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**BODY MASS INDEX, OBESITY AND LABOUR MARKET
OUTCOMES IN SPAIN**

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I. INTRODUCTION

1. Aim of the study

Determine if *body mass index (BMI)* – in particular high levels of **BMI: overweight and obesity** - from working-age males and females living in Spain affects to the probability of being in a specific labour status (inactivity, unemployment or employment).

Use data taken from the *European Health Interview Survey (EHIS) from 2009 in Spain*: first edition of the survey, comparable at supranational level and with high future prospects.

I. INTRODUCTION

2. Selection of the topic of study

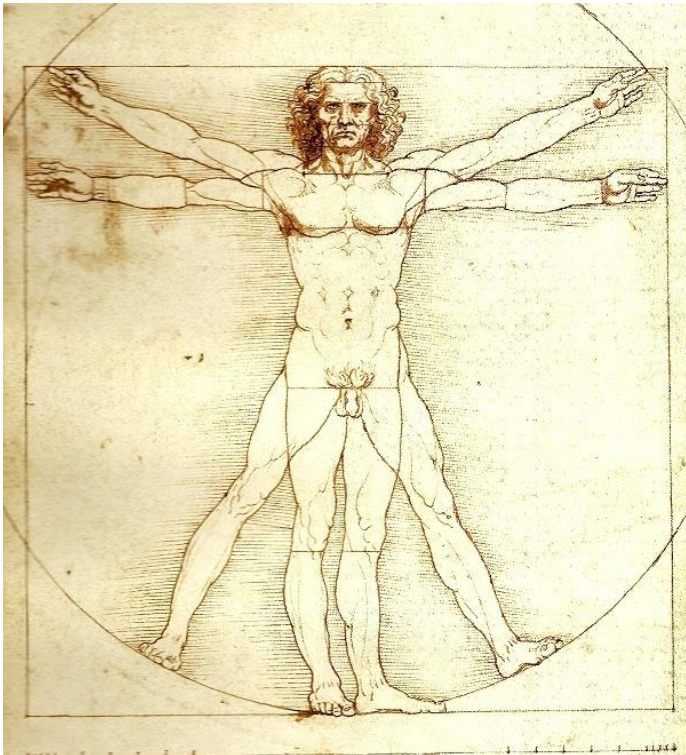
- **Overweight and obesity** are main **World-class problems** (WHO,2004 and WHO,2015) (FAO, 2014).
- **The importance of research on the consequences of overweight and obesity** in social relationship, lifestyle an socioeconomic status in people (Bozoyan and Wolbring, 2011; Caliendo and Wang-Sheng Lee, 2013; Cawley, 2004; Cawley, Han and Norton, 2009; Colchero and Bishai, 2007; Han, Norton and Powell, 2011; Lindeboom, Lundborg and Bas Van der Klaaus, 2010; Sabia and Rees, 2012).
- **Limited national studies** focused on the influence that **obesity has in the structure of the labour market in Spain.**
- **Main methodology:** the *European Health Interview Survey (EHIS) from 2009 in Spain.*
- **The results are representative** of the socioeconomic structure in Spain.

I. INTRODUCTION

3. Overweight and obesity. Definition and quantification

Overweight and Obesity: “abnormal or excessive fat accumulation that may impair health” (WHO).

Key point: both of them are risk factors for the health of people.



Adolphe Quételex (1796-1874) defined a *relative weight indicator* (*Quetelex's index*):

$$\text{BMI} = \frac{\text{Weight (kg)}}{\text{Height}^2 \text{ (m)}}$$

In 1972, Keys, Fidanza et al. published *Indices of relative weight and obesity* and renamed Quetelex's index as **Body mass index (BMI)**. They concluded that BMI is a convenient and reliable indicator of overweight and obesity. 5

I. INTRODUCTION

3. Overweight and obesity. Definition and quantification

The WHO classifies the nutritional status of adults, both men and women, using as key variable BMI:

BMI (kg/m²)	Nutritional status
Less than 18.5	Underweight
From 18.5 to 24.9	Normal weight
From 25.0 to 29.9	Overweight
From 30.0 to 34.9	Obesity class I
From 35.0 to 39.9	Obesity class II
Above 39.9	Obesity class III

Source: World Health Organization (WHO)

In this study, all levels of obesity have been clustered into one (BMI>30). In addition, the BMI variable has been used in its continuous version.

II. METHODOLOGY

1. Data collection: European Health Interview Survey in Spain (EHIS 2009).

Selection of the survey:

- **NATIONAL HEALTH SURVEY IN SPAIN 2011-2012 (8th edition).**
 - **Advantages:** Comparable backwards in time.
 - **Inconvenient:** Not comparable at supranational level or with EHIS 2009.
- **EUROPEAN HEALTH INTERVIEW SURVEY IN SPAIN 2009 (1st edition).**
 - **Advantages:** Comparable at European level and with high prospects in the future.
 - **Inconvenient:** No possibility to analyse time series backwards.

Both are similar in type of questionnaires, population area (residents of main family dwellings), sample size (approximately 24,000 theoretical observations), territory of application (national), and methods of collecting information (face-to-face interview mode: interviewer-PAPI and CAPI).

II. METHODOLOGY

1. Data collection: European Health Interview Survey in Spain (EHIS 2009).

EUROPEAN HEALTH INTERVIEW SURVEY (1ST EDITION) TEMPORARY DISTRIBUTION BY COUNTRIES

Year	Country
2006	Austria and Estonia.
2007	Slovenia and Switzerland.
2008	Belgium, Bulgaria, France, Cyprus, Latvia, Malta, Czech Republic, Romania and Turkey.
2009	Germany, Slovakia, Spain, Greece, Hungary and Poland.

Source: Methodology of the European Health Interview Survey, Eurostat.

EUROPEAN HEALTH INTERVIEW SURVEY IN SPAIN 2014, 2ND EDITION (EHIS 2014): results available in November 2015.

II. METHODOLOGY

2. Data and definition of variable

DATA	VARIABLES	
Cross-sectional	Dependent variables (LDV)	Independent variables
Household questionnaire + Adult questionnaire = 22.188 theoretical obs. (theoretical sample size). 20.891 obs. valid.	<p><i>SITU</i>: Occupational status of individuals.</p> <p>Values (probit model): =0, INACTIVE. =1, UNEMPLOYED =2, PART-TIME EMPLOYED =3, FULL-TIME EMPLOYED</p>	<p>Qualitative: Most of them.</p> <p>Level of studies, Region (CC.AA), Size of municipality, Disability, Household composition, Etc.</p>
Finally selected: 15.055 obs.(working-age individuals, 16-64 years old).	<p><u>Note</u>: <i>SITU</i> is obtained from the number of working hours of individuals, so that: INACTIVE and UNEMPLOYED = 0 hours of work per week. PAR-TIME EMPLOYED = less than 35/40 hours of work per week. FULL-TIME EMPLOYED = 35/40 hours of work per week.</p>	<p>Quantitative</p> <ul style="list-style-type: none"> • <i>Discrete</i> <ul style="list-style-type: none"> Age Number of children • <i>Continuous</i> <ul style="list-style-type: none"> BMI Household income level

II. METHODOLOGY

3. Econometric Model and Hypothesis

HYPOTHESIS:

1. Determine if **BMI influences the occupational status of individuals (SITU):** being inactive, unemployed or employed.

$$H_0: \beta_0 = 0$$

$$H_1: \beta_0 \neq 0$$

- Accepting H_0 : BMI does NOT affect the occupational status of subjects.
- Accepting H_1 : BMI influences the labour status of individuals.

1. Determine if dependent variable **SITU is truncated or censored:**

- H_0 : Theoretical distribution of $SITU_i$ coincides with its empirical distribution.
- H_1 : Theoretical distribution of $SITU_i$ does NOT coincide with its empirical distribution.

Levels of significance: 1%, 5% and 10% .

II. METHODOLOGY

3. Econometric Model and Hypothesis

ECONOMETRIC MODEL

Labour insertion equation:

$$SITU_i = \alpha + \beta_0 \times BMI_i + \beta_1 \times X_{1i} + \beta_2 \times X_2 + \dots + \beta_n \times X_{ni} + \varepsilon_i$$

Where:

$SITU_i$ = Dependent variable of the occupational status.

BMI_i = Independent variable of Body mass index.

$X_{1i}, X_{2i}, \dots, X_{ni}$ = Vector of socioeconomic, health and labour independent variables.

α = Independent parameter not associated with independent variables.

$\beta_0, \beta_1, \beta_2, \dots, \beta_n$ = Coefficients associated with independent variables.

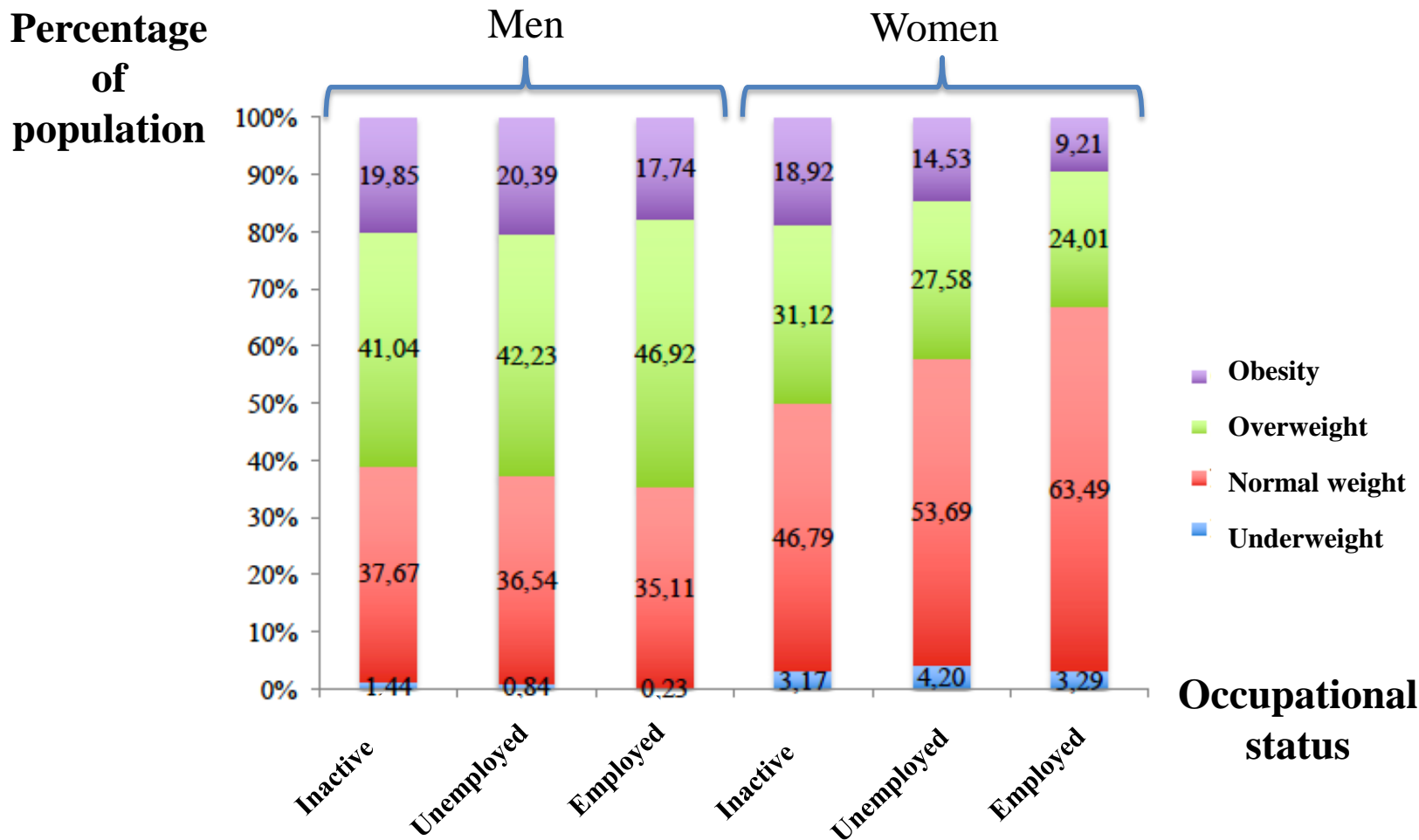
ε_i = Random error term, such that $\varepsilon_i \approx N(0, \sigma)$.

This equation is estimated using *ordered probit model* and *tobit model* (in the latter, SITU only adopts values 0= Not working and 1= Working).

III. RESEARCH

1. Descriptive Statistics

Distribution of population according to BMI and SITU

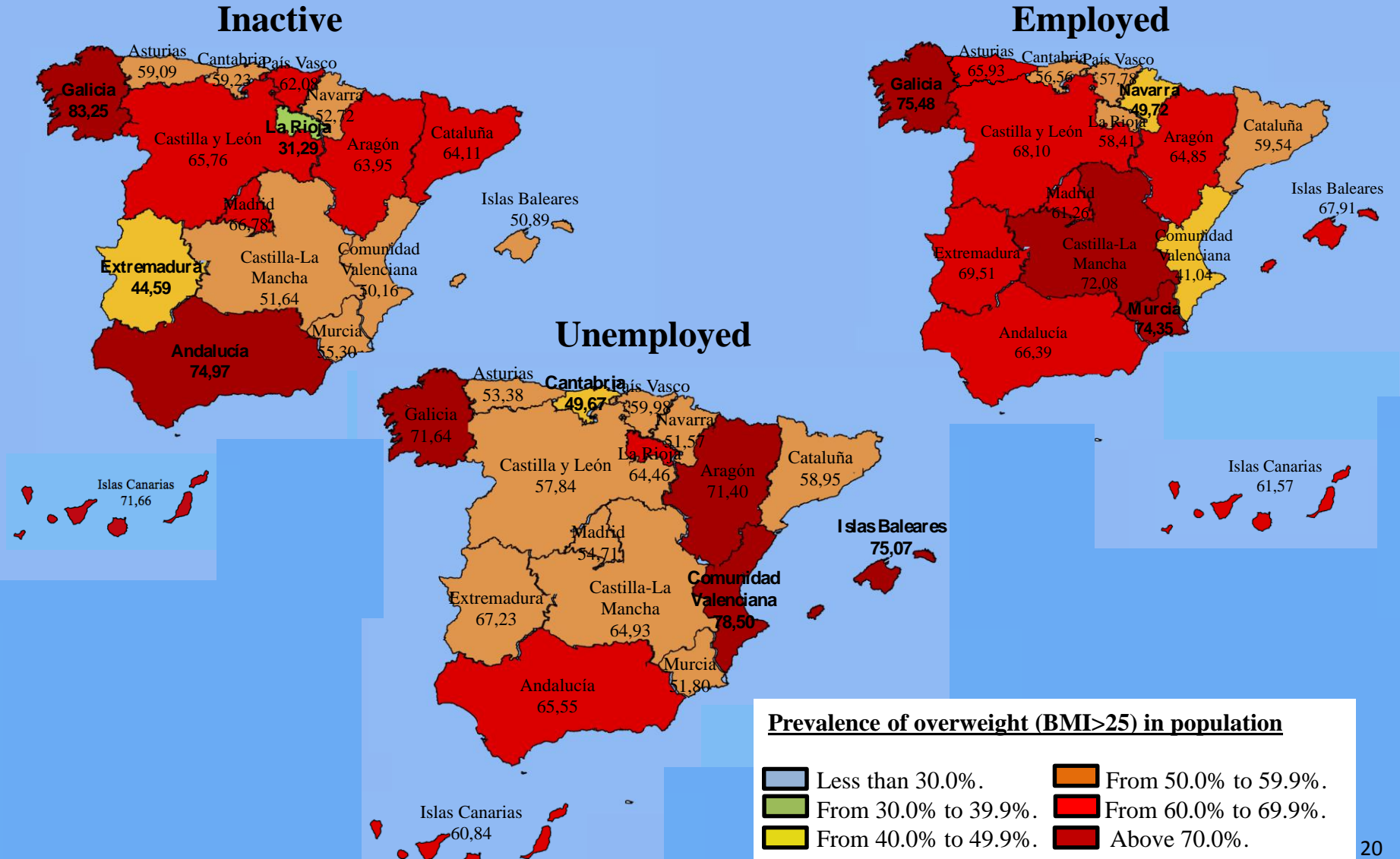


Source: Own elaboration with data from EHIS09.

III. RESEARCH

1. Descriptive Statistics

Distribution of male population by region (CC.AA), BMI and SITU



III. RESEARCH

1. Descriptive Statistics

Distribution of female population by region (CC.AA), BMI and SITU

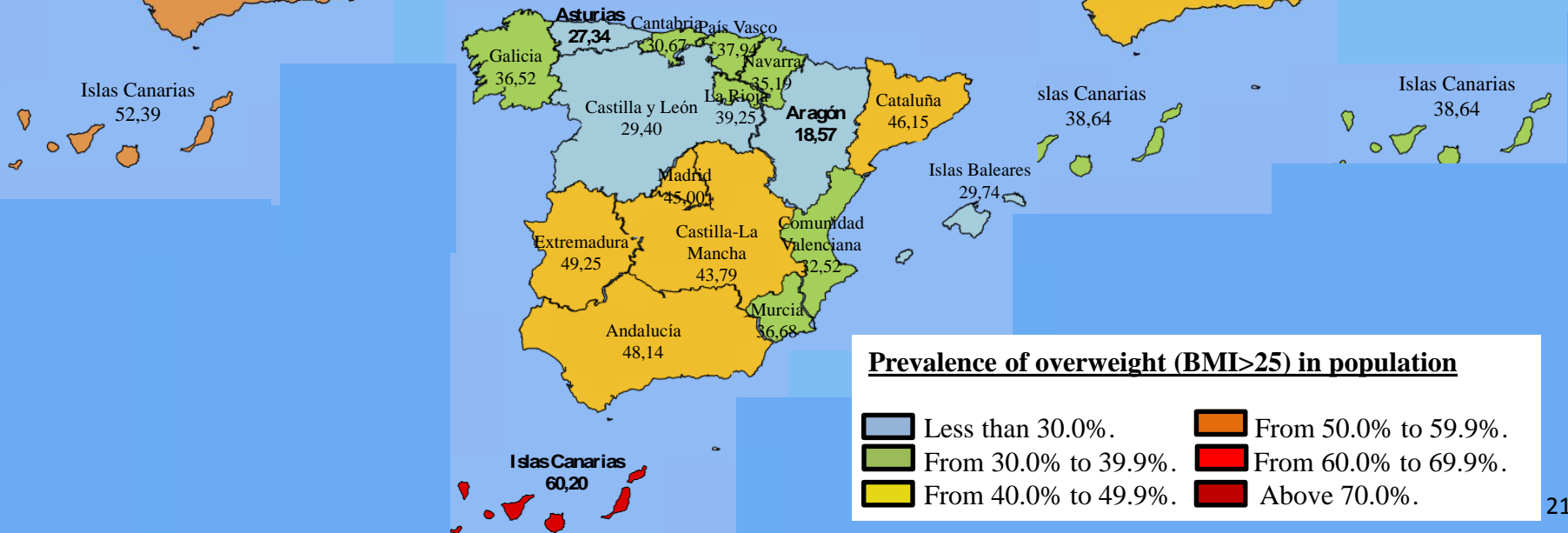
Inactive



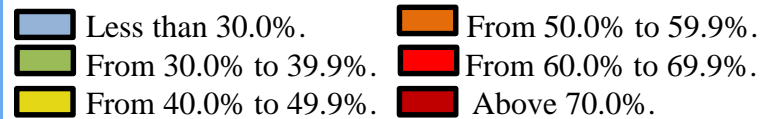
Employed



Unemployed



Prevalence of overweight (BMI>25) in population



III. RESEARCH

2. Econometric Analysis

HYPOTHESIS 1: DETERMINATE IF BMI INFLUENCES THE OCCUPATIONAL STATUS

Estimation of the labour insertion equation with a *probit model*:

Goodness of fit: Good.

Wald test and Pseudo R2 test: Both significant.

Table 1. Labour insertion equation estimated with an ordered probit model (0 = INACTIVE, 1 = UNEMPLOYED, 2 = PART-TIME EMPLOYED, 3 = FULL-TIME EMPLOYED)

Independent variables	Men			Women		
	Coefficients	z	P>[z]	Coefficients	z	P>[z]
BMI	0,0828	2,30	0,02**	0,5075	2,18	0,03**
BMI ²	-0,0015	-2,37	0,02**	-0,0010	-2,46	0,01***

III. RESEARCH

2. Econometric Analysis

HYPOTHESIS 1: DETERMINATE IF BMI INFLUENCES THE OCCUPATIONAL STATUS

MARGINAL EFFECTS OF VARIABLES BMI AND BMI²

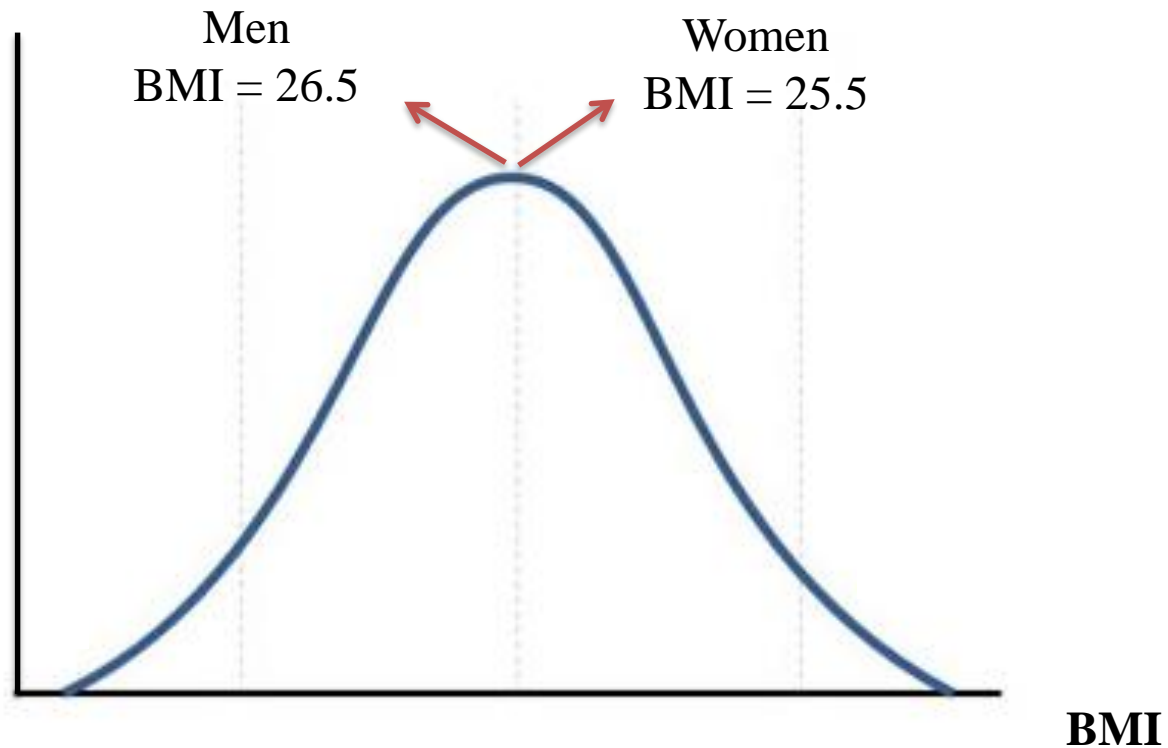
Variables	Total effect	Men			
		Inactive	Unemployed	Part-time employed	Full-time employed
Dependent variable: SITU	-	0,6786	0,1929	0,0156	0,1128
BMI	0,0148	-0,0297	0,0123	0,0015	0,0159
BMI ²	0,0003	0,0005	-0,0002	0,0000	-0,0003
Maximum value of $\left\{ \frac{d^2 SITU}{d BMI^2} \right\}$	-24,67	29,70	30,75	∞	26,50
SITU					
Dependent variable: SITU	Total effect	Women			
		Inactive	Unemployed	Part-time employed	Full-time employed
BMI	-	0,7961	0,1083	0,0467	0,0488
BMI ²	0,0072	-0,0144	0,0058	0,0035	0,0051
Maximum value of $\left\{ \frac{d^2 SITU}{d BMI^2} \right\}$	0,0001	0,0003	-0,0001	-0,0001	-0,0001
SITU	-36,00	24,00	29,00	17,50	25,50

III. RESEARCH

2. Econometric analysis

HYPOTHESIS 1: DETERMINATE IF BMI INFLUENCES THE OCCUPATIONAL STATUS

**Probability of
being full-time
employed**



III. RESEARCH

2. Análisis econométrico

HYPOTHESIS 2: DETERMINATE IF DEPENDENT VARIABLE OCCUPATIONAL STATUS (SITU) IS TRUNCATED OR CENSORED

Estimation of the labour insertion equation with a *tobit model*:

Goodness of fit: Good.

Wald test and Pseudo R2 test: Both significant.

Table 2. Labour insertion equation estimated with a Tobit model (0 = NOT WORKING, 1 = WORKING)

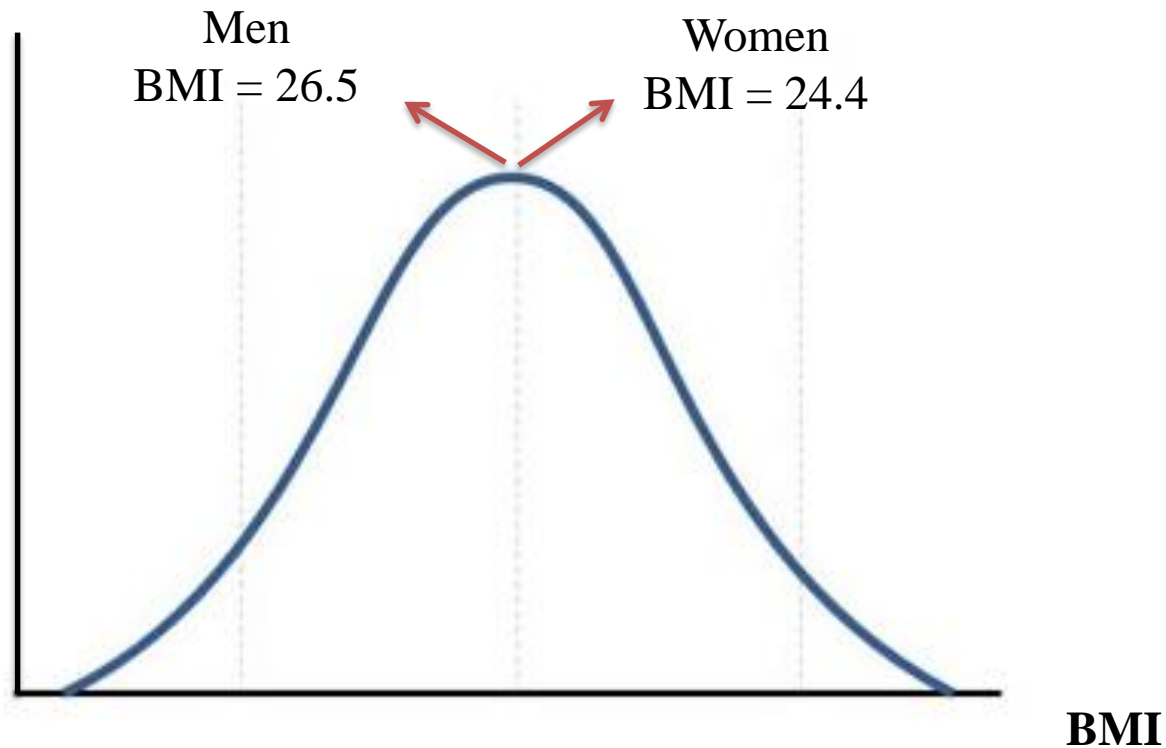
Independent variables	Coefficients	Men			Women		
		t	P>[t]	Coefficients	t	P>[t]	
BMI	0,0477	2,58	0,01***	0,0293	1,80	0,07*	
BMI ²	-0,0009	-2,59	0,01***	-0,0006	-2,13	0,03**	
Maximum value of $\left\{ \frac{d^2SITU}{d \text{ BMI}^2} \right\}$		26,50		24,42			

III. RESEARCH

2. Econometric analysis

**HYPOTHESIS 2: DETERMINATE IF DEPENDENT VARIABLE
OCUPATIONAL STATUS (SITU) IS TRUNCATED OR CENSORED**

Probability of
being
employed



IV. CONCLUSIONS

CONTRAST OF HYPOTHESIS	
Hypothesis 1	✓
Hypothesis 2	✓

- It is proved that BMI influences the occupational status of individuals, especially in obese women who are up to 9.5% less likely to be employed (Cawley, 2004).

V. LIMITACIONES OF THE STUDY

1. LIMITATIONS OF THE VARIABLE BODY MASS INDEX (BMI).
2. RELATIVELY OUTDATED SURVEY AND LIMITED DATA.
3. LIMITATIONS OF VARIABLES AND ESTIMATION METHODS:
 - Limited and qualitative dependent variables (LDV).
 - *Probit and Tobit models* are asymptotic (consistent, asymptotically normal and asymptotically efficient).
 - Importance of the initial value distribution of the variables.
4. REVERSE CAUSALITY.

VI. FUTURE RESEARCH LINES

- Analyse the 2nd edition of the European Health Survey in Spain (2014).
- Compare the results of EHIS09 and EHIS14 and work out time series.
- Expand the study to other countries of the European Union.
- Analyse the effect of overweight and obesity on other variables of the labour market (e.g. Salaries).



**THANK YOU VERY MUCH
FOR YOUR ATTENTION!**