

*HMM workshop*  
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**The prevalence of chronic diseases according to Body Mass Index categories and integer categories: The case of Spain**  
(work in progress)

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## Background 1

- **Medical file Jeroen**

**Height: 1.73 m**

**Weight 78 kg**

$$\text{BMI: } \frac{78}{1.73 * 1.73} = 26 = \text{overweight}$$

**Note on file: Dr Spijker needs to lose weight**

**Yet no other health conditions!!**

## Background 2

- Body Mass Index (BMI) is associated with many chronic conditions, but its relationship is generally non-linear:  
**lowest prevalence → individuals of normal weight**  
**highest prevalence → underweight or obese**
- Yet, the precise BMI at which common chronic conditions have the lowest prevalence is rarely analysed as BMI categories are used.

## Objective

- Analyse the association between (integer) BMI and common chronic conditions
- We do this for Spain for the period 2006-20.

# Data

- Data on BMI and chronic conditions (diagnosed and experienced during last 12 months) come from the Spanish Health Surveys (ENSE: 2006, 2011/12, 2017; EHIS: 2009, 2019/20).
- BMI categorised into the (standard) categories:

Underweight: BMI < 18.5 kg/m <sup>2</sup>	1.8%
Normal weight: 18.5 ≤ BMI < 25 kg/m <sup>2</sup>	43.9%
Overweight: 25 ≤ BMI < 30 kg/m <sup>2</sup>	37.4%
Class I obesity: 30 ≤ BMI < 35 kg/m <sup>2</sup>	13.1%
Class II and III (morbid) obesity: BMI ≥ 35 kg/m <sup>2</sup>	3.8%

Just 0.9% ≥ 40
- BMI as an integer per 1 kg/m<sup>2</sup> increment (≤16 to ≥40 kg/m<sup>2</sup>)
- Age range: 20-84

# Method

- Prevalence of CCs for each BMI category.
- Prevalence of CCs by BMI integer value. To obtain best fit we used generalized additive models (GAMs) (R package `ggplot2`) (not constrained to linear or quadratic forms).
- This method has been adopted in various disciplines, including psychology and medicine (Wiley, 2019).

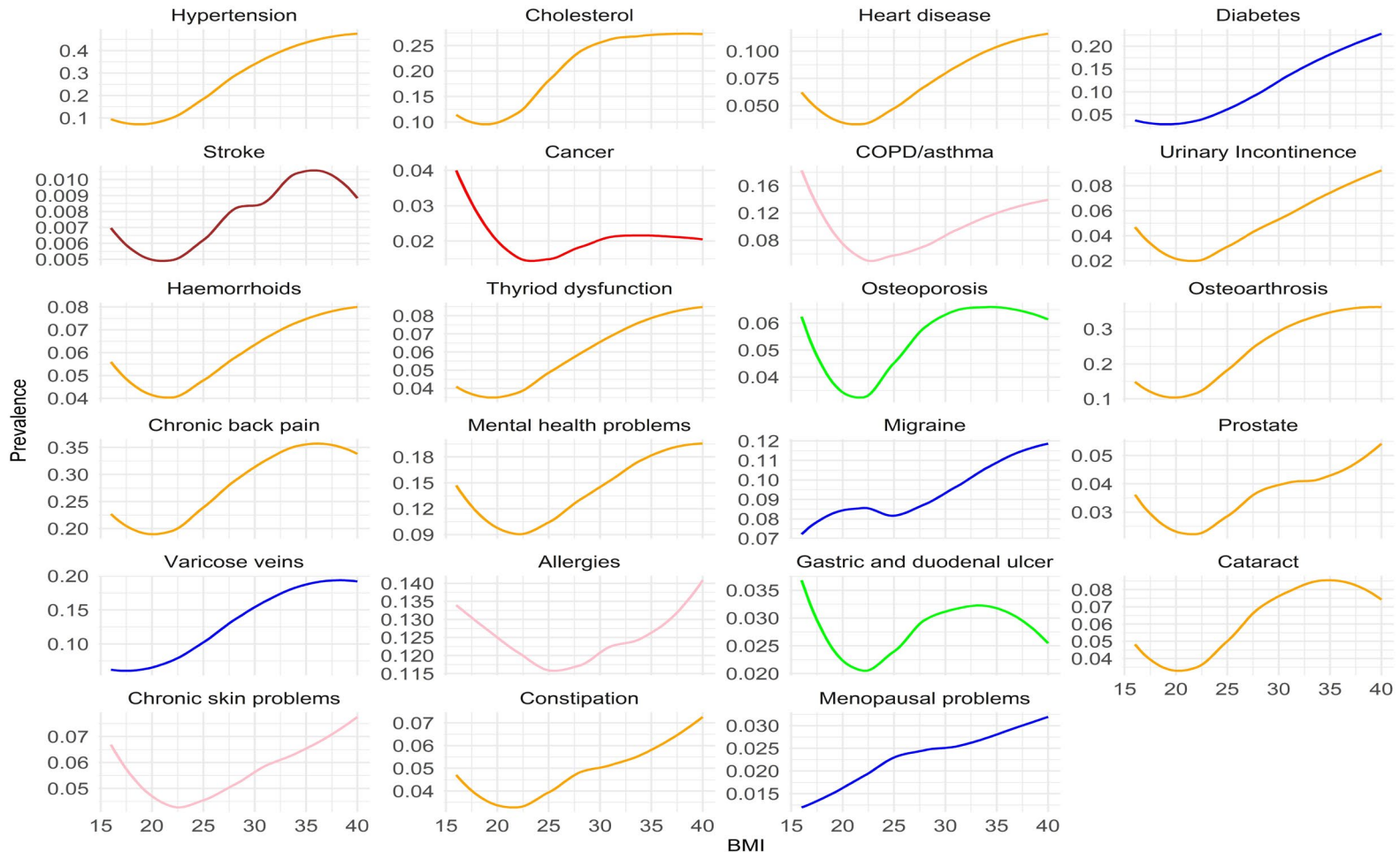
# Descriptive results

Prevalence (%) of chronic conditions (CC) and the BMI category distribution (%) by CC. Spain, 2006-2020

Chronic condition	Prevalence	BMI				
	Overall	<18.5	18.5-24.9	25.0-29.9	30.0-34.9	35+
Hypertension	18.3	0.4	21.9	45.1	24.0	8.6
High cholesterol	16.3	0.8	28.9	45.8	18.9	5.7
Heart disease	4.6	1.1	27.6	41.5	21.8	8.0
Diabetes	6.8	0.5	21.3	42.2	25.3	10.8
Stroke	0.6	1.5	30.7	42.8	18.0	7.0
Cancer	1.5	2.8	35.9	39.0	17.4	4.9
COPD/asthma	6.4	2.2	35.0	36.1	19.3	7.4
Urinary Incontinence	3.0	1.2	27.1	40.0	22.5	9.3
Haemorrhoids	4.7	1.5	36.1	39.4	16.9	6.1
Thyroid dysfunction	4.7	1.5	37.0	35.9	18.3	7.2
Osteoporosis	3.7	1.9	35.9	38.4	17.5	6.2
Osteoarthritis	16.5	0.8	28.0	42.6	21.0	7.6
Chronic back pain	23.2	1.5	36.0	39.6	17.2	5.6
Mental health problems	10.2	2.1	35.2	37.8	17.8	7.2
Migraine	8.9	2.3	44.2	33.8	14.3	5.3
Prostate problems (men only)	5.1	0.5	26.1	50.0	18.7	4.7
Varicose veins	9.6	1.0	33.2	38.4	20.1	7.3
Allergies	12.2	2.1	44.6	35.7	13.6	4.0
Gastric and duodenal ulcer	4.2	1.1	36.7	41.4	16.4	4.4
Cataract	4.2	1.1	28.8	43.3	20.4	6.3
Chronic skin problems	4.8	1.5	39.4	38.0	15.7	5.5
Constipation	3.7	1.8	38.4	38.0	15.8	6.1
Menopausal problems (women only)	4.2	1.3	41.6	36.0	15.2	5.8
<b>Total sample (weighted)</b>	-	<b>1.8</b>	<b>43.9</b>	<b>37.4</b>	<b>13.1</b>	<b>3.8</b>

# Main results

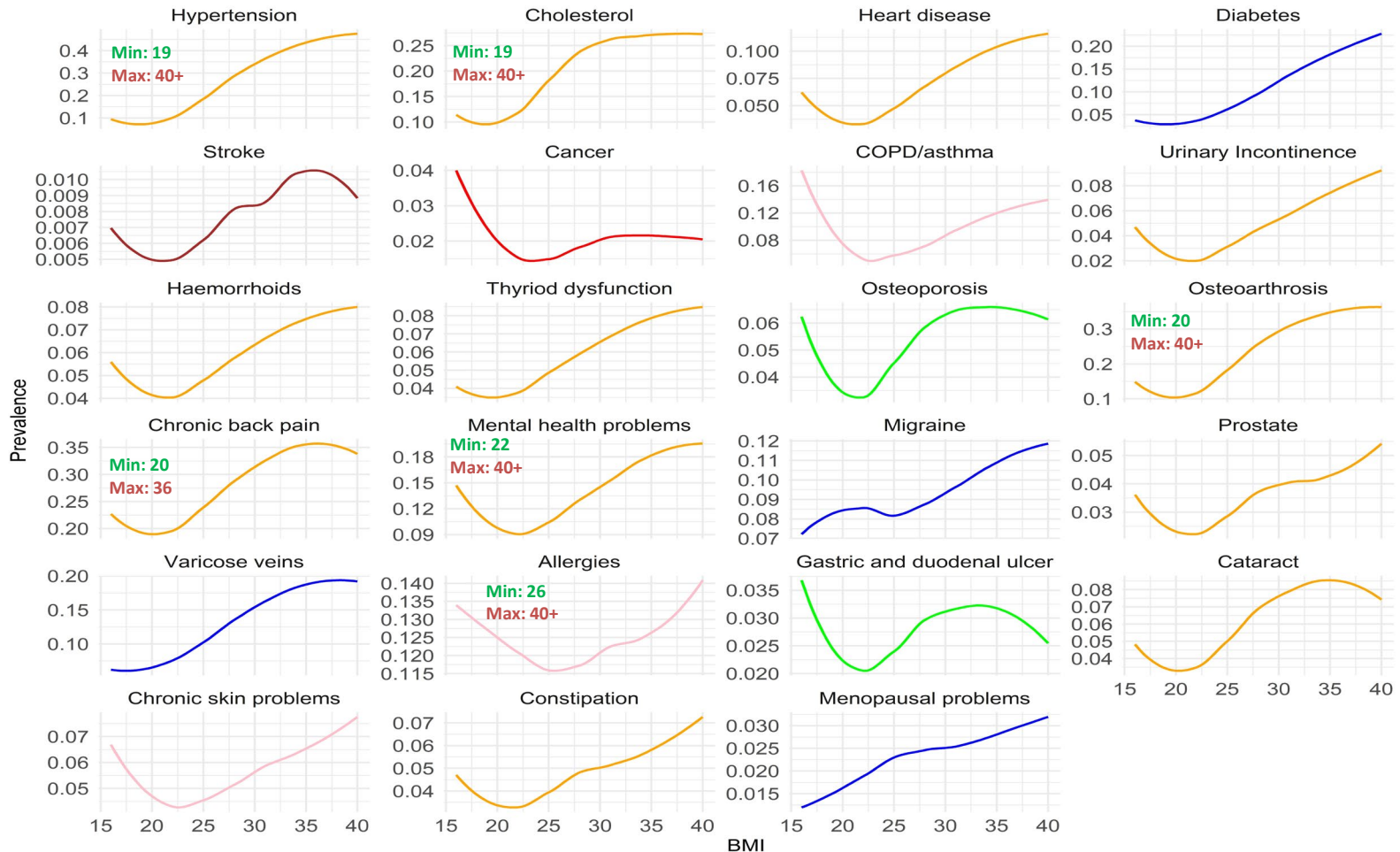
## Prevalence of chronic conditions according to integer BMI. Spain, 2006-20



Orange: J-Shaped; Green: Sinusoidal; Pink: U-shaped; Blue: exponential; Red: decrease; Brown: Other

# Main results

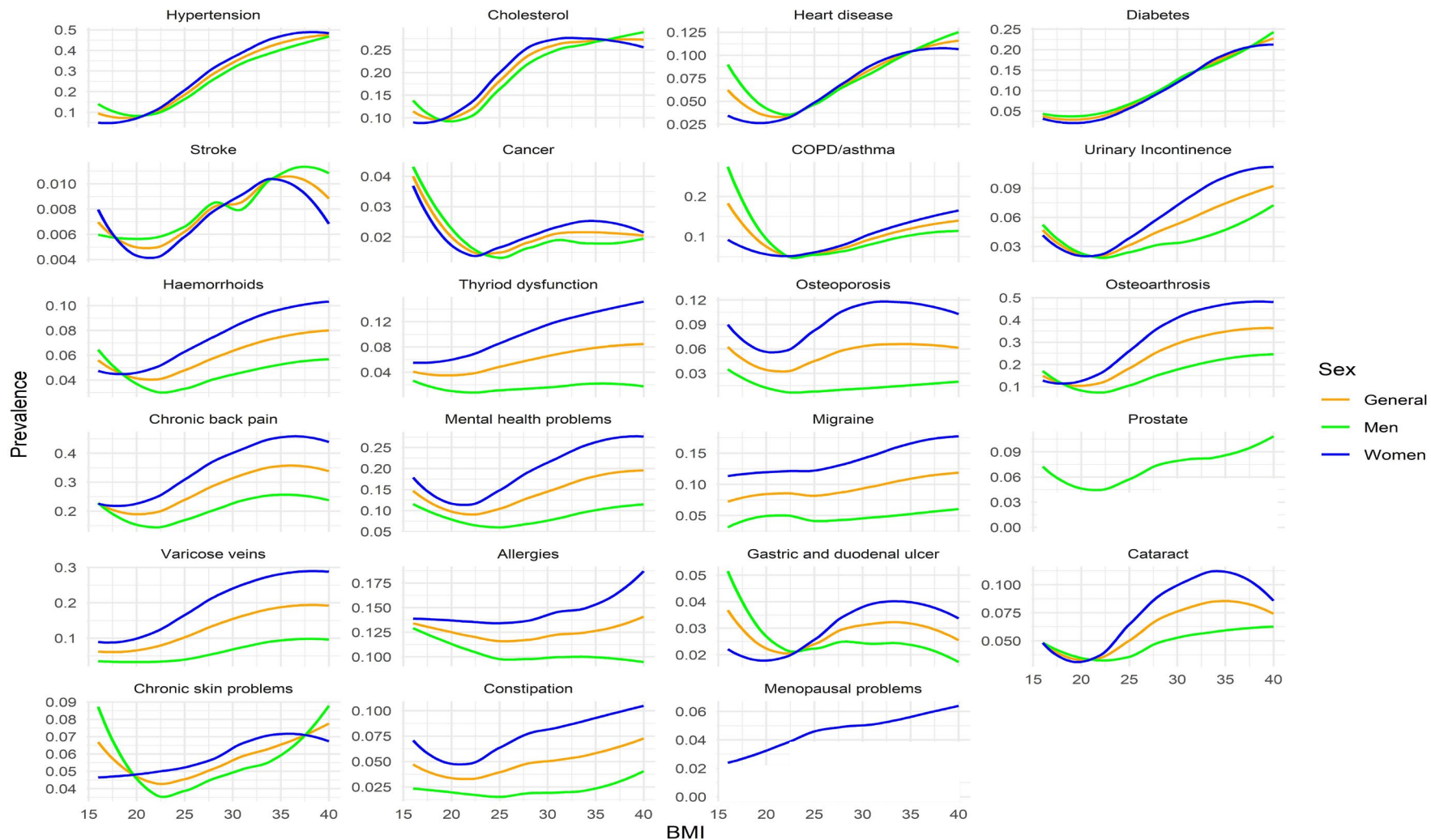
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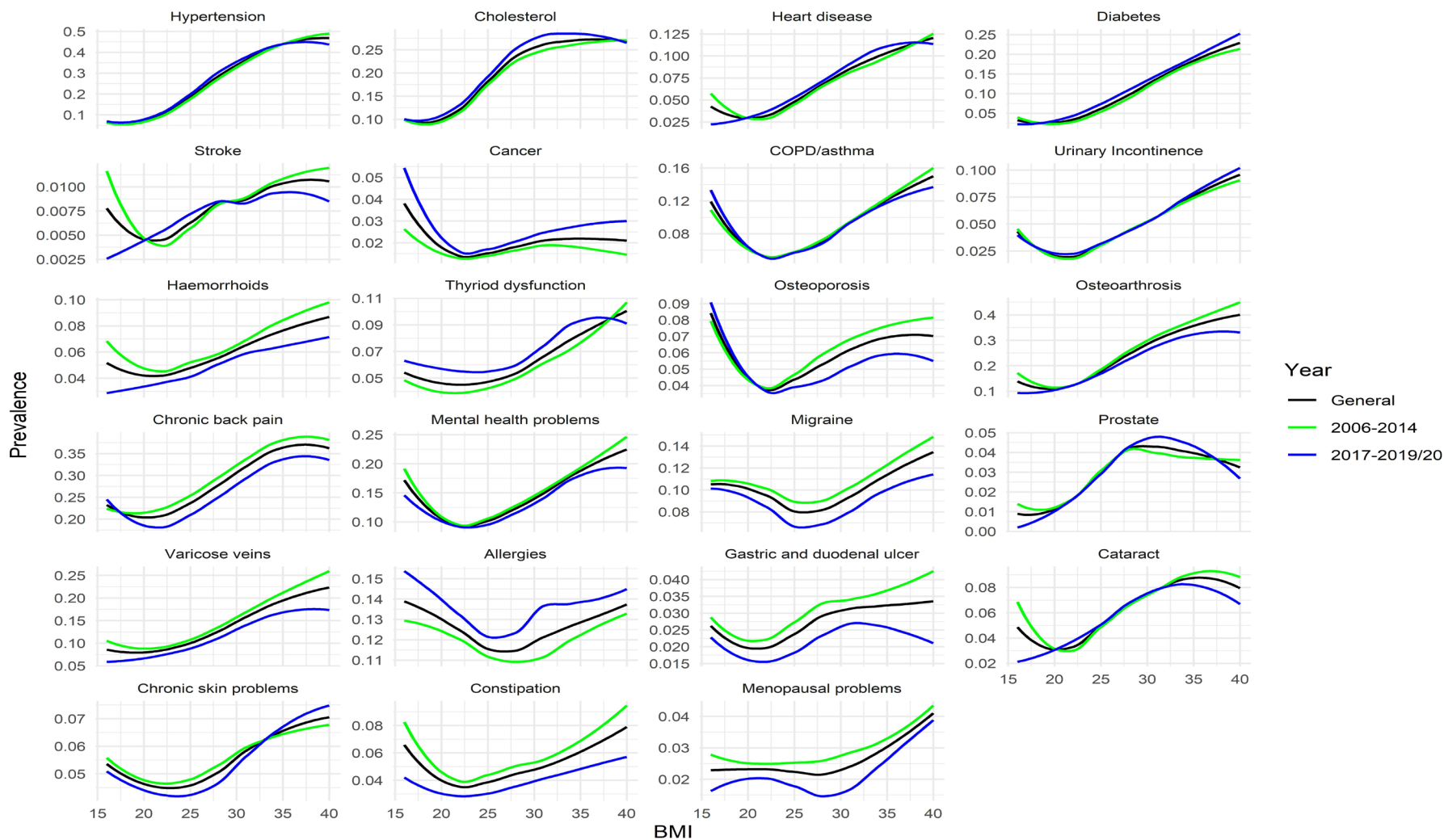
Orange: J-Shaped; Green: Sinusoidal; Pink: U-shaped; Blue: exponential; Red: decrease; Brown: Other



# Prevalence of chronic conditions by sex according to integer BMI. Spain, 2006-20



# Prevalence of chronic conditions by survey year according to integer BMI. Spain, 2006-20



# Discussion

- The prevalence of chronic conditions is generally lowest among people of normal weight and highest among obese people.
- The lowest prevalences for CCs was only found once when BMI values are considered overweight (namely allergies).
- Differences over time (mainly lower prevalences in 2017-19/20 than in 2006-11/12) and between sexes (lower for men except for some CC at low BMI levels) In addition, for certain CC, e.g. allergies and thyroid dysfunction, no association with BMI could be discerned.
- Our research thus indicates a more nuanced association between BMI and the prevalence of CC in Spain.
- This underscores the importance of targeted health policies that consider the complex and specific BMI thresholds for different chronic diseases to optimize preventive strategies and healthcare resource allocation.
- *Note: We are considering repeating the analysis for age groups and different categories of educational attainment, smoking status, alcohol consumption, and physical activity.*

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# Thank you!

# Eskerrik asko!

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