chapter 1, the term ‘hunger’ which refers to the physiological aspects of food insecurity was removed by the USDA while labelling the ranges of food insecurity due to problems in defining hunger in food insecure individuals. The term ‘uncertainty’ on the other hand refers to the psychological aspects of food insecurity in individuals such as worry and anxiety of procuring food (National Research Council, 2005). Some food insecurity studies (Alaimo, Olson, Frongillo & Briefel, 2001, Alaimo, Olson & Frongillo, 2002) have also used the term ‘food insufficiency’, which refers to the quality and quantity of safe and nutritious foods. There are five commonly used methods to measure food insecurity, which include the FAO method, household income and expenditure surveys, individual’s dietary intake, anthropometry and experience based food insecurity measurement scales.

2.1.1 FAO method

This method is based on the total calories per capita for a country using food balance sheet and calculates energy intake through household income and expenditure surveys (Cunningham, 2005). The FAO method focuses on the prevalence of undernourishment and the FAO compiles and sends regular reports of individuals who fail to reach the minimum energy requirement (FAO, 2019a). There have been few studies, which have employed the FAO method. The study conducted by Wessells, Singh & Brown (2012), in 188 countries examined the prevalence of nutritional deficiencies (zinc) through FAO food balance sheets. Another study conducted by Chen & Marques-Vidal in 2007 also employed the FAO method and reported changes in dietary intake in Mediterranean countries such as Spain, Portugal, France, Italy and Greece between 1966-2003 as these countries were found to be transitioning from a traditional to more Westernised form of diets. The advantages of the FAO method are that it is inexpensive in comparison to the other methods of measuring food insecurity and can generate data of the daily energy requirement of individuals in all countries (Pérez-Escamilla & Segall-Correa, 2008). The FAO method is also one with global coverage as it can estimate food insecurity in over 100

countries (de Haen, Klasen & Qaim, 2011). However, this method has been associated with some disadvantages, as it does not take into account dietary quantity. There is also a high rate of measurement error and discrepancies in the food balance sheets and there are problems establishing an average per capita cut off point based on gender, age and physical activity (Pérez-Escamilla & Segall-Correa, 2008).

2.1.2 Household income and expenditure surveys

This method includes interviewing individuals in households and collecting information such as the amount of money spent on food and takes into account the total calories consumed on average per individual. As indicated by the FAO (Cunningham, 2005), this method is useful in determining food insecurity by finding out whether the household falls below the average energy requirements based on age and gender. It also focuses on dietary quality and can be used to determine national food and nutrition (Pérez-Escamilla & Segall-Correa, 2008). This method has been commonly employed in research studies conducted by the USDA. The survey conducted by Coleman-Jensen et al in 2017 reported that a typical household in the US spent USD50 per person per week for food and undoubtedly, food secure households were more accustomed to spend more on food than those households who were food insecure. This method has been associated with some disadvantages as it only measures the food that is available and not the amount that is consumed or wasted. Further it is difficult to determine the amount of food consumed outside the households. There are also discrepancies in data collection used by different countries, hence it is difficult to compare across countries and finally this method is not cost-effective (Pérez-Escamilla & Segall-Correa, 2008).

2.1.3 Individual's dietary intake

This method records the food intake in individuals by means of their dietary history through food frequency questionnaires. The participants are requested to recall dietary history over the last 24 hours (Cunningham, 2005). There are some studies such as the one conducted by Kendall, Olson & Frongillo, 1996, which have used food frequency questionnaires and reported reduced fruit and vegetable intake and disordered eating in food insecure women. Another study which is a school based obesity prevention study conducted in the US employed food frequency questionnaires in fifth grade Hispanic children and found that food insecurity was negatively associated with obesity in children

and also children from severely food insecure households reported significantly lower nutritional intakes (Matheson, Varady J, Varady A & Killen, 2002). The main advantage of this method is that food consumption through dietary quantity and quality can be assessed directly and quickly (Pérez-Escamilla & Segall-Correa, 2008). The methods are flexible and can be adapted to fit the study (Cunningham, 2005). It helps understand food consumption at local and national levels hence the impact of food insecurity on the individual can be measured directly (Pérez-Escamilla & Segall-Correa, 2008). The major disadvantage with this method is the inaccuracy in the recall period of 24 hours as individuals find it difficult to remember the details of each dietary intake. There is also a likelihood of measurement error considering each individual's food preparation method and nutrient intake. It is also an expensive method that requires highly skilled professionals in order to input data and requires specialised software (Pérez-Escamilla & Segall-Correa, 2008).

2.1.4 Anthropometry

This method includes the use of human body measurement including size, weight, height and body proportions in order to determine nutritional status (Cunningham, 2005). According to Gibson, (1990), anthropometry is a safe and simple procedure to measure under-nutrition. It can be used in children, adolescents and adults and has well defined cut off points. The main advantages are that the procedure is fairly simple in recording weight and height; it is a relatively cost effective method and has strong cut off points (Pérez-Escamilla & Segall-Correa, 2008). However, anthropometry focuses only on the consequences of food insecurity (Pérez-Escamilla & Segall-Correa, 2008) as most of the food insecurity studies that have employed anthropometric measurements are from developing or third world countries and studies reporting under-nutrition in young children for whom nutritional deficiencies and problems such as stunting and malnutrition are common during the early developmental period. Further, the major limitation of this method is that it serves only as an indirect method of estimating the association between food insecurity and health status (Pérez-Escamilla & Segall-Correa, 2008). Anthropometry cannot specifically measure food insecurity nor can it be used as a proxy hence it can only be used in conjunction with other measurements such as surveys or food frequency questionnaires (Faber, Schwabe & Drimie, 2009). Also, the association between food insecurity and obesity is complex as research has indicated that individuals with low food

security are at higher risk of obesity while very low food secure individuals are severely thin or malnourished (Pérez-Escamilla & Segall-Correa, 2008). This method does not focus on changes in the nutritional status of vulnerable populations such as food insecure individuals and even though an individual's anthropometric results might be acceptable, they might still be at risk of food insecurity (Maxwell & Frankenberger, 1992).

2.1.5 Food insecurity experience measurement scales

This is considered to be one of the most reliable methods of direct assessment of food insecurity. Over the years there has been a lot of advancement in food insecurity measurement using individuals or household perceptions and experiences of food insecurity. The earliest method used to measure household food insecurity included the 'Radimer-Cornell', which focuses on food quality and quantity (Radimer et al, 1992). It focuses on the inability to consume nutritional foods due to lack of financial resources (Pérez-Escamilla & Segall-Correa, 2008). There have been other instruments developed since then including the Household Food Security Access Scale (HFIAS) (Coates, Swindale & Bilinsky, 2007) by the US Agency for International Development and the Household Food Security Survey Module (US-FSSM) (USDA, 2012) by the US Department of Agriculture (USDA). The HFIAS is an adaptation of the 18-item US-FSSM (Perez-Escamilla et al, 2004).

Household food insecurity questionnaires have been adapted and validated in various languages. The USDA's 15-item food insecurity instrument has been validated and adapted in Portuguese in Brazil (Perez-Escamilla et al, 2004) while the US-FSSM has been adapted and validated in Spanish, and specifically addresses the Hispanic American households (Harrison, Stormer, Herman & Winham 2003). The Latin American and Caribbean Scale (Escala Latinoamericana y Caribeña de Seguridad Alimentaria, ELCSA) (Comité Científico de la ELCSA, 2012) is a Spanish food insecurity questionnaire that focuses on food insecurity issues in Latin America and the Caribbean. However, none of these instruments are validated in Spain.

The Food Insecurity Experience Scale (FIES) is yet another food insecurity instrument, consisting of 8-items, developed by the FAO, in order to measure food insecurity in individuals and households and is a combination of the US-FSSM and the Latin American

and Caribbean Scale (ELCSA) (FAO, 2019b). This instrument was employed in the Gallup World Poll (2014-2018) and has been translated by the FAO into more than 170 languages in order to acquire food insecurity data from different countries in the world (FAO, 2019b). It has many advantages over other instruments such as its ease of administration; statistical effectiveness in cross-country comparisons of information; ability to clearly distinguish between various levels of food insecurity including by gender and helps identify vulnerable populations (FAO, 2019b). Despite its numerous strengths of being recognised as a global instrument of food insecurity in recent years, a continual validation of this instrument would be necessary in different countries in order to address cross-cultural and cross-national discrepancies (Saint Ville, Po, Sen, Bui & Melgar-Quiñonez, 2019).

As noted, there have been many food insecurity measurement scales that have been developed over the years and there are many advantages to this method as it measures the perceptions of food insecurity directly through affected individuals. In addition, it focuses on the psychosocial consequences of food insecurity while data collection and analysis are simple and inexpensive. These questionnaires can be adapted, validated and employed in different languages, countries and cultures (Pérez-Escamilla & Segall-Correa, 2008). However there are disadvantages such as establishing cut off points for classifying individuals or households as food secure and food insecure. There is no single food insecurity survey module to date that can measure 'hunger' in food insecure individuals (FAO, 2003b). Further, different countries could require different cut off points based on the severity of food insecurity because the frequency, prevalence and intensity of the food insecurity issue depends on each country's social and economic development (Pérez-Escamilla & Segall-Correa, 2008). For instance, the frequency, time reference and severity of food insecurity in households or individuals in the US or Canada could be different from countries such as Mexico or Brazil where economic and social conditions are different. Finally, most of these instruments including the FIES which have been employed globally are mainly focused on adults' perceptions of food insecurity experienced by themselves and/or of their children and do not necessarily represent the individual perceptions of older children i.e. adolescents (Fram, Frongillo, Draper & Fishbein, 2013).

In order to address the lack of an instrument that assesses food insecurity in older children, Fram et al, 2013 developed and validated a self-reported Child Food Security Assessment

instrument consisting of 32 items. Considering the length of this instrument, some studies have employed a shorter version (Altman, Ritchie, Frongillo and Madsen, 2018). However, the USDA's food security survey modules continue to remain popular over the years and have been employed in a majority of studies and surveys, not only in the US and Canada but also in Europe. European organisations such as the Food Standards Agency in the UK employed the 10-item US-FSSM to measure food insecurity in households in their 2016 'Food and You' survey (Bates, Roberts, Lepps & Porter, 2017). The USDA has also developed various versions of their 18-item instrument, US-FSSM including shorter versions of 6 and 10 items and in different languages. Further, they have also addressed the issues of not having an instrument that specifically measures food insecurity in older children by developing and validating the Child Food Security Survey Module (CFSSM).

2.2 Child Food Security Survey Module (CFSSM) (English)

This instrument CFSSM (see Annex 9.7) forms a part of the USDA's survey instruments, which is a valid and reliable tool in order to measure adolescents' perceptions of food insecurity in households. The instrument is unique as it is self-reported and does not require the presence of adults. The CFSSM aims to determine children's' perceptions of food insecurity from the 18 item US-FSSM, modifies the items suitably in order to make the language and formatting easier for comprehension by older children and yet retain the original content of the items (Connell, Nord, Lofton & Rehner, 2004)

Based on qualitative interviews with children, nine items chosen from the US-FSSM and two major changes were made in the CFSSM. The US-FSSM is a three-stage design survey module with screeners consisting of items specifically for adults and some items for children. However, the format of the instrument is complex and requires a greater degree of comprehension, which is often difficult for children to understand and respond. For this reason, the first change made in the CFSSM was in the response sets of the instrument, which was modified to a simple multiple-choice format with responses set as 'all/most of the time', 'some of the time' and 'none of the time'. This format was considered to be easier for children to comprehend and answer. The second change was in the time frame of the items. While the US-FSSM suggests a 12-month reference period, the authors shortened the time frame to 1 month. This was considering possible recall bias in children (Connell et al, 2004).

The 9-item CFSSM was piloted in a multi-ethnic sample of 467 adolescents aged 12-15 years in a secondary school in Mississippi, USA. The Rasch model was used to analyse responses to the food insecurity items. Reliability reported in the CFSSM at 0.69 was considered to be modest but acceptable. Both validity and reliability were considered to be adequate for children over 12 years of age, but unsuitable for children less than 12 years (Connell et al, 2004). The ranges of food security as proposed in the CFSSM are as follows: 0-1=food secure; 2-5=low food security and 6-9=very low food security. Although the US-FSSM classified children in households scoring ≥ 3 as food insecure, based on cognitive testing and the conceptual definition of food insecurity, the authors, Connell et al, 2004 in their study classified children scoring ≥ 2 as food insecure.

The CFSSM is a suitable instrument, which can be easily administered in adolescents, and has been recommended by the USDA. Not only has the CFSSM been employed in studies in the US but it has also been employed in other countries. The study by Hackett, Zubieta, Hernandez & Melgar-Quiñonez, 2007, which employed the CFSSM, indicated decreased nutritional intake of fruits, vegetables, legumes and oil in children in rural Ecuador. Also, the CFSSM has been used in a study in western Australia, which reported one of out five children to be food insecure (Godrich, Lo, Davies, Darby & Devine, 2017). Considering the lack of food insecurity questionnaires in Spanish for adolescents and also because the CFSSM has been used in research studies across different countries, we chose to adapt and validate the CFSSM into Spanish in order to employ it in our study.

CHAPTER 3: FOOD INSECURITY AND ITS EFFECTS ON RELATED VARIABLES

3.1 Food insecurity and adolescent health

Adolescence represents a crucial period of development whereby negative factors such as poverty could lead to long-term health implications for both the individual and society (Call et al, 2002). There are various biological and psychological changes that take place during the development period of adolescence (Toro, Gila, Castro, Pombo, & Guete, 2005) and inequalities during this period could result in major issues in adult life (Rajmil, Siddiqui, Taylor-Robinson & Spencer, 2015). Further, there is an increasing level of stress from pre-adolescence to adolescence (Rudolph, 2002). Experiences and social circumstances including poverty can lead to malnutrition influencing physical health during childhood ultimately worsening conditions during adolescence (Call et al, 2002). Adolescents who experience food insecurity in their households are less able to consume healthy dietary intakes and are at higher risk of nutrient deficiencies when compared to food secure adolescents (Bauer et al, 2015). This could result in issues such as stunted growth and development, poor physical health, obesity (Jones, 2017), anaemia, asthma and hospitalisation (Altman et al, 2018).

Apart from poorer physical health, adolescents also exhibit higher rates of psychological disturbances such as irritability, nervousness and anxiety (Gaspar de Matos, Tomé, Gaspar, Cicognani & Moreno, 2016). Poverty has been associated with mental health issues in adolescence (Fernandez-Rivas & Gonzalez-Torres, 2013) and mostly adolescents from low social classes experience higher rates of behaviour disorders, depression (McLaughlin et al, 2012) as well as psychosomatic symptoms including anxiety, headaches, back pain, nervousness etc. (Gaspar de Matos et al, 2016). Poor health during adolescence might be contributed due to various factors including socio-economic deprivation, family stress or unhealthy dietary intake (Utter, Izumi, Denny, Fleming & Clark 2017).

3.2 Effects on psychological wellbeing in adolescents

The term 'wellbeing' is not stable and can fluctuate especially in childhood and adolescence depending on changes and challenging situations in life and is linked to several factors including socioeconomic conditions in the family (Minkkinen, 2013).

Wellbeing is regarded to be a part of psychological health, linked to several psychological issues during adolescence (Navarro et al. 2019). On the other hand, the term ‘psychological wellbeing’ is multidimensional, and has not been well defined over the years (Dodge, Daly, Huyton & Sanders, 2012). However, it can be roughly defined as the ability of individuals to self-evaluate and fulfil various areas of their lives such as family, work and relationships (Cripps & Zyromski, 2015). With regard to psychological wellbeing, the Google scholar database found 18 studies from the years 1997-2018 using ‘food insecurity’ as the main keyword or related terms such as ‘food insufficiency’ with a combination of other keywords such as psychological wellbeing, adolescence, gender, SES, stress, anxiety, coping, depression, substance abuse, bullying and social dysfunction. The inclusion criteria were maintained to key concepts of food insecurity in adolescents in relation to a wide range of factors for psychological wellbeing including anxiety, stress, coping, depression etc. and research studies conducted in developed countries. The search resulted in mostly cross-sectional studies. 12 papers that assessed the effects of food insecurity on psychological wellbeing were finally selected. Out of the 12 papers, 11 papers specifically focussed on adolescents and one paper (Davison, Holloway, Gondara & Hatcher, 2018) examined suicide ideation in food insecure adults. The main descriptive of the 12 papers can be found in Table 2 followed by the theoretical explanation of the information and a brief summary.

Table 2: Studies examining associations between food insecurity and psychological wellbeing

Study	Design	Sample	Method-instruments	Statistical analyses	Controlled by SES	Result
Alaimo et al, (2001)	Cross-sectional representative survey, National Health and Nutrition Examination Survey (NHANES – III) (1988-1994)	<i>n</i> =6154, ♂ & ♀ 1-5 years <i>n</i> =5667, ♂ & ♀ 6-16 years Non Hispanic white, non-Hispanic Black, Mexican-American	Socioeconomic information, Food insufficiency questionnaire, household youth questionnaire	Ordinal logistic regression analyses	✓	Food insufficient children are more likely to experience health problems and poorer health status
Alaimo et al, (2002)	Cross-sectional representative survey, National Health and Nutrition Examination Survey (NHANES – III)	<i>n</i> =754, ♂ & ♀ 15-16 years Non Hispanic White, non-	Socioeconomic information, Food insufficiency questionnaire, diagnostic interview schedule	Logistic regression	✓	5% of adolescents reported attempting suicide and 38.8% reported at least one suicidal symptom, food insufficient and female adolescents report poor psychological wellbeing

	(1988-1994)	Hispanic Black, Mexican- American				
Ashiabi, (2005)	Cross-sectional study	<i>n</i> =11,614, ♂ & ♀ 6-11 years Blacks, Whites and other ethnicity	Socioeconomic information, food insecurity assessed based on food stamp information, health status, child emotional well-being and school engagement	Path analyses	✓	Food insecurity is associated with worse health status in children including negative effects on school engagement and exhibited higher risk of emotional and behavioural issues
Bernal et al, (2016)	Cross-sectional study	<i>n</i> =404 ♂ & ♀ 7-17 years Multi-ethnic sample	Inventory of items measuring food insecurity, management strategies and shame	Gamma analysis	✗	There is an association between child food insecurity and shame of others knowing they were out of food
Bruening et al, (2017)	Cross-sectional study	<i>n</i> =55 (mother- adolescent dyad) ♂ & ♀ Hispanic, US born, lived in	Socioeconomic information, 6 item Food Security Survey Module, Eating Behaviour inventory	Multivariate linear and logistic regression	✗	Food insecure adolescents report higher risk of behavioural issues and poor health status. Higher frequency of family meals and mindful eating but higher rate of binge eating behaviour observed in food insecure mother-adolescent

		the US for more than 10 years	including the Mindful Eating Questionnaire and binge eating			dyads.
Carter et al, (2011)	Cross sectional study	n=18955 ♂ & ♀ ≥15 years New Zealander/ European, Maori, Pacific, Asian, Other	Socioeconomic information including NZ-specific Jensen index and NZ deprivation index), Kessler 10 scale (K-10)	Logistic regression analyses	✓	Strong association between food insecurity and psychological distress. Food insecure females are at a higher risk of psychological issues.
Casey et al, (2005)	Cross-sectional study	n=399 ♂ & ♀ 3-17 years Black and White	Socioeconomic information, US Household Food Security Scale, Pediatric Quality of Life Initiative (PEDS QL)	Linear and logistic regression	✓	Household food insecurity is significantly associated with health-related quality of life. Older children aged 12-17 years reported lower psychosocial function

Davison et al, 2015	Cross-sectional study	n=5270 ♂ & ♀ >18 years	Socioeconomic information, items on suicide ideation, Household Food Security Survey Module (HFSSM)	Logistic regression	✓	Suicide ideation is significantly associated with moderate and severe food insecurity
Davison et al, 2018	Cross-sectional study	n=13450 ♂ & ♀ ≥12 years	Socio-demographic information, HFSSM, items on mood disorder, Canada's Alcohol and Other Drugs Survey	Poisson regression analysis	✓	Substance use and mood disorders are highly prevalent in food insecure individuals
Edwards and Taub (2017)	Cross-sectional representative survey from HBSC	n=12642 ♂ & ♀ 10-16 years Caucasians, African-Americans, Asians, Native Americans, Hawaiian,	HBSC survey consisting of food insecurity items from the USDA and items on bullying	Kruskal-Wallis H tests	✓	Food insecure children are at higher risk of bullying their peers and are also victims of bullying in comparison to food secure children

Hispanics

McLaughlin et al, (2012)	Cross-sectional study	<p>$n=18955$</p> <p>♂ & ♀</p> <p>13-17 years</p> <p>Non-Hispanic White, non-Hispanic Black, Hispanic, Other</p>	<p>Socioeconomic information, modified version of the Composite International Diagnostic Interview (CIDI) analysing DSM-IV disorders, USDA's Food Security Scale</p>	Logistic regression	✓	<p>Higher food insecurity observed in lower SES participants. Food insecurity is associated with increased levels of anxiety, behavioural and mood disorders.</p>
Roustit et al, 2010	Cross-sectional study	<p>$n=2346$</p> <p>♂ & ♀</p> <p>13-16 years</p> <p>Ethnic majority, ethnic minority</p>	<p>Socioeconomic information, Radimer-Cornell food insecurity questionnaire, items on scholastic outcomes</p>	Logistic regression	✓	<p>Household food insecurity is strongly associated with scholastic difficulties.</p>

Psychological distress in adolescents can result in negative thoughts and emotions (Cripps & Zyromski, 2015). It has been indicated that food insecurity impacts mental health resulting in psychological distress (Carter, Kruse, Blakely & Collings, 2011) and affects psychosocial functions during adolescence (Casey et al, 2005). The plausible theory of association between food insecurity and mental health problems involves a mechanism whereby acquiring adequate amounts of food becomes uncertain, thereby resulting in a strong stress response in individuals leading to anxiety and depression (Weinreb et al, 2002). Also, parents of adolescents in food insecure households experience chronic stress due to food deprivation, which in turn could negatively affect their parenting behaviours hence increasing risks of psychological issues in their adolescent children (Alaimo et al, 2002). This could possibly explain why food insecurity was found to be more strongly associated with adolescent mental health issues than other SES indicators (McLaughlin et al, 2012). Some studies have indicated that food insecure adolescents are at a higher risk of exhibiting behavioural and health issues that prevented them from attending usual activities in school (Alaimo et al, 2001) and they also experienced more psychological issues compared to their food secure peers (Bruening, Lucio & Brennofer, 2017). Furthermore, studies have found differences based on gender in the context of adolescent mental health. Adolescent females from food insecure households are considered to be at a higher risk of developing psychological issues such as depression (Alaimo et al, 2002).

It has been observed that as the severity of food insecurity in households increases, the risk of mental health issues including suicide ideation also increases (Davison, Marshall-Fabien & Tecson, 2015). It has also been proposed that mood disorders and substance abuse coexists in food insecure individuals (Davison et al, 2018). In addition, psychological problems including low self-esteem (Roustit, Hamelin, Martin-Fernandez & Chauvin, 2010), anxiety, stress and behavioural problems (Ashiabi, 2005) are commonly noted in food insecure adolescents. Food insecurity was observed to play a major role in depression which also increased the time duration of the latter hence associating food insecurity with more chronic cases of mental health disorders including dysthymia (Alaimo et al, 2002).

There are studies that have found associations between depression and low self-esteem (Orth, Robins, & Roberts, 2008). Self-esteem is a fluctuating and dynamic construct, which is a crucial aspect in the psychological functioning of adolescents (Moksnes,

Moljord, Espnes & Byrne, 2010). Adolescents with low self-esteem have low coping skills and are less equipped to handle stressful events (Orth, Robins & Meier, 2009) such as food insecurity. Ong, Bergeman, Bisconti & Wallace (2006) report that an individual's capacity to successfully handle stressful events in life is based on the ability to maintain a balance between positive and negative affects or emotional states. An accumulation of minor distressing events could trigger off stress resulting in higher rates of negative affects that could exist for variable amounts of time (Fields & Prinz, 1997; Ong et al, 2006).

Adolescence is a period consisting of a myriad of stressful circumstances that require effective coping mechanisms (Fields & Prinz, 1997). However, most adolescents exhibit passive coping during stressful events in life (Fields & Prinz, 1997) in order to avoid confronting distressing situations and expressing painful emotions. Social dysfunction refers to a state of emotional and behavioural dysregulation where individuals find it difficult to cope effectively with problems and display decreased social skills and interactions especially noticeable during the adolescence period (Bierman & Welsh, 2010). Social dysfunction in food insecure adolescents is observed through emotional and behavioural problems and their avoidance in engaging in school activities and interacting with peers (Ashiabi, 2005). Further, some studies have also reported higher levels of psychosocial and behavioural issues among food insecure children in comparison to their food secure peers as the former are more prone to bully and getting bullied in school (Edwards & Taub, 2017). Food insecurity in children has been associated with shame of others knowing that they are out of food and shame plays a major component of the stressful experience of food insecure children (Bernal, Frongillo & Jaffe, 2016). The lack of food resources is related to destructive and negative psychosocial behaviour (Edwards & Taub, 2017) including bullying, victimisation, feelings of unworthiness or low self-esteem and social dysfunction exhibited through withdrawal and avoidance of peers. All these negative traits and behaviours exhibited by food insecure children could be attributed to feelings of shame and stigma (Bernal et al, 2016), which has not been sufficiently examined in food insecurity studies.

In summary, as noted in Table 2, there are mainly cross-sectional studies assessing food insecurity through household surveys. It is evident that a wide range of instruments could determine psychological wellbeing, and most of the studies have been controlled by SES.

It can be observed that the sample size too varies greatly with the studies. Most of the cross-sectional studies report greater risk of psychological issues such as anxiety, depression and low self esteem in food insecure individuals. There is a need for a greater number of longitudinal studies examining the association between food insecurity and psychological wellbeing.

3.3 Impact on disordered eating and body image in adolescents

In the case of disordered eating and body image, the Google scholar database found 14 research studies from the years 1997-2018, using the main keyword ‘food insecurity’ along with a combination of other keywords including disordered eating, binge eating, dieting, weight control behaviour, restrictive feeding, weight stigma, eating disorder, body dissatisfaction, body image and SES. The inclusion criteria were maintained to studies with children and adolescents though few studies also included households. The search resulted in a wide range of mostly cross-sectional studies. Following the criteria as mentioned above, and excluding a commentary by Ambroziak, Azañón & Longo, (2017), 7 papers were finally selected specifically assessing the effects of food insecurity on disordered eating and/or body image in adolescents and households. The search was focused on studies in developed countries. The main descriptive of these 7 papers can be found in Table 3 followed by the theoretical explanation of the information and a brief summary.

Table 3: Studies examining associations between food insecurity and disordered eating and body image

Study	Design	Sample	Method-instruments	Statistical analyses	Controlled by SES	Result
Altman et al, (2018)	Cross-sectional study	n=14768 ♂ & ♀ 9-14 years Asian, African-American, Latino, Other, White	Socio-demographic information, Child Food Security Assessment, Body Shape Satisfaction Scale	Multivariable logistic regression	✓	Food insecure children were at a higher risk of increased body dissatisfaction
Bauer et al, (2015)	Cross-sectional study, adolescent mother dyad	n=2087 (adolescents) ♂ & ♀ White, African-Americans, Hispanic, Asian-American, Hawaiian, American-	Socio-demographic information, Project F-EAT survey included 6 item USDA’s Food Security Survey Module, dieting practices, healthy eating, parental comments and concerns about child’s weight, restrictive and pressured feeding	Logistic regression analysis	✗	Food insecure mothers were more likely to encourage dieting, use restrictive and pressured feeding practices, comment about child’s weight and report concern over child’s weight

		Indian, Other	practices			
Becker et al, (2017)	Cross sectional study	<i>n</i> =503 ♂ & ♀ Households Latino, African-American, White, Other	Radimer Cornell Food Insecurity Measure, 18 item Eating Disorder Diagnostic Scale (EDDS-5), Eating Disorder Examination Questionnaire (EDE-Q), Weight Self-Stigma Questionnaire (WSSQ), Penn State Worry Questionnaire PSWQ)	One-way ANOVA	✓	Adults with severe food insecurity who reported having hungry children at home exhibited higher levels of binge eating, weight self-stigma, higher ED pathology and worry. Compensatory behaviours including exercising, skipping meals etc. increased with increase in food insecurity level (i.e. very low food security)
Becker et al, (2019)	Cross sectional study	<i>n</i> =891 ♂ & ♀ Households Latino, African-American, White, Other	Sociodemographic information, Radimer-Cornell Food Insecurity Measure (RCFIM), Eating Disorder Diagnostic Scale 5 (EDDS-5), Patient Health Questionnaire (PHQ-8), Generalised Anxiety Disorder (GAD-7)	ANCOVA	✓	Adults with severe food insecurity and hungry children at home reported higher levels of eating disorder pathology combined with dietary restraint, anxiety and depression

Bruening et al, (2017)	Cross-sectional study	<p><i>n</i>=55 (mother-adolescent dyad)</p> <p>♂ & ♀</p> <p>Hispanic, US born, Lived in the US for more than 10 years</p>	<p>Socioeconomic information, 6 item Food Security Survey Module, Eating Behaviour inventory including the Mindful Eating Questionnaire and binge eating</p>	<p>Multivariate linear and logistic regression</p>	✗	<p>Food insecure adolescents report higher risk of behavioural issues and poor health status. Higher frequency of family meals and mindful eating but higher rate of binge eating behaviour observed in food insecure mother-adolescent dyads.</p>
Gulliford et al, (2006)	Cross-sectional study	<p><i>n</i>=1903,</p> <p>♂ & ♀</p> <p>16 years</p> <p>African-Caribbean, Indo-Caribbean, mixed, other, not known</p>	<p>An inventory of 6 item food security survey questionnaire, questions about weight perceptions, leisure-physical activity</p>	<p>Logistic regression</p>	✓	<p>Food insecure adolescents are more likely to desire gaining weight and engage in less physical activity</p>
Widome et al, 2009	Observational study, Project EAT	<p><i>n</i>=4746</p> <p>♂ & ♀</p> <p>Middle and high school</p>	<p>Socio-demographic information, USDA's Food Security Survey: 3 Stage Design with screeners, questions about healthy eating,</p>	<p>Multiple linear regression</p>	✓	<p>Food insecure children perceived barriers and inconvenience towards healthy eating and reported that healthy food did not taste good. Food insecure children also had higher</p>

children

White, Black,
Hispanic,
Asian, Native
American,
Other

household food
availability, fast food
intake, YAQ

BMI, ate fewer family
meals and more junk food

In the case of eating disorders, most research studies have focussed on adolescent girls and young women, however its association with socioeconomic factors such as food insecurity has not been extensively studied (Becker, Middlemass, Gomez, & Martinez-Abrego, 2019). The study by Becker, Middlemass, Taylor, Johnson & Gomez, (2017) has been one of the first to examine this specific association and has found a higher level of disordered eating including binge eating in food insecure individuals. Certain food insecure individuals are more vulnerable and predisposed to developing eating disorders and very low food security is a potential risk factor of developing eating disorders (Becker et al, 2019). Binge eating has been associated with psychological issues such as depression (Paxton & Diggins, 1997) and increasing symptoms of depression and anxiety are reported in individuals with severe food insecurity (i.e. very low food security) (Becker et al, 2019).

In the case of adolescents, parental influence in encouraging healthy eating has been associated with healthy weight and dietary quality (Bauer, Neumark-Sztainer, Fulkerson, Hannan & Story, 2011a). However, in some households, parents practice weight control behaviour and restrictive food access either deliberately in order to encourage weight loss in their children (Bauer, Berge & Neumark-Sztainer, 2011b; Loth, MacLehose, Fulkerson, Crow & Neumark-Sztainer, 2013) or due to food insecurity (Bauer et al, 2015). As a result, higher incidences of maladaptive weight control behaviour and disordered eating are observed in these households (Loth et al, 2013). Further, restrictive feeding practices are more observed with daughters of food insecure households than sons (Bauer et al, 2015).

Individuals with 'very low food security' experience weight stigma and exhibit higher levels of eating disorder pathology (Becker et al, 2017). However, there are some contradictory findings in the association between food insecurity and disordered eating behaviour. While some studies have indicated weight control behaviour and restrictive feeding practices in food insecure households, some others have found that food insecure adolescents are more prone to exhibiting disordered eating behaviours such as binge eating and consuming nutritionally poorer diets (Bruening et al, 2017). Food insecure individuals are reported to have an increased tendency to overeat when food is available hence increasing their risk of being overweight (Widome, Neumark-Sztainer, Hannan, Haines & Story, 2009). While food secure individuals have a steady flow of food resources, and are more likely to perceive themselves as overweight, on the other hand, food insecure

individuals due to food scarcity often perceive themselves to be thinner (Ambroziak et al, 2017). In this line, food insecure adolescents were also more focused on gaining weight and spending less time on physical activity (Gulliford, Nunes & Rocke, 2006).

However, it is also important to take into account compensatory behaviours such as over exercising, skipping meals etc. which have been observed in individuals with very low food security in order to reduce the discomfort after binge eating (Becker et al, 2017). This could explain the extreme ranges observed in eating disorders fluctuating from dietary restriction to binge eating in food insecure individuals. Introducing regular patterns of eating could prevent eating disorders. However, the complexity that exists in the case of food insecurity due to irregular eating makes it challenging and untreated eating disorders could continue bouts of binge eating behaviour in food insecure individuals (Becker et al, 2019).

Body image is a multidimensional concept, which refers to the perceptions and attitudes towards one's own body but not necessarily one's appearance (Cash & Pruzinsky, 2004). Body dissatisfaction on the other hand is more related to the cognitive-affective aspects of body image, which can result in negative self-evaluation of one's own body (American Psychiatric Association, 2013; Mountford & Koskina, 2017). Body dissatisfaction particularly refers to the condition whereby individuals are unhappy with the shape, build, weight or other parts of their body thus increasing the risk of indulging in unhealthy eating behaviour; adopting slimming techniques; smoking and taking diet pills (Neumark-Sztainer, Paxton, Hannan, Haines & Story, 2006). In general, adolescents exhibit concerns about weight and could develop body image problems at a very early age (O'Dea 1999). Unhealthy weight control practices have been commonly observed in adolescents (O'Dea & Caputi, 2001). There is an association between SES and body image as higher SES has been associated with better body image (O'Dea & Caputi, 2001). However, in the context of food insecurity, there have been few conflicting findings about body image during adolescence. Regarding associations between food insecurity and body dissatisfaction, studies on this topic are rare, mainly with children and adolescents. The only study conducted to date with children focused on this association suggests that food insecure children might be more dissatisfied with their bodies (Altman et al, 2018, see Table 3).

In summary, as observed in Table 3 there are mainly cross-sectional studies assessing the associations between food insecurity and body image and disordered eating. As noted, a wide range of instruments has been used to measure food insecurity, but the Radimer-Cornell food insecurity instrument and the USDA's Food Security Survey modules have been commonly used. However, we find that the measures adopted to assess body image and disordered eating in each of these studies to be different and the mode of assessment is either through common questionnaires such as the BSQ or an inventory of questionnaires consisting of specific items on weight control and feeding practices, binge eating behaviour, weight stigma, fast food & fruit and vegetable intake etc.

3.4 Food insecurity and dietary habits in adolescents

Likewise, in the case of dietary habits, we performed the Google scholar database search between 1997-2018, which yielded results for 7 research studies notably in recent years, 2004-2015 using the main keyword 'food insecurity' along with a combination of other keywords including diet quality, Mediterranean diet, dietary patterns and dietary habits. The inclusion criteria were maintained to studies with children and households in developed countries. The search resulted in cross-sectional studies. However, only 2 papers specifically assessed the effects of food insecurity on dietary habits in adolescents. The main descriptive of these papers can be found in Table 4 followed by the theoretical explanation of the information and a brief summary.

Table 4: Studies examining associations between food insecurity and dietary habits

Study	Design	Sample	Method-instruments	Statistical analyses	Controlled by SES	Result
Bhattacharya et al, (2004)	Cross-sectional study from survey data NHANES III	<i>n</i> =34,000 ♂ & ♀ Children and Adults White, Black, Hispanic	Socio-demographic information, Current Population Survey included USDA's Food Security Survey Module, USDA's Healthy Eating Index (HEI)	Regression analyses	✓	Children with food insecurity or poverty are not affected by nutritional outcomes unlike adults
Dykstra et al, 2016	Cross-sectional study	<i>n</i> =821 ♂ & ♀ Children African-American, Hispanic, White, Other	Socio-demographic information, Breakfast Patterns Survey (BPS), 6 item US-FSSM, anthropometric measurements	ANOVA	x	There were no differences in breakfast patterns between food secure and food insecure children

Dietary indices for children and adolescents are important to study the individual dietary patterns and intake in order to promote healthy eating (Lazarou & Newby, 2011). The Mediterranean diet has been found to be associated with positive health outcomes including protection against cardiovascular diseases, metabolic diseases, cancer prevention, increased longevity etc. (Grosso et al, 2013). However, diets in modern times have undergone drastic changes with the introduction of higher consumption of calorie laden and highly processed foods including soft drinks, meat products combined with a lower consumption of fruits and vegetables (Grosso & Galvano, 2016).

SES plays an important role as adolescents of low SES are considered to consume less healthy diets and fewer intakes of fruits and vegetables (Bauer et al, 2015). The consumption of low fruits and vegetables are related to the consumer price index as fruits and vegetables are more expensive and thereby unaffordable for individuals of low SES (Sturm, 2005). Further, fewer grocery stores and many fast food restaurants in neighbourhoods of low SES contribute to further unhealthy eating practices (Riediger, Shoostari, & Moghadasian, 2007). The association between food insecurity and low SES could explain that food insecure adolescents have greater access to nutritionally poor, energy dense foods (Kirkpatrick & Tarasuk, 2008). Yet some studies such as the one conducted by Dykstra et al, 2016 found no differences in breakfast patterns between food secure and food insecure children and explain that the lack of differences could be due to several reasons including the young age of children (up to 12 years) in their study and the availability of free breakfast in schools. Further, Bhattacharya, Currie & Haider, (2004) have also found no significant differences in dietary habits between food secure and food insecure children. The authors explain that children, unlike adults, might not be as affected by the lack of food resources at home as they are able to compensate at school or elsewhere. Another factor to consider which explains the lack of differences in dietary habits between food secure and food insecure children is the change in the food environment over recent years in children and adolescents of all socioeconomic classes (low, medium or high) which has led to the over reliance on the fast food environment and lower consumption of fruits and vegetables (Grosso & Galvano, 2016). As a result, there are not many drastic changes in the quality of their diets. However, studies focussing on both factors including dietary quality and quantity are important in food insecure households.

In summary, as observed in Table 4, there are only 2 studies centred in the area of food insecurity. Most of the other studies focus on SES and have reported the strong association between high SES and better dietary habits. As a result, future studies should be focussed on the associations of food insecurity and dietary habits in adolescents.

3.5 Association with other variables: gender, age, weight status, socioeconomic status and family affluence, and ethnicity

In the case of gender, food insecurity is found to be more common in households with single parents headed by females in comparison to male dominated households (Coleman-Jensen et al, 2017). However, there are some contradictory studies focussed on gender differences in food insecurity in adolescents. Some studies indicate that both adolescent boys and girls are equally likely to experience severe food insecurity in their households, although girls are more likely to report food insecurity than boys (Hadley, Lindstrom, Tessema, & Belachew, 2008; Shanafelt, Hearst, Wang & Nanney, 2016). A recent study, which used data from the Gallup World Poll of 146 countries in Europe, Asia, North America, Latin America and Caribbean, Australia-New Zealand etc. has also reported that females worldwide from both developed and developing nations are at a higher risk of food insecurity when compared to males (Broussard, 2019). As explained by Broussard (2019), women have a greater role in managing food resources and might be more aware of food insecurity in households. Also, an additional factor could be that men associate the lack of finances and food resources with shame and as a result, might be less likely to report food insecurity in households (Broussard, 2019). However, another recent study found that adolescent males are at a higher risk of food insecurity than females which could be explained by the reason that males have higher nutritional needs than females but they could feel more pressure to cut down on food portions in their households for the sake of younger members of their family (Niemeier & Fitzpatrick, 2019). Gender differences were also found to be more prominent in severely food insecure households (Hadley et al, 2008). Considering the contradictory findings in this area, more studies are required to determine the association between gender and food insecurity.

With respect to age, food insecurity is notably higher in older children (Shtasel-Gottlieb, Palakshappa, Yang, & Goodman, 2015; Nord, 2009). Children especially adolescents are

aware of food insecurity in their households (Fram et al, 2011). Some studies have reported that adolescents are twice as likely to experience food insecurity and four times more likely to experience very low food security than their younger siblings in food insecure families (Bauer et al, 2015). Young children are often protected from food insecurity as they are considered more vulnerable than their older siblings who have a better chance of acquiring food from other sources outside the home and are more able to withstand hunger (Fram et al, 2011). Further, protective mechanisms have been observed in food insecure households such as adolescents protecting their younger siblings by sacrificing their own food portions and ensuring their siblings have enough to eat (National Research Council & Institution of Medicine, 2013).

Weight status is yet another highly debated topic in food insecurity. There have been inconsistent findings about the association between overweight and obesity with food insecurity (Dinour, Bergen & Yeh, 2007). The important factor related to food insecurity and childhood obesity/overweight is that mothers of younger children in food insecure households are reported to provide higher calories and appetite stimulants to children in order to compensate concerns for their child's under-nutrition (Bauer et al, 2015). Dietary intakes during childhood predict weight outcomes in adolescence and, as explained by Riediger et al, (2007), childhood and adolescence are critical periods whereby the development of obesity could result in unhealthy eating and weight issues in adulthood. However, parents of adolescents exercise more control over dietary intake in order to conserve food resources at home (Bauer et al, 2015). Further, adolescents in food insecure households in general consume cheap, energy dense foods and experience intermittent patterns of eating less when resources are limited and they exhibit tendencies to overeat when resources are readily available (Tester, Lang & Laraia, 2016). This could result in drastic changes in food intake, (Olson, Bove & Miller, 2007) resulting in unhealthy eating behaviours by consuming foods of lower dietary quality despite an overall decrease in dietary quantity leading to health problems such as obesity (Bauer et al, 2015). Also, food insecure adolescents are at a higher risk of eating in response to negative emotions (Ash, 2014). This could explain the association between food insecurity and obesity/overweight in childhood and adolescence.

It has been studied that socioeconomic inequalities influence health behaviours in individuals including adolescents (MacIntyre & Hunt 1997). Food insecurity has been associated with low SES (Sarlio-Lahteenkorva & Lahelma, 2001). This could be attributed to the reason that individuals of low SES are at a social disadvantage of being unable to purchase and consume food of higher dietary quality (Darmon & Drewnowski, 2008). Further, households of low SES are at higher risk of food insecurity as they have decreased financial and food management skills and are unable to pay bills, stretch groceries or prepare healthy meals (Wight et al, 2014). Socioeconomic status can be measured using multiple indicators including income, education and occupation (Currie, Elton, Todd & Platt, 1997). However, measuring SES in adolescents has been considered difficult as most children are unaware of their parents' occupations or unable to describe them sufficiently thus posing a challenge at the time of coding occupational class in SES surveys (Currie et al, 1997). Likewise, family affluence has also been associated with low SES as individuals of low SES are at a greater disadvantage of material hardships (Iceland & Bauman, 2007). According to Currie et al, (1997), adolescents are more aware of information related to family affluence such as the possession of cars, telephones etc., when compared to information about household SES. Material affluence is considered to be an important indicator of poverty and prosperity and can effectively indicate individual wellbeing (Hruschka Hadley & Hackman, 2017) and material hardships have been associated with food insecurity (Hadley et al, 2011; Fafard-St-Germain & Tarasuk, 2018).

Some studies have found ethnicity or racial background to be an important factor in food insecurity, with ethnic minority households reported to be at a higher risk (Altman et al, 2018). This is especially true in the case of food insecurity studies conducted in the United States where the highest proportion of food insecurity is found in African-Americans followed by Hispanic Americans with Caucasians (non Hispanics) reporting a lower percentage of food insecurity (USDA, 2016; Feeding America, 2017). However, a study conducted in the United States indicated that non-Hispanics (i.e. Caucasians) are more likely to be food insecure than Hispanics (Niemeier & Fitzpatrick, 2019). As explained by the authors of this study, some communities of ethnic minorities tend to be protective and might prevent their neighbours from being food insecure. Another study conducted in the United Kingdom, also reported higher rates of food insecurity in Caucasian women when compared to ethnic minorities (Power et al, 2017). As explained by Power et al, (2017),

one of the reasons for lower food insecurity rates in ethnic minority households might be due to the effective management of resources. This suggests that ethnicity is an important factor associated with food insecurity but other factors such as SES could play a far more crucial role in its association with food insecurity in households.

Taking into account that food insecurity can be influenced by factors such as age, gender, weight status, SES, family affluence and ethnicity, we used them as adjustment variables and also potential confounders in our study.

CHAPTER 4: DESIGN AND OBJECTIVES

4.1 Design of Study 1 and 2:

Studies 1 and 2 are cross-sectional. They were conducted in the secondary school, IES Torre del Palau at Terrassa in Barcelona in Spain.

4.2 Study 1: Objectives

Food insecurity has been well researched in countries such as the United States, Canada and United Kingdom. These countries have collected data through national surveys in order to find out the prevalence rates of food insecurity in both adults and children. However, there is a scarcity of food insecurity studies in Mediterranean countries like Spain. Previous reports in Spain have indicated an increase in child poverty and malnutrition. But, as previously mentioned, the term ‘food insecurity’ has not been widely used in media reports or studies in Spain. Further, there are no previously validated Spanish instruments to measure food insecurity in adolescents. Unlike younger children who find it difficult to report food insecurity, adolescents have a better idea about information related to food insecurity in their households such as financial issues, food scarcity, rationing of food etc. As a result, a self-reported questionnaire was required in order to understand their perceptions of food insecurity in their household. This study has developed a validated, self-reported, Spanish instrument specifically for adolescents aged 12-16 years and has hence focussed on the following objectives:

- translation of the CFSSM (English) to CFSSM-S (Spanish) (as explained in ‘Procedure’ in the Methods section)
- assessment of the psychometric properties of the CFSSM-S
- assessment of the internal structure of the CFSSM-S with exploratory and confirmatory factor analysis (EFA and CFA) in a sample of Spanish adolescents
- examining the measurement invariance across gender, grade, weight status, socio-economic status (SES) and family affluence
- determining the relationship of food insecurity with external variables such as gender, grade, weight status, SES and family affluence as a way to study its validity.

4.3 Study 2: Objectives and hypotheses

There has been a huge rise in food insecurity since the economic crisis of 2008. It is for the first time that a research study conducted in the field of food insecurity in Spain provides prevalence rates of food insecurity in adolescents across a wide age range (12-16 years). Food insecurity can impact the health and wellbeing of children particularly adolescents and there has been a lack of food insecurity studies in Spain examining its associations with crucial variables such as psychological wellbeing, body image and dietary habits. The associations between food insecurity and psychological wellbeing have been studied in countries such as the United States, Canada and United Kingdom but never in Spain. Also, concepts such as disordered eating and body image have not been previously studied in the context of food insecurity within the Spanish population. Although there are studies that have reported poor dietary habits in low SES individuals, its association with food insecurity has not been sufficiently researched. For these reasons, Study 2 focussed on the following objectives:

- determining the prevalence rates of food insecurity in a sample of Spanish adolescents
- examining differences in psychological wellbeing in food secure and food insecure Spanish adolescents in terms of their self-esteem, positive and negative emotions, stress and coping
- investigating if there are differences in body image, eating behaviour and dietary habits in food secure and food insecure Spanish adolescents

Hypotheses

- based on the findings of previous studies (conducted outside Spain) which have examined the associations between food insecurity and psychological wellbeing, we expect to find poorer psychological wellbeing in the form of lower self esteem, lower levels of positive emotions, greater levels of stress and lower rates of coping in the case of food insecure Spanish adolescents
- also on the basis of the literature and findings of few non-Spanish studies, we expect food insecure adolescents to report higher levels of body dissatisfaction and greater drive for thinness compared to their food secure peers.

CHAPTER 5: METHODS

5.1 Participants

The study sample initially consisted of 475 adolescent males and females from a secondary public school in Terrassa in Catalonia (Spain) from the four years of Compulsory Secondary Education as per the Spanish education system (equivalent to US grades 7-10). After excluding participants due to absenteeism at the time of the assessment (n=46) and lack of consent (n=3), 426 participants (53% males and 47% females) took part in the study. Participants were aged 12-16 years with a mean (SD) age of 13.8 (1.2) years. Participants were roughly distributed across grades (7 to 10): 26.1%, 28.6%, 25.6% and 19.7% respectively. The racial/ethnic background of participants was as follows: 88% Europeans (85.2% from Spain), 6.3% other origin (4.2% mixed origins), 3.8% Latino, 1.9% Africans (1.2% from Sub-Saharan African and 0.7% from North Africa). Participants were categorized according to the following SES: high 14%; medium-high 24.5%; medium 24.7%; medium-low 27.1% and low 9.7%. The mean Body Mass Index (BMI) of the total sample was 21.11 kg/m² (SD=3.95). As per the World Health Organisation (WHO), ‘growth reference criteria for BMI for age’ (WHO, 2007), participants in this study were classified as: severely thin 0.5%; thin 1.5%; normal 67.7%; overweight 21.6% and obese 8.7%.

5.2 Measures

Food Insecurity

Child Food Security Survey Module – Spanish version (CFSSM-S) (Shankar-Krishnan et al., 2018) contains 9 items based on participants’ perceptions of food insecurity in their households. The instrument focuses on questions such as worries about food running out, consumption of cheap foods, eating less, inability to eat a balanced diet, cutting down portion sizes, skipping meals, going hungry, not eating for a whole day. The CFSSM-S is equivalent to its original English version (Connell et al, 2004). The reference period of the CFSSM-S was set to 12 months. Responses were based on a Likert scale. A score of 1 was provided for affirmative responses ‘a lot’ and ‘sometimes’ and 0 for negative response ‘never’. Higher scores indicated food insecurity. The internal consistency ($\omega=0.95$) and goodness of fit for the one factor model of CFSSM-S was found to be excellent. The

measurement invariance indicated that the CFSSM-S could be used in males and females and different groups of weight status, grades, SES and family affluence. Significant higher CFSSM-S scores were found for participants with lower SES and family affluence. Although no significant differences were found for weight status, participants of the overweight and obese groups showed higher CFSSM-S scores than participants of normal weight. The following three categories of the food security classification were established in the original study (Connell et al, 2004) and the United States Department of Agriculture (USDA)'s new nomenclature (USDA, 2005): 0-1=food secure; 2-5=low food security and 6-9=very low food security. In this study, participants were grouped into two categories i.e. 0-1 = food secure and 2-9 = food insecure.

Psychological wellbeing

The Spanish version of the *Rosenberg Self-Esteem Scale (RSES)* (Martin-Albo, Núñez, Navarro & Grijalvo, 2007) was used in this study. It consists of 10 items and is identical to the original English version (Rosenberg, 1965). It was based on a 4-point Likert where the scale was scored from 1 (totally disagree) to 4 (totally agree) and negative items are scores in the reverse order. Higher scores indicated higher self-esteem. The internal consistency with Cronbach's alpha (.85 to .88) and test-retest correlation (.84) were found to be satisfactory in the original Spanish version (Martin-Albo et al, 2007). The Cronbach's alpha in our study was .85.

The Spanish version of the *PANASN (Positive and Negative Affect Schedule for children and adolescents)* (Sandín, 2003) was developed in order to assess positive and negative emotions and feelings in children and adolescents. It contains 20 items, 10 items evaluating positive affect (for example: interested, excited, enthusiastic etc.) and 10 items for negative affect (for example: distressed, upset, guilty etc.). It was scored as never=1, sometimes=2, a lot of times=3. Items of positive and negative affect were scored separately and higher scores indicated either affect. Internal consistency with Cronbach's alpha was acceptable (above .70) in the Spanish version (Sandín, 2003). In our sample, Cronbach's alpha for PANASN positive (PANASN+) was .73 and .75 for PANASN negative (PANASN-).

The Spanish version of the *General Health Questionnaire (GHQ12)* (López-Castedo & Fernández, 2005) consisted of 12 items that evaluated self-perceived general wellbeing of

adolescent's emotional state. It was based on a 4 point Likert scale of 0-3 where negative items were scored the following: never=0, sometimes=1, a lot of times=2 and always=3. Positive items were reverse scored. Further, items were separated based on two factors originally namely "anxiety" and "social dysfunction". As a measure of psychological wellbeing and considering the content of the items and suggestions of names by other versions (Sánchez-Lopez and Dresch, 2008), we have renamed both factors as "Stress" (I), containing references to stress and self-confidence and "Coping" (II), containing references to social dysfunction, coping skills, problem solving and enjoyment. Higher scores indicated higher stress and lower coping. Internal consistency with Cronbach's alpha was high (above .85) and test-retest correlation was .79 in the Spanish version (López-Castedo and Fernández, 2005). In our sample, Cronbach's alpha was .80 for GHQ12 stress and .71 for GHQ12 coping.

Body image, disordered eating and dietary habits

The Spanish version of the *Body Shape Questionnaire (BSQ)* (Warren et al, 2008) was used in its reduced version of 10 items retaining the structure of the original English version (Cooper, Taylor, Cooper, Fairbum and Phil, 1987). It was scored as never=1, rarely=2, sometimes=3, often=4, very often=5 and always=6. It focused on specific parts of the body and related concerns about body weight and shape. Higher scores indicated higher body dissatisfaction. The 10-item version of BSQ demonstrated metric invariance and was found to be the most consistent compared to other short versions (Warren et al, 2008). In our sample, Cronbach's alpha for the 10-item BSQ was .90

The Spanish version of the *Body Dissatisfaction (BD)* and *Drive for Thinness (DT)* subscales from the *Eating Disorder Inventory (EDI-3)* (Elosua, López-Jáuregui & Sánchez-Sánchez, 2010) consists of 17 items. Negatively worded items were scored as never=0, few times=0, sometimes=1, often=2, almost always=3, always=4. Positively worded items were reverse scored. Items were separated based on subscales, BD and DT. Higher scores for BD indicated higher body dissatisfaction while higher scores for DT indicated obsession for drive for thinness. The internal consistency with Cronbach's alpha in non-clinical samples was .44 to .95 and test-retest values were .85 to .99. In our sample, internal consistency with Cronbach's alpha was .86 for EDI BD and .83 for EDI DT.

KIDMED (Serra-Majem et al, 2004) consisting of 16 items was used to evaluate the dietary habits of adolescents based on the Mediterranean Diet Quality Index. The index ranged from 0-12 where negative responses were scored 0 and affirmative responses were scored +1 or -1. Based on the total scores, three categories based on adherence to a Mediterranean diet were established, namely: high adherence (≥ 8), average adherence (4-7) and low adherence (≤ 3).

Weight Status: Height in centimetres (cm) was measured by a SECA portable stadiometer, model 214 (20-207 cm; accuracy range of 0.1cm) and weight in kilograms (kg) using SECA portable scales model 8777021094 (0-200 kg; accuracy range of 0.1 kg) in order to achieve same consecutive measurements. Weight status was calculated using WHO 2007 growth reference criteria (WHO, 2007) were calculated based on participants' height, weight and age.

Socioeconomic Status: The '*Four-Factor Index of Social Status*' (Hollingshead, 1975) was used to determine SES of the household using a weighted average of each parent's education and occupation level. Education scores ranged from 1-7 (i.e. primary school to graduate degree) and occupation scores ranged from 1-9 (i.e. unemployed to higher executives). SES was calculated by adding Education score $\times 3$ and Occupation score $\times 5$; then, total scores, which ranged from 8-66, were categorized into five different levels namely high (55-66), medium-high (40-54), medium (30-39), medium-low (20-29) and low (8-19).

Family Affluence: The Spanish version of the '*Family Affluence Scale III*', *FAS-III* (Moreno et al, 2016) was used in the study. It consists of six questions asking participants about the possession of a car and dishwasher, number of bedrooms, bathrooms, computers/mobile phones and vacations per year. A four point ordinal scale ranging from 0-3 was used for the six questions. The scores were added and the cut off points set for purchasing power were 0-6 for low, 7-9 for medium and 10-13 for high adherence (≥ 8), average adherence (4-7) and low adherence (≤ 3).

5.3 Procedure

The access to the secondary school was enabled through the support of the Community and Health Services of the City Council of Terrassa. The completion of questionnaires and

anthropometric measurements took place during normal class hours within four days for 4 grades (2 hours of class time on average per grade) in April 2017. Participants were requested to complete a paper and pencil booklet with battery of questionnaires and socioeconomic data (see Annex 9.4). Postgraduate students of psychology were trained and involved in administering questionnaires, taking anthropometric measurements and providing specific instructions to participants. Anthropometric measurements following a standardized procedure (Sánchez-Carracedo et al, 2013) were carried out in situ in a private room near the classroom where questionnaires were administered.

Translation of the CFSSM-S: The adaptation of the CFSSM-S from English to Spanish was conducted in three main steps following the International Test Commission Guidelines (International Test Commission, 2010; Muñiz, Elosua & Hambleton, 2013). Firstly, an expert, native in the target language (Spanish) possessing a good level of the source language (English) translated the CFSSM instrument from English to Spanish. Secondly, the translated document was examined by a panel of experts comprising of various academicians from the field of eating behaviours and disordered eating. The expert panel compared the translated version to the original one taking into account parameters such as item format, grammar and writing, culture etc., by using a scoring based on a Likert scale of 1-5. In the case of discrepancies, the items were re-modified by the panel that further introduced minor changes to the translated document. Further, the translated document was administered to a group of 15 adolescent boys and girls of 12-16 years in order to make sure that it was easily comprehensible. Minor changes were made to the document. Finally, the official translation services of our university further corrected and approved the translated document according to the standards of the Council of Europe's Common European Framework of Reference for Languages (see Annex 9.5).

This thesis consisting of two related studies was conducted according to the guidelines laid down in the Declaration of Helsinki and all procedures involving human subjects/patients were approved by the ethics committee of Universitat Autònoma de Barcelona (see Annex 9.2). Written informed consent was obtained from both participants and parents of participants (see Annex 9.3).

5.4 Statistical analyses

5.4.1 Study 1

Analyses were conducted with the statistical software packages Mplus version 8 and IBM SPSS Statistics version 23. First, to determine the internal structure of the nine CFSSM-S items a cross-validation design was employed, by splitting the sample randomly in two sub-samples. In the first sub-sample, EFA with extraction of one and two factors was conducted, with geomin rotation for the two-factor solution. And in the second sub-sample, CFA was conducted to test if the EFA solutions could be replicated. For both analyses, the WLSMV (weighted least-squares means and variance) method of estimation for categorical items was applied, using the polychoric correlation matrix, given that responses to items were dichotomous. Goodness-of-fit was evaluated with the common indices (Jackson, Gillaspay & Purc-Stephenson, 2009): χ^2 , root-mean-square error of approximation (RMSEA), comparative fit index (CFI) and Tucker–Lewis index (TLI). We followed the usual cut-off points (Brown, 2006). RMSEA < 0.08 and CFI and TLI > 0.90 would indicate acceptable fit, and RMSEA < 0.06 and CFI and TLI > 0.95 would indicate excellent fit.

Once dimensionality was established in the whole sample, assessment of measurement invariance was conducted to determine whether the questionnaire measured the same trait across different subgroups. Measurement invariance was conducted across the following groups of responses: gender, grade, weight status, SES and FAS. For variables with low ($n < 100$) or very unequal sample sizes in some categories, the following groupings were considered: grade 7 and 8 v. grade 9 and 10; overweight and obesity v. normal weight (data for participants with underweight were excluded because of very low sample size, $n = 8$); high, medium-high and medium v. medium-low and low SES; and low and medium v. high FAS. Measurement invariance involved four sequential steps: (i) configural (equal form); (ii) equivalence of factor loadings (metric or weak measurement invariance); (iii) item thresholds (scalar or strong measurement invariance); and (iv) item uniqueness (strict measurement invariance). Model identification for each step was established using the fixed-factor method (Ezpeleta and Penelo, 2015). Comparison between nested models was

conducted with the scaled difference χ^2 test (DIFFTEST option of Mplus; α level set at 0.05).

Next, internal consistency was assessed with the omega coefficient (McDonald, 1999). Finally, once measurement invariance was established, comparisons of observed CFSSM-S scores among gender, grade, weight status, SES and FAS were conducted with one-way ANOVA.

5.4.2 Study 2

All analyses were conducted using IBM SPSS Statistics version 25. MANCOVA was used to investigate food insecurity, as an independent variable in the analysis, and its associations with psychological wellbeing, body image, disordered eating and dietary habits as dependent variables. Effect size measures (Cohen's *d*) were obtained and could be interpreted by means of Cohen's criteria (Cohen, 1988); 0.2 indicated 'small' effect size, 0.5 'medium' and 0.8 'large'. Previous studies have found significant associations between food insecurity and SES and family affluence. There have been inconsistent findings regarding weight status, with some studies reporting an association between overweight and obesity with food insecurity (Casey et al, 2006) and other studies not finding significant differences for weight status (Shankar-Krishnan et al, 2018). Age is an important factor in food insecurity studies. Parents of food insecure households protect younger children from food insecurity more than older children, who are reported to be twice as likely to experience food insecurity (Fram et al, 2011). In the case of gender, a recent study has reported that females worldwide are at a higher risk of food insecurity when compared to males (Broussard, 2019). Furthermore, some studies have found ethnicity or racial background to be an important factor in food insecurity, with ethnic minority households reported to be at a higher risk (Altman et al, 2018). In view of the foregoing, SES, family affluence, weight status, age, gender and ethnicity were used as adjustment variables (potential confounders) in this study and were added to the models.

CHAPTER 6: RESULTS

6.1 Study 1

Internal structure: Dimensionality. Internal Consistency

Descriptives for the 9 CFSSM-S items are displayed in Table 5. Mean (and SD) values ranged from 0.01 (0.10) to 0.26 (0.44). There were no missing values for any item.

Table 5 Descriptives of items and standardised parameters for the CFA 1-factor solution (Model F in Table 6).

Items	<i>M (SD)</i>	Factor loading	Item threshold	Uniqueness
1. Worry	0.26 (0.44)	.73	0.63	.46
2. Food run out	0.08 (0.26)	.79	1.44	.37
3. Cheap food	0.15 (0.36)	.78	1.04	.39
4. Balanced meal	0.08 (0.27)	.80	1.42	.36
5. Eat less	0.05 (0.22)	.95	1.65	.10
6. Meals cut	0.06 (0.24)	.84	1.57	.29
7. Skip a meal	0.03 (0.16)	.93	1.95	.16
8. Hungry	0.07 (0.26)	.75	1.46	.44
9. Not eat for a whole day	0.01 (0.10)	.97	2.35	.05
Total score	0.78 (1.45)			
Internal consistency (omega coefficient)		.95		

Regarding the cross-validation strategy, no differences were observed for gender, grade, weight-status, SES, and FAS between the two random subsamples ($p \geq .410$). Two eigenvalues for EFA in the first subsample ($n = 205$) were above 1 (5.89 and 1.24), scree-test suggesting the extraction of only one factor. The 1-factor model with EFA showed acceptable fit [$\chi^2 (27) = 66.0$, RMSEA = 0.084, CFI = 0.952, TLI = 0.937], all factor loadings were above 0.30 (0.54-0.97) and statistically significant ($p < 0.05$). The 1-factor model with CFA in the second subsample ($n = 221$) showed excellent fit [$\chi^2 (27) = 29.5$, RMSEA = 0.021, CFI = 0.995, TLI = 0.993], with all standardised factor loadings above 0.30 (0.71-0.96) and statistically significant ($p < 0.05$). Moreover, we also examined a 2-factor solution in both subsamples. The 2-factor model with EFA and geomin rotation in the first subsample showed better fit than the 1-factor model [$\chi^2 (19) = 22.2$, RMSEA = 0.029, CFI = 0.96, TLI = 0.993], but some parameters were unsatisfactory and a simple structure was not attained: item 7 showed a standardised factor loading above 1, items 2 and 5 showed cross-loadings (factor loadings above 0.30 in both factors), and the factor correlation was high ($r = 0.62$). However, we tried to replicate this 2-factor model with CFA in the second subsample, by allocating each item onto the factor with a higher factor loading (items 1-3-4 and 2-5-6-7-8-9). This 2-factor model with CFA and correlated factors in the second subsample did not improved fit when compared to the 1-factor solution [$\chi^2 (18) = 28.1$, RMSEA = 0.019, CFI = 0.996, TLI = 0.994] and factor correlation was excessively high ($r = 0.92$), indicating overlap between factors (Brown, 2006).

Considering these results, we selected the 1-factor model. Table 5 shows the parameters for this model with CFA in the whole sample ($N = 426$). Factor loadings (all statistically significant, $p < 0.05$) and item thresholds ranged, respectively, from 0.73 and 0.63 (item 1) to 0.97 and 2.35 (item 9). Goodness of fit (model F in Table 6, which will be commented in the next section) was excellent [$\chi^2 (27) = 43.4$, RMSEA = 0.038, CFI = 0.984, TLI = 0.979].

Omega internal consistency value derived from CFA in the whole sample was excellent ($\omega = 0.95$).

Internal structure: Measurement Invariance

Table 6 displays the results of CFAs baseline models by group and measurement invariance analyses. Fit for baseline models (model 0) and for configural invariance across groups of responses (model 1) was satisfactory (RMSEA \leq 0.055, CFI \geq 0.942, TLI \geq 0.923). Full weak (equivalence of factor loadings), strong (equivalence of item thresholds), and strict (equivalence of uniqueness invariance) was achieved ($p \geq$ 0.105) for all the groups of responses considered. These findings provide support for the equivalence of CFSSM-S scores across gender, grade, weight-status, SES and FAS, and comparisons among these groups will be readily interpretable.

Table 6: Fit indices for measurement invariance analyses across gender, grade, weight status, SES, and FAS.

Groups	Model fit and invariance	Goodness-of-fit indices				Comparison		
		χ^2 (df)	CFI	TLI	RMSEA (90% CI)	Models	$\Delta\chi^2$ (Δ df) ^a	<i>p</i>
Gender	A0a: males (<i>n</i> = 226)	33.5 (27)	.988	.984	.033 (.000; .064)			
	A0b: females (<i>n</i> = 200)	33.9 (27)	.991	.987	.036 (.000; .069)			
	A1: configural (equal form)	67.4 (54)	.989	.986	.034 (.000; .058)			
	A2: A1 plus equal factor loadings (weak invariance)	70.0 (62)	.993	.992	.025 (.000; .050)	A2 vs A1	7.5 (8)	.483
	A3: A2 plus equal thresholds (strong invariance)	75.8 (70)	.995	.995	.020 (.000; .045)	A3 vs A2	3.8 (8)	.878
	A4: A3 plus uniquenesses free (strict invariance) ^b	73.3 (61)	.990	.988	.031 (.000; .054)	A3 vs A4 ^b	6.1 (9)	.728
Grade	B0a: 01-02 (<i>n</i> = 233)	26.4 (27)	1.000	1.002	.000 (.000; .050)			
	B0b: 03-04 (<i>n</i> = 193)	42.8 (27)	.970	.960	.055 (.019; .085)			
	B1: configural (equal form)	67.3 (54)	.987	.983	.034 (.000; .058)			
	B2: B1 plus equal factor loadings (weak invariance)	69.8 (62)	.993	.991	.024 (.000; .049)	B2 vs B1	7.8 (8)	.449
	B3: B2 plus equal thresholds (strong invariance)	79.8 (70)	.991	.990	.026 (.000; .049)	B3 vs B2	11.2 (8)	.190
	B4: B3 plus uniquenesses free (strict invariance) ^b	79.3 (61)	.983	.980	.037 (.000; .059)	B3 vs B4 ^b	6.3 (9)	.705
Weight-status	C0a: normal-weight (<i>n</i> = 279)	44.6 (27)	.942	.923	.048 (.020; .073)			
	C0b: over-weight and obesity (<i>n</i> = 125)	26.9 (27)	1.000	1.000	.000 (.000; .069)			
	C1: configural (equal form)	71.7 (54)	.978	.971	.040 (.000; .063)			

	C2: C1 plus equal factor loadings (weak invariance)	78.1 (62)	.980	.977	.036 (.000; .058)	C2 vs C1	10.4 (8)	.235
	C3: C2 plus equal thresholds (strong invariance)	87.2 (70)	.979	.978	.035 (.000; .056)	C3 vs C2	10.0 (8)	.267
	C4: C3 plus uniquenesses free (strict invariance) ^b	74.0 (61)	.984	.981	.032 (.000; .056)	C3 vs C4 ^b	14.5 (9)	.105
SES	D0c: high, medium-high, and medium (<i>n</i> = 266)	28.4 (27)	.998	.998	.014 (.000; .051)			
	D0e: medium-low and low (<i>n</i> = 155)	37.0 (27)	.953	.937	.049 (.000; .085)			
	D1: configural (equal form)	64.1 (54)	.991	.988	.030 (.000; .055)			
	D2: D1 plus equal factor loadings (weak invariance)	75.0 (62)	.986	.984	.032 (.000; .055)	C2 vs C1	9.0 (8)	.343
	D3: D2 plus equal thresholds (strong invariance)	85.0 (70)	.984	.984	.032 (.000; .054)	C3 vs C2	11.4 (8)	.180
	D4: D3 plus uniquenesses free (strict invariance) ^b	75.0 (61)	.985	.983	.033 (.000; .056)	C3 vs C4 ^b	12.4 (9)	.192
FAS	E0a: low and medium (<i>n</i> = 246)	35.2 (27)	.981	.975	.035 (.000; .064)			
	E0b: high (<i>n</i> = 180)	29.3 (27)	.995	.994	.022 (.000; .063)			
	E1: configural (equal form)	64.6 (54)	.989	.985	.030 (.000; .055)			
	E2: E1 plus equal factor loadings (weak invariance)	66.8 (62)	.995	.994	.019 (.000; .046)	E2 vs E1	6.8 (8)	.555
	E3: E2 plus equal thresholds (strong invariance)	74.5 (70)	.995	.995	.017 (.000; .044)	E3 vs E2	7.7 (8)	.461
	E4: E3 plus uniquenesses free (strict invariance) ^b	67.5 (61)	.993	.992	.022 (.000; .048)	E3 vs E4 ^b	9.1 (9)	.431
	F: Final model (overall sample; <i>N</i> = 426)	43.4 (27)	.984	.979	.038 (.014; .058)			

^a $\Delta\chi^2$ based on DIFFTEST approach obtained from MPlus (scaled difference chi-square test for WLSMV method of estimation)

^bTest for invariance of uniquenesses for categorical indicators proceeds backwards (for more details, see Muthén & Muthén, 1998-2013; also, e.g., http://www.lesahoffman.com/CLP948/CLP948_Lecture07_Invariance.pdf)

Relation to external variables

Direct CFSSM-S scores were calculated by applying the simple weighting method (Abad, Olea, Ponsoda & Garcia, 2011). No differences were found by gender ($p = 0.344$), grade ($p = 0.765$) and weight-status ($p = 0.061$). CFSSM-S scores differed only for SES [$F_{(1416)}=13.53, p<.005$] and FAS [$F_{(1423)}=11.15; p<.001$]. A linear trend ($p\leq.005$) was found as lower the SES and FAS, higher the CFSSM-S scores. Further, a slightly but statistically significant quadratic trend ($p=0.031$) was found for the association between food insecurity and SES indicating that the increase in CFSSM-S scores between participants with medium-low and low SES was higher than that for the remaining contiguous SES levels (see Annex 9.1).

6.2 Study 2

Following the food security classification established in the original instrument (Connell et al, 2004) and according to the USDA's new nomenclature (USDA, 2005), 1.9% of participants experienced very low food security, 16.4% had low food security and 81.7% were found to be food secure. As noted in Table 5, 26% of participants worried a lot or sometimes about food running out, 8% ran out of food, 15% consumed cheap foods, 8% could not eat a balanced meal, 5% had to eat less, 6% had to cut the size of their meals, 3% had to skip a meal, 7% were hungry and 1% did not eat for a whole day.

Table 7 shows the main descriptives of gender, age, weight status, SES, family affluence and ethnicity and their associations with Food Security Status. Pearson's chi-square tests reported significance for only SES ($p < .001$) and family affluence ($p < .001$) thus indicating low SES and family affluence in food insecure participants.

Table 7: Descriptives and tests of significance for gender, grade (age), weight status, SES, FAS and ethnicity based on a comparison between food secure and food insecure groups

<i>Variable</i>	<i>Level</i>	Food Security Status		Test of significance	
		Food secure <i>n</i> (%)	Food insecure <i>n</i> (%)	χ^2	<i>P</i>
Gender	Males	189 (83.6%)	37 (16.4%)	1.209	.272
	Females	159 (79.5%)	41 (20.5%)		
Grade (age)	01 (12-13 years)	92 (82.9%)	19 (17.1%)	1.087	.780
	02 (13-14 years)	96 (78.7%)	26 (21.3%)		
	03 (14-15 years)	91 (83.5%)	18 (16.5%)		
	04 (15-16 years)	69 (82.1%)	15 (17.9%)		
Weight-status	Normal weight	233 (83.6%)	46 (16.4%)	1.919	.383
	Overweight	71 (79.8%)	18 (20.2%)		
	Obesity	27 (75%)	9 (25%)		
SES	High	57 (96.6%)	2 (3.4%)	54.203	<.001
	Medium-high	97 (94.2%)	6 (5.8%)		
	Medium	86 (82.7%)	18 (17.3%)		
	Medium-low	84 (73.7%)	30 (26.3%)		
	Low	20 (48.8%)	21 (51.2%)		
FAS	High	166 (92.2%)	14 (7.8%)	27.997	<.001
	Medium	149 (76.8%)	45 (23.2%)		
	Low	33 (63.5%)	19 (36.5%)		
Ethnicity	European	310 (82.9%)	64 (17.1%)	3.048	.384
	Other origin	20 (71.4%)	8 (28.6%)		
	Latino	12 (75%)	4 (25%)		
	African	6 (75%)	2 (25%)		

Note: Food Security Status: score 0-1=food secure; score 2-9=food insecure. SES: Socioeconomic Status; FAS: Family Affluence Scale. In bold, significant differences

Table 8 provides the mean and standard deviation of all variables and MANCOVA results including B, CI (95%) and effect size (Cohen's *d*) for Food Security Status. Multivariate analysis of covariance (MANCOVA) was performed to determine the effect of CFSSM-S on the dependent variables. The Box test reveals that equal variances cannot be assumed, $F_{(45, 44476)}=1.803$, $p=.001$. Although the result is right at the limit, some authors point out that Box's *M* is highly sensitive, hence unless p is $<.001$ and sample sizes are unequal, it has been recommended to ignore it (Tabachnick & Fidell, 2019). We employed Pillai's trace as a test statistic since it is the most robust test. This criterion indicates significant differences in the associations between food insecurity and the set of dependent variables (Pillai=.070, $F_{(9, 356)}=2.96$, $p=.002$, multivariate $\eta^2 = .07$).

Several adjusted variables significantly influenced the dependent variables: weight status (Pillai=.253, $F_{(9, 356)}=13.302$, $p<.001$); age (Pillai=.087, $F_{(9, 356)}=3.751$, $p<.001$); SES (Pillai=.054, $F_{(9, 356)}=2.253$, $p=.018$) and gender (Pillai=.154, $F_{(9, 356)}=7.207$, $p<.001$). In the analysis of each dependent variable, Levene's test shows that variance homogeneity was fulfilled for all dependent variables except for BSQ, PANASN+ and EDI-DT. In these cases, the Welch correction was applied (Welch, 1947; Ruxton, 2006; Derrick, Toher & White, 2016).

Regarding food security status, food insecure participants reported significantly lower scores for RSES ($F_{(1, 364)}=10.30$; $p=.001$); lower scores for PANASN+ ($F_{(1, 85)}=5.79$; $p=0.018$); higher scores for GHQ12-stress ($F_{(1, 364)}=12.23$; $p=.001$) and GHQ12-coping ($F_{(1, 364)}=18.19$; $p<.001$); higher levels of BSQ ($F_{(1, 85)}=10.22$; $p=0.002$), higher scores for EDI-BD ($F_{(1, 364)}=15.59$; $p<.001$) and higher scores for EDI-DT ($F_{(1, 85)}=11.72$; $p=.001$). The effect size for these variables ranged on average between medium to large. EDI-BD in food insecure participants showed the highest effect. No significant differences were found for KIDMED and PANASN- (see Table 8). The overall results indicate poorer psychological wellbeing with lower self-esteem, lower positive affect, higher levels of stress and lower coping, greater body dissatisfaction and higher drive for thinness in food insecure adolescents.

Table 8: Descriptives and MANCOVA for variables based on comparison of total scores between food secure and food insecure groups

	Food Security Status						MANCOVA	CI 95%	Cohen's d		
	Food secure			Food insecure							
	Males	Females	Total	Males	Females	Total					
	<i>M(SD)</i>	<i>M(SD)</i>	<i>M(SD)</i>	<i>M(SD)</i>	<i>M(SD)</i>	<i>M(SD)</i>	B	<i>F</i> (df)	<i>p</i>		
RSES	33.31 (4.34)	30.30 (5.42)	31.93 (5.08)	30.14 (4.79)	27.06 (4.92)	28.43 (5.07)	2.245	10.30 (1, 364)	.001	0.87 to 3.62	0.69
PANASN-	17.04 (3.30)	18.61 (3.17)	17.76 (3.33)	17.43 (4.09)	20.03 (3.25)	18.80 (3.87)	-0.761	2.40 (1, 364)	.122	-1.72 to -.20	0.28
PANASN +	24.50 (3.03)	24.35 (2.91)	24.43 (2.97)	23.32 (3.50)	22.46 (4.09)	22.86 (3.82)	1.094	5.79 (1, 85)*	.018	.20 to 1.98	0.35
GHQ12 Stress	5.17 (3.37)	6.76 (4.06)	5.90 (3.78)	7.00 (3.78)	9.69 (4.11)	8.49 (4.16)	-1.896	12.23 (1, 364)	.001	-2.96 to -.83	0.58
GHQ12 Coping	3.60 (2.38)	4.45 (3.07)	3.99 (2.75)	4.86 (2.83)	6.94 (2.59)	6.02 (2.88)	-1.696	18.19 (1, 364)	<.001	-2.47 to -.91	0.50
BSQ	12.23 (3.29)	16.48 (8.41)	14.19 (6.53)	14.90 (6.11)	20.44 (10.99)	17.97 (9.49)	-3.005	10.22 (1, 85)*	.002	-4.85 to -1.15	0.46
EDI-BD	4.75 (6.31)	9.33 (8.70)	6.85 (7.83)	9.28 (7.12)	14.44 (9.01)	12.14 (8.56)	-3.947	15.59 (1, 364)	<.001	-5.91 to -1.98	0.80
EDI-DT	3.71 (4.22)	6.94 (7.03)	5.20 (5.90)	7.07 (6.39)	9.64 (8.23)	8.49 (7.52)	-2.760	11.72 (1,85)*	.001	-4.34 to -1.17	0.60
KIDMED	6.87 (2.35)	6.55 (2.46)	6.72 (2.40)	5.97 (2.63)	5.97 (2.29)	5.97 (2.43)	0.381	1.23 (1, 364)	.268	-.29 to 1.05	0.19

Note: Food Security Status: score 0-1=food secure; score 2-9=food insecure; RSES: Rosenberg Self-Esteem; PANASN: Positive and Negative Affect Schedule for children and adolescents; GHQ12: General Health Questionnaire; BSQ: Body Shape Questionnaire; EDI-BD: Eating Disorder Inventory (Body Dissatisfaction); EDI-DT: Eating Disorder Inventory (Drive for Thinness); KIDMED: Mediterranean Diet Quality Index. M = mean; SD = standard deviation; df = degrees of freedom, CI 95% = confidence interval 95%. Significant differences in bold. All variables adjusted for gender, ethnicity, age, weight status, socioeconomic status and family affluence.
*Degrees of freedom (df) corrected for non-homogeneity of variances. In bold, significant differences

CHAPTER 7: DISCUSSION

7.1 Study 1

This study examined the validity of the CFSSM-S scores in terms of internal structure, measurement invariance and relation to external variables. Despite previous reports and studies in Spain on malnutrition and poverty, the focus has not been much on food insecurity. There have been no validated food insecurity questionnaires in Spain. Further there have been no instruments that specifically measure food insecurity in adolescents, considering the fact that parents cannot accurately report children's unique experiences and perceptions of food insecurity in households (Fram, Bernal & Frongillo, 2015). Our study is the first in Spain to carry out the adaptation and validation of a self-reported food insecurity questionnaire for adolescents. The results indicate that this instrument is valid and reliable for measuring perceptions of food insecurity adequately in Spanish adolescents.

The first objective was to examine the internal structure of the instrument. Our results showed that a 1-factor model obtained a better fit, supporting the unidimensionality of the CFSSM-S and that all 9 items belong to one factor i.e. 'food insecurity'. We found that the endorsement of items in our sample was similar to the original instrument (Connell et al, 2004), moreover, the ordering by groups of items based on threshold estimates in our CFA was almost identical to those obtained in the CFSSM with the Rasch model. Item 1, the least severe item of food insecurity, received maximum number of affirmative responses. Worry or uncertainty about food was an expected psychological response from participants who were anxious about maintaining sufficient food supplies in their household (Tarasuk, 2001). In our study, the second and third most endorsed items 3 and 4 about 'consumption of cheap food' and 'lack of balanced diets' respectively indicate that the adolescents were aware of the differences in diet quality. This affirms the fact that adolescents despite their knowledge about diet quality may have less control over the management of food resources at home (Connell et al, 2004). As expected, item 9 was the most severe indicator of food insecurity that questions participants about not eating for a whole day thus depicting insufficient food intake and it was also the item which was least endorsed in both studies.

The second objective of this study was to examine the measurement invariance of the instrument. Some studies such as the one by the USDA, performed the ‘test of invariance’ in their HFSSM instrument employed in the Current Population Survey and found that food insecurity can be measured in all three populations including households with children, households without children but with elderly members and households without children or elderly members (Hamilton, Cook, Thompson, Buron, Frongillo, Olson & Wehler, 1997). Another study by Kilanowski & Lin, (2012) examined the invariance of the short version, 5-item HFSSM in a Latin migrant population and found that the adapted HFSSM performed suitably in the Latin sample. Our results indicate that the CFSSM-S can be used for both boys and girls, within a wide age range of adolescence (12-16 years) and for different levels of weight status, SES and FAS. This ensures that the instrument is measuring the same construct across these groups providing support for making comparisons among these groups in a readily interpretable way.

As equivalence for these groups had been established, further, we proceeded with our third objective, which was to study the mean differences in food insecurity scores of the groups. The results indicate that there were no differences with gender. There are very few studies focussed on gender differences in food insecurity. Out of these studies, few of them indicate that both adolescent boys and girls are equally likely to experience severe food insecurity in their households, although girls are more likely to report food insecurity than boys (Hadley et al, 2008; Shanafelt et al, 2016). But a recent study conducted as part of the Gallup world poll has reported that females worldwide are at a higher risk of food insecurity than males (Broussard, 2019). Contradictory to the study by Broussard in 2019, another recent study by Niemeier & Fitzpatrick, also in 2019, found that adolescent males are at a higher risk of food insecurity than females. Niemeier & Fitzpatrick, 2019 propose that males have higher nutritional needs than females but they sacrifice and cut down on food portions in their households for the sake of younger members in their family, thus resulting in them becoming food insecure (Niemeier & Fitzpatrick, 2019). But, gender differences were found to be more prominent in severely food insecure households (i.e. households with very low food security) (Hadley et al, 2008). However, only 1.9% of adolescents in our study experienced very low food security, which could explain the lack of gender differences. Further, discrepancies in gender between studies could be also explained by the variation in the sample contributed by various factors including ethnicity

and socioeconomic conditions of regions or countries. For instance, some of the studies including those by Hadley et al (2008) based in Ethiopia, Shanafelt et al (2016) based in rural Minnesota and the study by Broussard (2019) from the Gallup world poll consists of data from third world nations and developed countries where gender differences might be more prominent due to cultural norms or barriers and socioeconomic issues such as poverty. Our study includes adolescents from a developed nation where gender differences due to socioeconomic issues or cultural differences in the context of food insecurity might not be prominent. Taking into account, all these factors, we concur that more studies are required to determine the association between gender and food insecurity.

With regard to age, there have been studies, which have indicated that food insecurity is more common in older children than younger children (Shtasel-Gottlieb et al, 2015) Food insecurity is notably higher in households with adolescents because parents often protect younger children who are considered more vulnerable than their older siblings (Nord, 2009). Several protective mechanisms are observed in food insecure households where not only parents try to protect their youngest children but also adolescents (i.e. older siblings) protect their younger siblings by making sure that they have enough to eat (National Research Council & Institution of Medicine, 2013). The WHO has defined the age of adolescence as 10-19 years, however most recently; they have classified young people under a broader age group of 10-24 years (WHO, 2019). As a result, some studies (Sawyer, Azzopardi, Wickremarathne & Patton, 2018) with adolescents have adopted this new age bracket between 10-24 years of age. Our study included only a small sample of adolescents from 12-16 years; hence as expected, we were unable to find these differences based on age or grade.

Regarding weight status, our results are in alignment with previous studies (Eisenmann Gundersen, Lohman, Garasky & Stewart, 2011; Nguyen, Ford, Yaroch, Shuval, & Drope, 2017) that have indicated that even though there are no statistically significant differences, the percentage of food insecure participants is 25% in the obese group and 20.2% in the overweight group in comparison to 16.4% participants of normal weight status (see Table 7). Also, the overweight and obese groups showed slightly higher food insecurity scores (see Annex 9.1). Weight status has been a highly debated subject in the field of food insecurity. There have been inconsistent findings about the association of overweight and obesity with food insecurity (Dinour et al, 2007). Some studies have

confirmed this association in food insecure adolescents aged 12-16 years (Holben & Taylor, 2015; Casey et al, 2006). Food insecure households in general consume cheap, energy dense foods and experience intermittent patterns of eating less when resources are limited and overeating when resources are readily available (Tester et al, 2016). This results in drastic changes in food intake, which in turn could contribute to weight gain (Olson et al, 2007). In Mediterranean countries such as Spain there has been a change from more traditional to westernised diets with the overconsumption of meats and nutritionally deficient foods, especially among children and adolescents, irrespective of social class (Grosso & Galvano, 2016), which might explain the lack of significant differences in weight status between food secure and food insecure groups in our study.

With respect to SES, our results showed that food insecure participants reported lower SES and the statistically significant quadratic trend observed in our study (see Annex 9.1) reveals that the majority of participants from medium low and low SES reported food insecurity in comparison to other SES categories. These results are in alignment with previous studies that have reported the association between SES and food insecurity (Sarlio-Lahteenkorva & Lahelma, 2001). This could be explained by the fact that individuals from low SES have a lower adherence to follow dietary guidelines and recommendations in comparison to those individuals of higher SES (Power, 2005). Households with greater economic hardships find it difficult to stretch food resources and need to often cut down not only on the quantity of food but also on nutritional quality (Wight et al, 2014). SES is an important factor which can be measured in terms of income, education and profession (Currie et al, 1997), but the disadvantage in the case of SES arises due to its difficulty in measurement in the case of children who are often unaware of their parents' occupations thus arising in problems in coding occupation in SES surveys (Currie et al, 1997).

In this regard, family affluence is a useful socioeconomic indicator, which has been associated with low SES (Iceland & Bauman, 2007). Our results indicated that food insecure participants reported lower FAS and are in alignment with previous studies that indicate food insecurity is associated with greater material hardships (Iceland & Bauman, 2007; Loopstra & Tarasuk, 2013; Fafard-St-Germain & Tarasuk, 2018). As explained by Hruschka et al, 2017, there are different ways of estimating social inequalities in order to have a better idea about multiple dimensions of wealth in households and material

affluence is one of the different welfare indicators of food insecurity. Due to the challenges faced by children in measuring SES through parental income, family affluence on the other hand is found to be an easier indicator in measuring the presence and number of specific material goods and assets in their households (Hruschka et al, 2017). Material hardships, which refer to spending less on material items and utilities, are reported to increase as the severity (i.e. very low food security) of food insecurity increased in households (Fafard-St-Germain & Tarasuk, 2018).

Our results support the validity of the CFSSM-S to be an instrument with good psychometric properties which can be employed in adolescents of both genders, of ages between 12-16 years, as well as different weight status, SES and family affluence categories. In addition, our results are in alignment with previous studies, which indicate the association between food insecurity and external variables such as SES and family affluence. In the case of weight status, despite the lack of statistically significant association with food insecurity, the higher rate of food insecurity in the overweight and obese groups support the results presented in previous studies. However, the contradictory results in food insecurity studies with regard to overweight and obesity, facilitate the need for further research in this area.

7.2 Study 2

The current study has examined the association between food insecurity and psychological wellbeing, body image, disordered eating, and dietary habits in Spanish adolescents. There are reports from survey data indicating food insecurity prevalence rates in households in Spain. However, to the best of our knowledge, this is the first study to examine the relationship between food insecurity and crucial variables by means of self-reported perceptions in Spanish adolescents. The overall results of our study indicate poor psychological wellbeing, greater body dissatisfaction and higher drive for thinness in food insecure Spanish adolescents.

Regarding food security status, 18.3% of participants in this study experienced food insecurity while 81.7% of participants were found to be food secure. It is important to note that the participants belonged to medium to medium-low SES from the city of Terrassa in Catalonia, Spain. Although 18.3% is a fairly high prevalence rate for food insecurity in

adolescents in a developed nation such as Spain, it is important to note that our data is not representative of the entire Spanish population. Reports have indicated that 20% of the population of Catalonia has been affected by poverty (Generalitat de Catalunya, 2017) and as per the 2017 Save the Children report, there has been a 23% rise in severe child poverty in Catalonia in recent years (Save the Children, España, 2017). Furthermore, the prevalence rate of adolescent food insecurity (18.3%) in our study is similar to the original study conducted by the authors, Connell et al, 2004, who adapted and validated the instrument, CFSSM. However, there are slight differences in the ‘very low food security’ group. There are more participants with ‘very low food security’ in the original study (5%) when compared to ours (1.9%). Our sample consisted of a majority of participants from medium and medium-low SES, from the large metropolitan city of Terrassa, which could explain the reduced number of participants with ‘very low food security’. Though the original study did not provide socioeconomic information of their participants, the data was collected from a local school in the state of Mississippi, which reports the highest prevalence rate of food insecurity in the United States of America (Coleman-Jensen et al, 2017). This could explain the differences in the ‘very low food security’ group in both studies.

We also find a similar prevalence rate of 18% child food insecurity rate reported in the 2016 annual household food security survey conducted by the USDA in the United States (Coleman-Jensen et al, 2017; Feeding America, 2018). But, the UNICEF Innocenti report in 2017, consisting of nationally representative data from 147 countries on households with children under 15 years of age, indicates a prevalence rate of 14% and 12% in the European Union (EU) and Spain respectively (Pereira et al, 2017). Although that prevalence rate in Spain is lower than the rate observed in our study, it is important to note that the UNICEF Innocenti report includes children under 15 years old, while our study included a specific age range of 12 to 16 years and, as discussed previously, older children are at a higher risk of food insecurity (Bauer et al, 2015; Fram et al, 2011). Furthermore, differences in methodology, such as telephone surveys and the use of a similar, but different instrument i.e. FIES to assess food insecurity in the UNICEF Innocenti report, are important factors to be considered, which could explain the disparity in food insecurity rates. As a result, future studies are required in order to determine the prevalence rates of food insecurity across a wider age range of adolescents in Spain.

The first objective of our study was to assess whether food insecurity is associated with poor psychological wellbeing in Spanish adolescents. To reiterate, wellbeing, which is an important psychological indicator, is not a stable construct, and on the contrary fluctuates during childhood and adolescence (Minkkinen, 2013; Navarro et al, 2019). As previously stated, the term ‘psychological wellbeing’ tends to be multidimensional, and has not been well defined over the years (Dodge et al, 2012), although it can refer to the ability of individuals to self-evaluate and fulfil various areas of their lives such as family, work and relationships (Cripps & Zyromski, 2015). Studies focused on psychological wellbeing have examined a wide range of indicators, such as depression, anxiety and social dysfunction (Siddique & D’Arcy, 1984), self-esteem (Roustit et al, 2010), and positive and negative affect (Ong et al, 2006) etc. Lower levels of self-esteem, happiness, and satisfaction are observed in adolescents with low psychological wellbeing (Amato, 1994) with higher levels of depression (Flouri & Buchanan, 2003) and social problems (Wilkinson, 2004). For these reasons, we assessed psychological wellbeing in adolescents by taking into account relevant indicators during adolescence such as self-esteem, positive and negative emotions, stress and coping.

Self-esteem is considered an important factor of psychological wellbeing (Moksnes et al, 2010) that can fluctuate in adolescence and is a crucial indicator of health outcomes (Erol & Orth, 2011). Adolescents with low self-esteem reported poorer mental and physical health and could also face far more negative consequences in adulthood such as worse financial prospects or criminal behaviour in comparison to adolescents with higher self-esteem (Trzesniewski et al, 2006). Self-esteem is notably an important factor in the case of social class especially among adolescence as adolescents from low SES are at a higher risk of low self-esteem (Abernathy, Webster & Vermeulen, 2002). Lower self-esteem was observed in the food insecure group in our study with a medium-large effect size. It was also reported in the research conducted on food insecure adults by the National Research Council & Institute of Medicine, (2013). This indicates that similar to low SES, food insecurity could also have a very negative impact on an individual’s self-esteem. Furthermore, low self-esteem is a risk factor that has to be taken into consideration in the case of food insecurity as it can affect key areas of life during adolescence (Erol & Orth, 2011). As only a few studies have focused on the association between food insecurity and

self-esteem, further research, especially in adolescents, is recommended in order to examine this association more closely and confirm these findings.

While higher life satisfaction is positively linked to a better living, lower life satisfaction on the other hand results in several psychosocial problems (Alfaro-Inzunza, Ramírez-Casas del Valle & Varela, 2019). Fewer positive emotions were found in food insecure adolescents in comparison to the food secure group. Positive emotions are linked to subjective wellbeing and happiness, which can include various factors such as intellectual performance; ability to concentrate; problem solving skills etc. (Hofmann, Sawyer, Fang & Asnaani, 2012). Positive affect has been noted in highly resilient individuals and it serves as a protective factor in combating daily stress while also providing protection against mental disorders. It has been proposed that a deficit of positive emotions and excessive negative emotions can lead to depressive disorders (Hofmann et al, 2012; Gross & Jazaieri, 2014). A higher level of positive emotions in adolescence could result in better physical and psychological health along with decreased tendencies towards risk behaviours in adulthood (Hoyt, Chase-Lansdale, McDade & Adam, 2012). On the other hand, infrequent positive emotions have been observed in individuals with psychological problems such as dysthymia (Gross & Jazaieri, 2014). Prior research has provided data about food insecurity and its associations with both depression (Alaimo et al, 2002) and anxiety (Ashiabi, 2005), however there have been no previous studies that have examined the deficit of positive emotions in adolescents that have taken food insecurity into account. Major stressful events can lead to a lack of positive emotions in adolescents (Young, Sandman & Craske, 2019). As a result, our data supports the notion that food insecurity could be a stressful event as worrying about procuring food triggers anxiety (Poole-Di Salvo, Silver & Stein, 2016) and emotional issues during adolescence (Moksnes et al, 2010).

Our results indicate higher scores in the stress subscale and lower scores in the coping subscale in food insecure adolescents compared to their food secure peers with a medium effect size. The 'stress' and 'coping' subscales assess a complex group of contents, including stress, self-confidence, coping skills, problem solving, enjoyment and social dysfunction. Rather than a major negative life event, an accumulation of minor distressing events in adolescence is all that it takes to trigger stress, leading to higher rates of negative affects that could exist for variable amounts of time in the lives of adolescents (Ong et al,

2006; Fields & Prinz, 1997). Stress is a common component noticed in food insecure individuals (Bernal et al, 2016) who often experience a continuous period of psychological distress, which includes worrying about getting their next meal, eating poor quality food and having to ultimately reduce portion sizes (Che & Chen, 2001).

Furthermore, during stressful events, adolescents often exhibit passive coping in order to avoid confronting problems (Fields & Prinz, 1997). Social dysfunction refers to emotional and behavioural problems resulting in lower levels of social skills, which can be especially common in adolescence (Bierman & Welsh, 2010). It is yet another noticeable feature related to the inability of adolescents to cope during stressful events (Rubin et al, 2009). Lower scores in the 'coping' subscale, which includes 'social dysfunction', in food insecure participants can be worrisome, since they are reported to exhibit both emotional and behavioural distress in the form of social dysfunction, which is often indicated by their avoidance of engaging in school activities and interacting with peers (Ashiabi, 2005). Our findings are aligned with other studies, which have found that food insecure adolescents exhibit greater behavioural and emotional problems, including higher levels of stress and anxiety (Kleinman et al, 1998). They experience a sense of worthlessness and hopelessness (Alaimo et al, 2002), are withdrawn and passive and also exhibit low motivation and coping skills at school (Ashiabi, 2005). Food insecure adolescents are also more prone to bully or getting bullied in comparison to their food secure peers (Edwards & Taub, 2017). As explained by Bernal et al, (2016), food insecurity has been associated with shame especially among adolescents, but this association has not been widely examined in many studies. The lack of food resources has been linked to several psychosocial, behavioural issues such as bullying and victimisation (Edwards & Taub, 2013) while the shame experienced by food insecure children has been associated with greater levels of hostility with increasing age (Heaven, Ciarrochi, & Leeson, 2009) and risk of several negative consequences including self-inflicting injury such as suicide attempts (Bernal et al, 2016). The shame and stigma experienced by food insecure children could explain some of the psychological issues experienced by them, especially the inability to cope and social dysfunction in the form of avoidance and withdrawal from peers and emotional dysfunction including low self-esteem, anxiety and worthlessness (Bernal et al, 2016).

The second objective of our study was to determine whether food insecurity is associated with disordered eating, body dissatisfaction and poor dietary habits in Spanish adolescents. In the case of disordered eating, our findings indicate higher scores for drive for thinness in food insecure adolescents in comparison to their food secure counterparts with a medium effect size. It has been observed that controlling, food-related parenting practices are associated with adolescent eating behaviours in households, either deliberately in order to encourage weight loss in adolescents (Bauer et al, 2011b; Loth et al, 2013) or due to factors such as food insecurity (Bauer et al, 2015). According to some studies, eating and weight-related disorders, such as weight stigma and concerns about gaining weight, are common in food insecure households (Becker et al, 2017). But in general, food insecure adolescents are more prone to binge eating behaviour when food is available (Tester et al, 2016). Binge eating is often associated with shame and guilt (Sanftner, Barlow, Marschall & Tangney, 1995) and is also a contributing factor to weight gain in food insecure adolescents (Tester et al, 2016). Considering that food insecure adolescents are at a higher risk of being overweight (Widome et al, 2009), factors such as shame and guilt could subsequently increase the risk of drive for thinness in food insecure adolescents. To our knowledge, drive for thinness has not been studied in the context of food insecurity and our study adds this factor to the list of disordered eating behaviours.

Our results show higher body dissatisfaction in food insecure adolescents with a medium to large effect size. As previously mentioned, body dissatisfaction can result in negative self-evaluation of one's body (American Psychiatric Association, 2013; Mountford & Koskina, 2017). Not only do adolescents in general exhibit unhealthy weight control practices but also in general, higher body dissatisfaction has been reported in adolescents from higher SES households (O'Dea & Caputi, 2001). Food insecure individuals on the other hand often perceive themselves to be thin due to food scarcity and have a distorted (thinner) body image (Ambroziak et al, 2017). Our findings, which suggest that food insecure adolescents are more dissatisfied with their bodies, are in alignment with a recent study (Altman et al, 2018) that reported for the first time in body image literature that food insecurity was associated with greater body dissatisfaction in children. As explained by Altman et al, (2018), food insecurity is a stressful situation whereby children become more conscious about the shape and size of their bodies hence resulting in greater degrees of body dissatisfaction. This clearly explains the pattern in food insecure individuals which as

previously mentioned is linked to binge eating behaviour whereby they tend to overeat when food is available, experience feelings of shame and guilt and subsequently exhibit higher levels of body dissatisfaction leading to increased drive for thinness. However, there is still limited literature and contradictory findings in body image with regard to its association with food insecurity, which calls for the need for further studies in this area. And to our knowledge, ours is the first study to examine its association with adolescents.

Dietary habits of adolescents were reported by determining their adherence to the Mediterranean diet. Our results were unable to find differences in dietary habits based on participants' food security status. Food insecure adolescents are considered to be at a greater risk of consuming poor quality diets (Kirkpatrick & Tarasuk, 2008) and both food insecurity and poor diet quality has been independently associated with poor mental health (Davison, Gondara & Kaplan, 2017). However, similar to our result, other authors (Dykstra et al, 2016; Bhattacharya et al, 2004) have found no differences in diet quality between food secure and food insecure children. The study by Dykstra et al, (2016) cites the young age of children (less than 12 years) and the availability of free breakfast meals in schools to be possible reasons for the lack of differences in diet quality between food insecure and food secure children. Bhattacharya et al, 2004 also explain the possibility that schoolchildren, unlike adults, might not be as affected by the lack of food resources at home as they may be able to compensate at school or elsewhere, thereby minimising drastic reductions in diet quality. Furthermore, diets in recent times, especially in the case of children and adolescents, irrespective of SES, have undergone drastic changes with higher consumption of calorie laden and highly processed foods including soft drinks and meat products combined with a lower consumption of fruits and vegetables (Grosso & Galvano, 2016). This could explain the lack of differences in dietary habits between food secure and food insecure participants. Another point to consider is that the KIDMED specifically focuses on diet quality rather than quantity, and food scarcity is a common factor in food insecure households, which cannot be measured by the KIDMED. As a result, future research focussing on diet quantity in addition to quality in the field of food insecurity is recommended in order to confirm these findings.

In general, we find the overall results of this study to be consistent with previous literature in terms of poor psychological wellbeing such as low self-esteem, lower positive emotions

and higher levels of stress and coping. Despite the lack of sufficient literature in this area, our study has also examined and found greater levels of drive for thinness in food insecure adolescents as well as higher body dissatisfaction in comparison to their food secure counterparts.

7.3 Overall limitations and strengths of Study 1 and 2

One of the limitations of this study is its limited sample size. For instance, due to insufficient number of cases, we could not analyse the measurement invariance and mean differences for the weight status categories namely ‘thin’ and ‘severely thin’ while the ‘overweight’ and ‘obese’ groups had to be paired together in that case. Another limitation that we would have to consider is that adolescents self-reported their socio-demographic information. Future research could also focus on test-retest reliability of CFSSM-S scores, as our study determined only internal consistency as a measure of reliability. Shame and guilt are important factors of psychological wellbeing in the case of food insecure adolescents related to the inability to have enough food to eat, which is an important part of psychological wellbeing, which was not included in this study. Not many previous studies have considered the associations between food insecurity and dietary habits; hence even though we did not find an association between these two variables in adolescents, further research should be conducted in order to confirm these results. Also, previous literature has reported binge-eating behaviour to be common in the case of food insecure individuals and an assessment focussing on this variable could have shed light on its association to adolescents. Another point to be considered in this study being cross-sectional, causality cannot be inferred. Finally, our study is not a representative sample of food insecurity in Spain as its rates could vary in different Spanish regions.

This study which determined the internal structure of the CFSSM-S and examined the measurement invariance across different variables successfully achieved its objective that in general, the relationships of food insecurity scores with all external variables assessed are in line with results from previous studies, providing support for the validity of this instrument. The CFSSM-S is the first validated self-reported instrument in Spain, which can be used with psychometric guarantees to measure food insecurity in adolescents. Our study not only assessed the dimensionality of the instrument but it also carried out the

measurement invariance, which indicates that the CFSSM-S is a suitable instrument for older children between 12-16 years of both genders and across a wide range of weight status, SES and FAS categories. The anthropometric measurements of weight and height were not self-reported by adolescents, rather it were collected *in situ* by trained research staff following a standardised protocol. We also consider our overall findings, reporting poorer psychological wellbeing, higher body dissatisfaction and drive for thinness in food insecure Spanish adolescents, to be consistent with previous studies. As far as we know, a highly relevant positive association between food insecurity and higher body dissatisfaction in adolescents has been found for the first time in this field. This study also promotes ‘drive for thinness’, an important factor in disordered eating behaviour to be considered in food insecurity studies. Self-reported life satisfaction is considered to be a reliable indicator of subjective wellbeing (Cunsolo, 2017) and our study focuses on self-reported perceptions of several variables related to psychological wellbeing. Finally, weight status, which was included as a potential confounder in the analysis together with other confounders, was not self-reported but was measured objectively.

7.4 Main findings, overall conclusion and research implications

The following are the main findings of our study:

- The 1-factor model with CFA of the CFSSM-S showed excellent fit
- The omega internal consistency from CFA of the CFSSM-S was excellent
- Measurement invariance indicated CFSSM-S to be a suitable instrument with good psychometric properties measuring the same constructs for the following groups:
 - both genders
 - wide age range (12-16 years),
 - different categories of weight status
 - different categories of SES and family affluence
- Higher CFSSM-S scores observed for low SES and low FAS participants

- CFSSM-S scores found to be higher especially for medium-low and low SES participants
- 18.3% were food insecure in this study (16.4%=low food security and 1.9%=very low food security) and 81.7% were food secure
- Lower self-esteem observed in food insecure adolescents
- Lower levels of positive emotions noted in food insecure adolescents
- Food insecure adolescents reported higher levels of stress
- Lower levels of coping observed in food insecure adolescents
- Higher levels of body dissatisfaction reported in food insecure adolescents
- Higher drive for thinness observed in food insecure adolescents

Food insecurity has been a major issue in recent years since the economic crisis in 2008 (Loopstra et al 2015, Loopstra et al, 2016). It has affected both developed and developing nations of the world. Problems such as low income and high food prices post economic crisis have been major factors for households finding it difficult to access and afford healthy and safe foods prepared under sanitary conditions (Kirkpatrick & Tarasuk, 2003; Barrett, 2010;) thereby increasing their risk of food insecurity. Food insecurity has been associated with socioeconomic indicators such as poverty as the prevalence rates of food insecurity are higher in households living near or below the poverty line (Nord et al, 2008). Even though, food insecurity and poverty are inter-related socioeconomic indicators, food insecurity should be considered an independent socioeconomic indicator as some studies have differentiated both these concepts and noted that households earning higher than the poverty line could also be food insecure (Gundersen, 2013). Further, associations between them in children may change depending on different definitions of poverty (Wight et al. 2014).

The rise in food insecurity has resulted in large-scale consequences on the health and wellbeing of individuals. However, this thesis focussed specifically on adolescents, considering that major physiological and developmental changes take place during the

adolescence period and socioeconomic factors such as poverty have long-term repercussions on the health and wellbeing of adolescents (Call et al, 2002). Further, food insecurity has been found to be more prevalent in older children i.e. adolescents in comparison to younger children who are protected by parents in food insecure households (Fram et al, 2011). There has been a lack of data about prevalence rates of food insecurity in adolescents (of a wide age range) in Spain. As a result, prior to conducting these studies, the exact prevalence rate of food insecurity in adolescents was uncertain. Even though the 18.3 % food insecurity rate in adolescents in study may not be representative of the whole of Spain. It is important for future research studies to confirm this percentage in different Spanish regions because as observed in this study, food insecurity can pose a major risk to the health and wellbeing of adolescents.

As observed in this thesis, poor psychological wellbeing; greater drive for thinness and greater body dissatisfaction in food insecure adolescents are important factors to be addressed in the context of public health. We agree with the recent study conducted by Becker et al, 2019, confirming that the treatment of eating disorders becomes more complicated when present along with food insecurity, as food insecure individuals find it difficult to maintain regular eating patterns. As a result, problems associated with the psychological and physical health and wellbeing of adolescents should be tackled as early on as possible in order to prevent major health issues later on in the lives of these individuals. This could help prevent and cut down on public health costs in terms of hospitalisations; frequent visits to the doctor; eating disorders; nutritional deficiencies; psychological problems including long-term depression or dysthymia etc.

This thesis has attempted to address the lack of information about food insecurity in adolescents in Spain. It has examined some of the key issues including developing and validating a suitable self-reported Spanish food insecurity instrument which can be employed in schools and households in order to measure food insecurity in adolescents. It has also examined the associations of food insecurity with crucial variables such as psychological wellbeing, body image, disordered eating and dietary habits in Spanish adolescents.

Some of the key findings of this study could be useful in three main areas such as public health, psychology and research. It could help public health experts address issues, as well as formulate suitable interventions to prevent some of the major problems related to food insecurity in adolescents in Spain. Changes in public health policies; counselling in schools; the re-introduction of programs including subsidised school meals; community targeted information for food insecure families such as healthy cooking and eating and food bank vouchers could be some of the possible measures in order to help adolescents and their families overcome or reduce some of the issues imposed by food insecurity. In addition, public health awareness in local communities about food insecurity would be essential in order to minimise the stigma and shame among individuals inflicted by food insecurity. It can also enlighten professionals working in the mental health field including psychologists in order to prevent some of the psychological issues such as depression in food insecure adolescents. Lastly, this thesis could motivate researchers to perform national surveys and studies in the field of food insecurity in adolescents in Spain to confirm prevalence rates and its associations with key variables related to the health and wellbeing of adolescents.

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9. ANNEXES

9.1 Descriptives for the total CFSSM-S score and comparison by gender, grade, weight status, SES, and FAS.

CFSSM-S total score (0-9)		Descriptives			Comparison		Polynomial contrasts	
Variable	Level	<i>M</i>	<i>SD</i>	<i>n</i>	<i>F</i> (df)	<i>p</i>	LT (<i>p</i>)	QT (<i>p</i>)
Gender	Males	0.72	1.44	226	0.90 (1, 424)	.344		
	Females	0.85	1.46	200				
Grade	01	0.78	1.30	111	0.38 (3, 422)	.765		
	02	0.89	1.59	122				
	03	0.69	1.33	109				
	04	0.74	1.58	84				
Weight-status	Normal-weight	0.64	1.12	279	3.54 (1, 401)*	.061		
	Overweight	1.07	1.96	89				
	Obesity	0.92	1.44	36				
SES	High	0.20	0.64	59	13.53 (1, 416)*	<.005	<.005	.031
	Medium-high	0.36	0.73	103				
	Medium	0.81	1.71	104				
	Medium-low	0.96	1.25	114				
	Low	1.95	2.22	41				
FAS	Low	1.37	1.77	52	11.15 (1, 423)*	.001	<.005	.771
	Medium	0.94	1.48	194				
	High	0.43	1.22	180				

*Degrees of freedom (df) corrected for non-homogeneity of variances (Levene's test); LT: linear trend; QT: quadratic trend. In bold: $p < .05$.



9.2 Ethical Approval



Comisión de Ética en la Experimentación Animal y Humana (CEEAH)

Universitat Autònoma de Barcelona
08193 Bellaterra (Cerdanyola del Vallès)

La Comisión de Ética en la Experimentación Animal y Humana (CEEAH) de la Universitat Autònoma de Barcelona, reunida el día **29-04-2016**, acuerda informar favorablemente el proyecto titulado "**The effects of food insecurity on the eating behaviours and psychological wellbeing of adolescent children in Spain**" presentado por **David Sánchez Carracedo**

<p>Elaborado:</p> <p>Nombre: Nuria Perez Pastor Cargo: Secretària de la CEEA de la UAB Fecha:</p> 	<p>Aprovado:</p> <p>Nombre: Josep Santaló Pedro Cargo: President de la CEEAH de la UAB Fecha:</p> 
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9.3 Consent Form – Participants



Información para los participantes

Título del proyecto: Los efectos de la inseguridad alimentaria en las alteraciones alimentarias y el bienestar psicológico en adolescentes
Director: Dr. David Sánchez-Carracedo: Departamento de Psicología Clínica y de la Salud, Edifici B / Despatx B5b.035 / Campus de la UAB / 08193 Bellaterra, Barcelona / david.Sanchez@uab.cat

Nos gustaría invitarte a participar en esta investigación. Por favor, lee este documento cuidadosamente.

Detalles sobre el estudio y su propuesta:
La adolescencia es un periodo importante de la vida para el crecimiento y el desarrollo. Promover la salud de los adolescentes es esencial para su salud futura en la etapa adulta. Hay muchos niños y jóvenes en nuestro país que no tienen acceso a comidas nutritivas. La falta de acceso a alimentos saludables y seguros se denomina "inseguridad alimentaria", la cual tiene varias consecuencias negativas sobre la salud, en especial durante la adolescencia. Este estudio puede ayudar a determinar si la inseguridad alimentaria tiene algún efecto sobre las actitudes y conductas alimentarias y el bienestar psicológico durante la adolescencia, tema que apenas ha sido estudiado hasta el momento. Los resultados de este estudio pueden ayudar a conocer mejor los efectos de la inseguridad alimentaria y a prevenir las desigualdades sanitarias en los adolescentes.

Los adolescentes de Enseñanza Secundaria Obligatoria del IES Torre de Palau habéis sido invitados a tomar parte de este estudio, que cuenta con el apoyo de la *Agència de Salut Pública de Catalunya* y el de los *Serveis de Salut de l'Ajuntament de Terrassa*.

Procedimiento
Te solicitamos que firmes y entregues el modelo de consentimiento informado y que contestes a una serie de cuestionarios en los que, de forma anónima, nos facilites datos sociodemográficos e información y opiniones sobre cuestiones relacionadas con la inseguridad alimentaria, tu salud y bienestar y actitudes y conductas relacionadas con la alimentación. Te tomaremos medidas de peso y altura para determinar tu índice de masa corporal.

Anonimato y protección de datos:
No hay ninguna desventaja ni riesgo asociado a participar en este estudio y puedes dejar de participar en el momento que desees. Todos los datos serán recogidos y almacenados de acuerdo a la Ley de Protección de Datos de 1998. La información será guardada de forma anónima y almacenada en bases de datos protegidas con contraseña en la *Universitat Autònoma de Barcelona*. Nadie excepto el equipo de investigación tendrá acceso a esa información. Los resultados pueden dar lugar a publicaciones científicas, ser presentados en congresos o dar lugar a trabajos de investigación o tesis doctorales. Los resultados de este estudio también pueden ser facilitados a los centros educativos participantes si así lo requieren.

Si no tienes inconveniente en participar en este estudio, te rogamos firmes el consentimiento informado,

Consentimiento informado para participantes

Por favor, completa este documento una vez haya leído cuidadosamente el documento de información para participantes. Este estudio ha sido revisado y aprobado por el Comité de Ética y Experimentación Animal y Humana de la UAB (Proyecto ID N. 3451, abril de 2016). Gracias por aceptar tu participación en este estudio. Si tienes cualquier duda sobre el mismo, por favor, contacta con el director del proyecto.

Declaración del participante
Yo (participante) _____

- He leído el documento de información para participantes, y entiendo las implicaciones del estudio.
- Entiendo que, si no deseo participar en este proyecto, podré retirarme inmediatamente.
- Doy mi consentimiento para el procesamiento de la información para los fines de este estudio de investigación.
- Entiendo que la información facilitada será tratada de un modo estrictamente confidencial y de acuerdo con la Ley de Protección de Datos de 1998
- Declaro que he entendido completamente las propuestas del estudio y acepto la participación en el mismo

Firma: _____ Fecha: _____

9.4 Pilot Study Inventory

¡No contestes nada dentro de este recuadro!

	Escuela	Curso	Línea	n. cuestionario
N. Caso	□ □	□ □	□ □	□ □
		Peso	□ □ □ □	□ kg
		Altura	□ □ □ □	□ cm

Este es un cuestionario anónimo y los datos serán tratados de forma confidencial. Por favor, contesta con total sinceridad sin dejar ninguna pregunta en blanco. No hay respuestas correctas o incorrectas. Nos interesa tu opinión sincera.

Fecha de hoy: ___ / ___ / ___

Fecha de nacimiento: ___ / ___ / ___

Sexo: Femenino Masculino

¿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) _____

¿Qué estudios tienen tu padre y tu madre?:

	Padre	Madre
1. Nunca estudió (no sabe leer ni escribir o lo hace con dificultad) _____	□	□
2. Estudios básicos/primarios, terminados o sin terminar _____	□	□
3. Estudios secundarios (bachillerato o formación profesional), terminados o sin terminar _____	□	□
4. Estudios universitarios, terminados o sin terminar _____	□	□
5. No tengo o no veo a esa persona _____	□	□

Escribe qué trabajo realizan tus padres (por ejemplo, maestro/a, conductor/a de autobús, camarero/a, médico, electricista, enfermera, etc.):

Padre: _____

Madre: _____

Si tus padres no trabajan, señala por qué razón:

	Padre	Madre
1. Está enfermo/a, jubilado/a o estudiante _____	□	□
2. Está buscando trabajo _____	□	□
3. Cuida de otros o se ocupa de la casa _____	□	□
4. No lo sé _____	□	□
5. No tengo o no veo a esa persona _____	□	□

RSES-Q

Por favor, lee cada uno de las siguientes frases y marca con una «X» la opción que mejor refleja tu acuerdo con cada una de ellas.

		Muy en desacuerdo	En desacuerdo	De acuerdo	Muy de acuerdo
1	En general, estoy satisfecho conmigo mismo				
2	A veces pienso que no soy bueno en nada				
3	Tengo la sensación de que poseo algunas buenas cualidades				
4	Soy capaz de hacer las cosas tan bien como la mayoría de las personas				
5	Siento que no tengo demasiadas cosas de las que sentirme orgulloso				

		Muy en desacuerdo	En desacuerdo	De acuerdo	Muy de acuerdo
6	A veces me siento realmente inútil				
7	Tengo la sensación de que soy una persona de valía, al menos igual que la mayoría de la gente				
8	Ojalá me respetara más a mí mismo				
9	En definitiva, tiendo a pensar que soy un fracasado				
10	Tengo una actitud positiva hacia mí mismo				

CFSSM-S

Las siguientes preguntas se refieren a la situación alimentaria en tu casa **durante los últimos doce meses**. Por favor marca con una «X» la respuesta que mejor describa tu situación.

		Mucho	A veces	Nunca
1	¿Te has preocupado porque la comida en casa se acabara antes de que tu familia tuviera dinero para comprar más?			
2	¿Se ha acabado la comida que compró tu familia y no habéis tenido dinero para comprar más?			
3	¿Tus comidas sólo han incluido una poca variedad de alimentos baratos porque tu familia se estaba quedando sin dinero para más?			
4	¿Con qué frecuencia no has podido comer una comida equilibrada porque tu familia no tenía suficiente dinero?			
5	¿Has tenido que comer menos porque tu familia no tenía suficiente dinero para comprar comida?			
6	¿El tamaño de tus raciones se ha reducido porque tu familia no tenía suficiente dinero para comida?			
7	¿Has tenido que saltar alguna comida porque tu familia no tenía suficiente dinero para comprarla?			
8	¿Te ha pasado que tenías hambre y no has comido porque tu familia no tenía suficiente comida?			
9	¿Has estado un día entero sin comer porque tu familia no tenía suficiente dinero para comida?			

FAS

1. Tienes un dormitorio para ti solo? No Sí

2. ¿Cuántos ordenadores tiene tu familia? (incluyendo portátiles y tabletas, NO incluyendo videoconsolas ni *smartphones*)
 Ninguno Uno Dos Más de dos

3. ¿Cuántos baños (habitación con una bañera/ducha o ambas) hay en tu casa?
 Ninguno Uno Dos Más de dos

4. ¿Tiene tu familia un lavavajillas en casa? No Sí

5. Durante los últimos 12 meses, ¿cuántas veces saliste de vacaciones con tu familia? (viajar fuera del país)
 Nunca Una vez Dos veces Más de dos veces

6. ¿Tiene tu familia coche propio o furgoneta? No Sí, uno Sí, dos o más

PANAS

A continuación, se indican algunas frases que los chicos y chicas utilizan para describirse a sí mismos. Lee detenidamente cada frase y marca cada una de ellas con una «X» en el espacio correspondiente a una de las tres alternativas (“Nunca”, “A veces” o “Muchas veces”). No existen contestaciones buenas ni malas. Recuerda que tienes que señalar la alternativa que mejor se ajuste a tu forma de ser.

		Nunca	A veces	Muchas veces
1	Me intereso por la gente o las cosas			
2	Me siento tenso, agobiado, con sensación de estrés			
3	Soy una persona animada, suelo emocionarme			
4	Me siento disgustado o molesto			
5	Siento que tengo vitalidad o energía			
6	Me siento culpable			
7	Soy un chico asustadizo			
8	Estoy enfadado o furioso			
9	Me entusiasmo (por cosas, personas, etc.)			
10	Me siento orgulloso (de algo), satisfecho			
11	Tengo mal humor (me altero o irrito)			
12	Soy un chico despierto, “despabilado”			
13	Soy vergonzoso			
14	Me siento inspirado			
15	Me siento nervioso			
16	Soy un chico decidido			
17	Soy una persona atenta, esmerada			
18	Siento sensaciones corporales de estar intranquilo o preocupado			
19	Soy un chico activo			
20	Siento miedo			

GHQ-12

Por favor marca con una «X» la respuesta que mejor describa cómo te has sentido **las últimas semanas**.

		Nunca	A veces	Muchas veces	Siempre
1	¿Te has notado constantemente agobiado y en tensión?				
2	¿Te has sentido poco feliz o deprimido?				
3	¿Tus preocupaciones te han hecho perder mucho sueño?				
4	¿Has tenido la sensación de que no puedes superar tus dificultades?				
5	¿Has perdido confianza en ti mismo?				
6	¿Has pensado que eres una persona que no vale para nada?				
7	¿Has podido concentrarte bien en lo que hacías?				
8	¿Te has sentido capaz de tomar decisiones?				
9	¿Has sentido que estás desempeñando un papel útil en la vida?				
10	¿Has sido capaz de hacer frente adecuadamente a tus problemas?				
11	¿Te sientes razonablemente feliz considerando todas las circunstancias?				
12	¿Has sido capaz de disfrutar de tus actividades normales de cada día?				

BSQ

Desearíamos saber cómo te has sentido respecto a tu aspecto durante las **últimas cuatro semanas**.

Lee por favor cada una de las afirmaciones o preguntas que siguen y marca con una «X» la opción de la derecha con la que mejor te identifiques. Contesta por favor a todas las preguntas.

		Nunca	Raramente	Alguna vez	A menudo	Muy a menudo	Siempre
1	Cuando te has aburrido, ¿te has preocupado por tu figura?						
2	¿Te has sentido tan mal con tu figura que has llegado a llorar?						
3	¿Has evitado correr para que tu carne no botara?						
4	Incluso comer poco, ¿te ha hecho sentirte gordo?						
5	Estar desnudo (por ejemplo, cuando te duchas), ¿te ha hecho sentirte gordo?						
6	¿Te has imaginado cortando partes gruesas de tu cuerpo?						
7	¿Has evitado ir a actos sociales (por ejemplo, una fiesta) porque te has sentido mal con tu figura?						
8	¿Te has sentido excesivamente gordo o redondeado?						
9	¿Has vomitado para sentirte más delgado?						

10	¿Te ha preocupado que tu carne tenga aspecto de piel de naranja (celulitis)?						
----	--	--	--	--	--	--	--

EDI-3 (DT &BD)

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 «X» si lo que se dice te ocurre. Es importante que contestes a todas las frases con sinceridad.

		Nunca	Pocas veces	A veces	Muchas veces	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 satisfecho con mi figura						
9	Exagero o doy demasiada importancia al peso						
10	Me gusta la forma de mi trasero						
11	Estoy preocupado porque querría ser una persona más delgada						
12	Creo que mis caderas son demasiado anchas						
13	Me siento hinchado 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						

KIDMED

Por favor, marca con una «X» según la respuesta sea afirmativa o negativa.

		Si	No
1	Tomas una fruta o un zumo natural todos los días		
2	Tomas una segunda pieza de fruta todos los días		
3	Tomas verduras frescas (ensaladas) o cocinadas regularmente una vez al día		
4	Tomas verduras frescas o cocinadas de forma regular más de una vez al día		
5	Consumes pescado con regularidad (por lo menos 2-3 veces al a semana)		

6	Acudes una vez o más a la semana a un centro de comida rápida (<i>fast-food</i>) tipo hamburguesería		
7	Te gustan las legumbres y las tomas más de 1 vez a la semana		
8	Tomas pasta o arroz casi a diario (5 días o más a la semana)		
9	Desayunas un cereal o derivado (pan, etc.)		
10	Tomas frutos secos con regularidad (al menos 2-3 veces a la semana)		
11	Se utiliza aceite de oliva en casa		
12	Te saltas el desayuno		
13	Desayunas un lácteo (yogurt, leche etc.)		
14	Desayunas bollería industrial, galletas o pastelitos		
15	Tomas 2 yogures y/o 40 g queso cada día		
16	Tomas golosinas y/o caramelos varias veces al día		

**Muchas gracias por tu
participación**

9.5 Professional language translation (English-Spanish) certificate for CFSSM-S

Servei de Llengües

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UALT

Unitat d'Assessorament Lingüístic i Traduccions
Documents de Recerca

CERTIFICATE VALIDATING THE LANGUAGE REVISION OF THE SUBMITTED ARTICLE

May 3, 2017

To whom it may concern:

The Language Advisory & Translation Unit of the *Servei de Llengües* at the *Universitat Autònoma de Barcelona* hereby confirms that the translation into Spanish of the document entitled "Self-Administered Food Security Survey Module for Children Ages 12 Years and Older", written in English by C. L. Connell, M. Nord, K.L. Lofton & K. Yadrick and has been revised by a native Spanish-speaking professional translator/corrector, and is now deemed to be acceptable, *from the point of view of its language*. The correction of this document has specifically focused on the grammar, lexis, orthography and syntax of the language used, in accordance with the accepted rules and guidelines for Spanish.

We recognise that the general use of language in the article indicated in this certificate, as defined by broadly applied language-assessment standards such as those of the Council of Europe's Common European Framework of Reference for Languages, is in all other senses of native-like competence.

Lluc Potrony Julià
Language Advisory & Translation Unit
Servei de Llengües
Universitat Autònoma de Barcelona

Document validated by the UAB Translation Service

9.6 CFSSM-S

Spanish version of the Child Food Security Survey Module (CFSSM-S)

Las siguientes preguntas se refieren a la situación alimentaria en tu casa **durante los últimos doce meses**. Por favor, marca la respuesta que describa mejor tu situación. No escribas tu nombre en la hoja. Tus respuestas se mantendrán en secreto.

1. ¿Te ha **preocupado** que se acabara la comida de tu casa antes de que tu familia tuviera dinero para comprar más?
_____ MUCHO _____ A VECES _____ NUNCA
2. ¿La comida que compró tu familia **se acabó** y no tuvisteis dinero para comprar más?
_____ MUCHO _____ A VECES _____ NUNCA
3. ¿Tus comidas consistieron solo en una pequeña variedad de **alimentos baratos** porque tu familia se estaba quedando sin dinero para comida?
_____ MUCHO _____ A VECES _____ NUNCA
4. ¿Con qué frecuencia no has podido tomar una **comida equilibrada** porque tu familia no tenía suficiente dinero?
_____ MUCHO _____ A VECES _____ NUNCA
5. ¿Has tenido que **comer menos** porque tu familia no tenía suficiente dinero para comida?
_____ MUCHO _____ A VECES _____ NUNCA
6. ¿**Se ha reducido** el tamaño de tus comidas porque tu familia no tenía suficiente dinero para comida?
_____ MUCHO _____ A VECES _____ NUNCA
7. ¿Has tenido que **saltarte alguna comida** porque tu familia no tenía suficiente dinero para comida?
_____ MUCHO _____ A VECES _____ NUNCA
8. ¿Has sentido **hambre** y no has comido porque tu familia no tenía suficiente comida?
_____ MUCHO _____ A VECES _____ NUNCA
9. ¿Has estado un **día entero sin comer** porque tu familia no tenía suficiente dinero para comida?
_____ MUCHO _____ A VECES _____ NUNCA

9.7 CFSSM

Self-Administered Food Security Survey Module for Children Ages 12 Years and Older

[Begin Child Food Security Survey Module]

The following questions are about the food situation in your home during the last month. Please circle the answer that best describes you. Do not put your name on the paper. Your answers will remain a secret.

1. Did you worry that food at home would run out before your family got money to buy more?

- A LOT
 SOMETIMES
 NEVER

2. Did the food that your family bought run out, and you didn't have money to get more?

- A LOT
 SOMETIMES
 NEVER

3. Did your meals only include a few kinds of cheap foods because your family was running out of money to buy food?

- A LOT
 SOMETIMES
 NEVER

4. How often were you not able to eat a balanced meal because your family didn't have enough money?

- A LOT
 SOMETIMES
 NEVER

5. Did you have to eat less because your family didn't have enough money to buy food?

- A LOT
 SOMETIMES
 NEVER

6. Has the size of your meals been cut because your family didn't have enough money for food?

- A LOT
 SOMETIMES
 NEVER

7. Did you have to skip a meal because your family didn't have enough money for food?

- A LOT
 SOMETIMES
 NEVER

8. Were you hungry but didn't eat because your family didn't have enough food?

- A LOT
- SOMETIMES
- NEVER

9. Did you not eat for a whole day because your family didn't have enough money for food?

- A LOT
- SOMETIMES
- NEVER

[End of Child Food Security Survey Module]

9.8 Cover page of the Spanish Adaptation and Validation of the Child Food Security Survey Module (CFSSM-S)

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Spanish adaptation and validation of the Child Food Security Survey Module (CFSSM-S)

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Abstract

Objective: The present study aimed to assess the: (i) internal structure of the Spanish Child Food Security Survey Module (CFSSM-S) with exploratory and confirmatory factor analysis (EFA and CFA); (ii) measurement invariance by gender, grade, weight status, socio-economic status (SES) and family affluence; and (iii) relationships with these external variables.

Design: A cross-sectional study was conducted. The CFSSM-S and other tools were employed to assess food insecurity, weight status, SES and family affluence, respectively.

Setting: A secondary school (grades 7–10) in the city of Terrassa in Catalonia, Spain.

Subjects: Participants included adolescent boys and girls (*n* 426) aged 12–17 years.

Results: The cross-validation design with EFA and CFA captured a single factor, 'food insecurity'. The goodness-of-fit for the one-factor model with CFA (root-mean-square error of approximation = 0.038, comparative fit index = 0.984, Tucker–Lewis index = 0.979) and internal consistency ($\omega = 0.95$) were excellent. The measurement invariance indicated that CFSSM-S could be used across genders, grades, weight status, SES and family affluence. Only mean differences for SES and family affluence were found which showed a linear trend, indicating higher CFSSM-S scores for participants with lower SES and family affluence. Of participants, 1.9% experienced very low food security, 16.4% low food security and 81.7% were food secure.

Conclusions: The CFSSM-S is the first validated instrument to assess food insecurity with psychometric guarantees in Spanish adolescents. Researchers and health practitioners in Spain could use this self-reported questionnaire to gain more information about adolescent health in relation to food insecurity.

Keywords
Adolescents
Confirmatory factor analysis
Cross-validation
Food insecurity
Measurement invariance

The economic downturn in 2008 has resulted in food insecurity becoming a huge public health burden in Europe^(1,2). The aftermath of the crisis led to an increase in unemployment and poverty in developed countries like Spain as well as contributed to issues in food affordability and nutritional status⁽³⁾. In Spain, the gap between upper and lower social classes has widened significantly and child poverty rates are considerably higher than the rich world average⁽⁴⁾. The onus falls on notable reductions in social benefits and meal subsidies, which have greatly affected the well-being of individuals in Spain, particularly children⁽⁵⁾. Specifically, 20% of the population in Catalonia, Spain are living under the poverty line⁽⁶⁾. This region also reported an increase of 23% in child poverty in 2017, with

261 970 children living in severe poverty⁽⁷⁾. There have been studies that have explored the relationship between poverty and food insecurity and it has been noted that higher levels of food insecurity are experienced in households living near or under the poverty line⁽⁸⁾. However, it is not necessary that all households living in poverty are food insecure or all food-insecure households face poverty⁽⁹⁾. It is thereby essential to understand the definition of food insecurity.

Food insecurity does not simply refer to the lack of access to food. It is defined as 'the limited or uncertain availability of nutritionally adequate and safe foods or limited or uncertain ability to acquire acceptable foods in socially acceptable ways'^(10,11). Considering high food

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