

# Supplementary material: Spatial analysis of determinants of COVID-19 vaccine hesitancy in Portugal

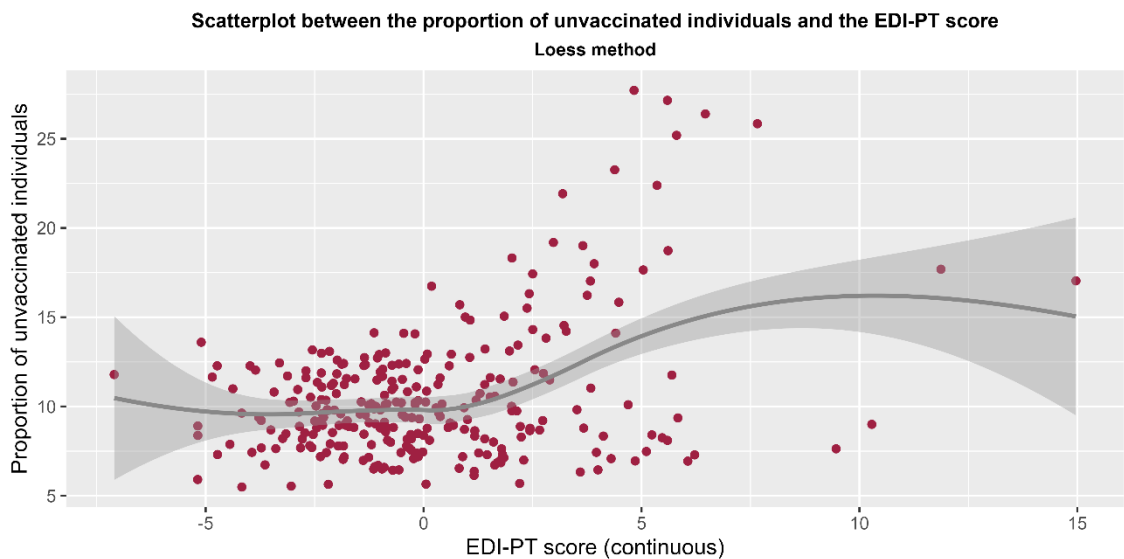


Figure S1. Scatterplot between the proportion of unvaccinated individuals and the EDI-PT score (each dot represents a municipality).

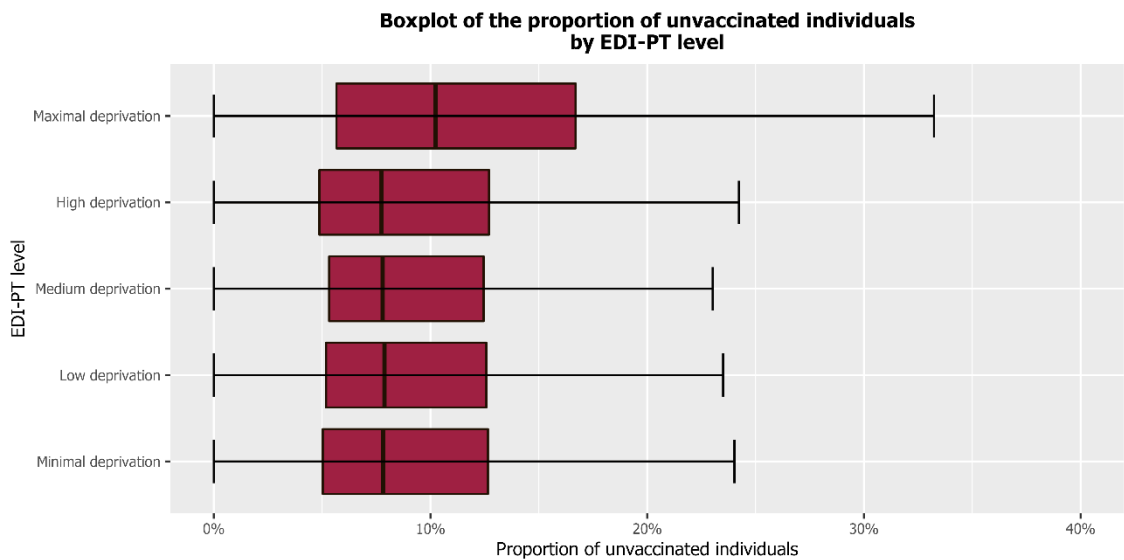


Figure S2. Boxplot of the proportion of unvaccinated individuals by EDI-PT level.

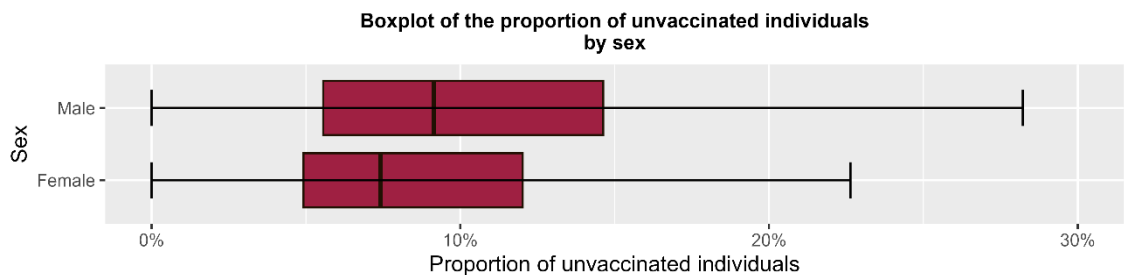
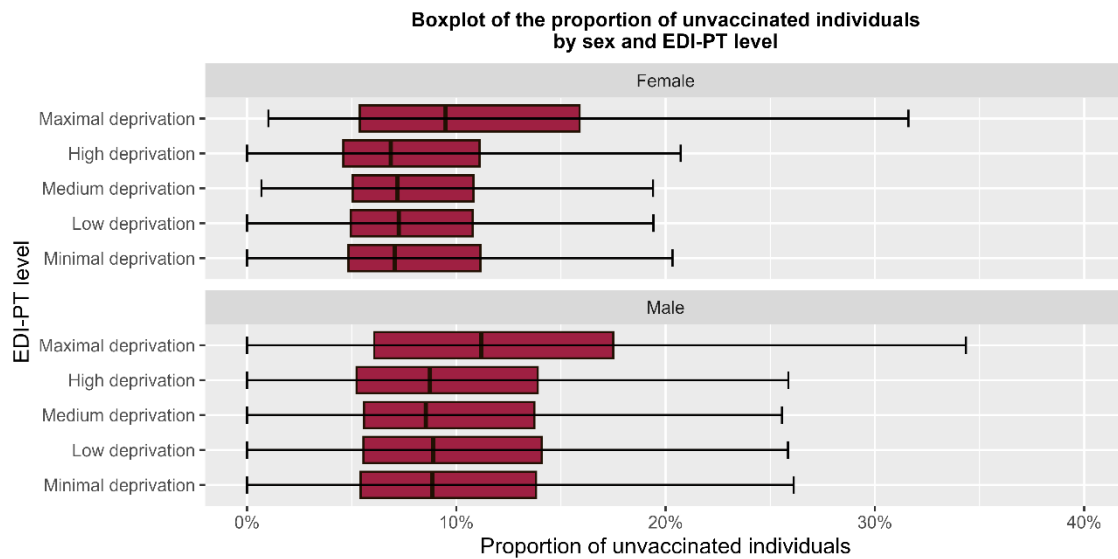
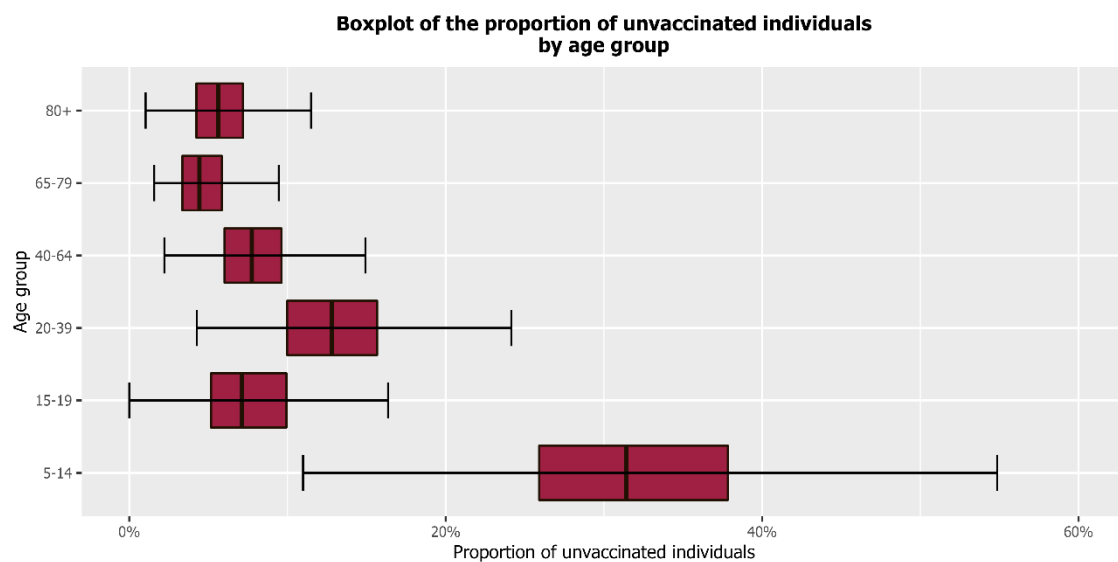


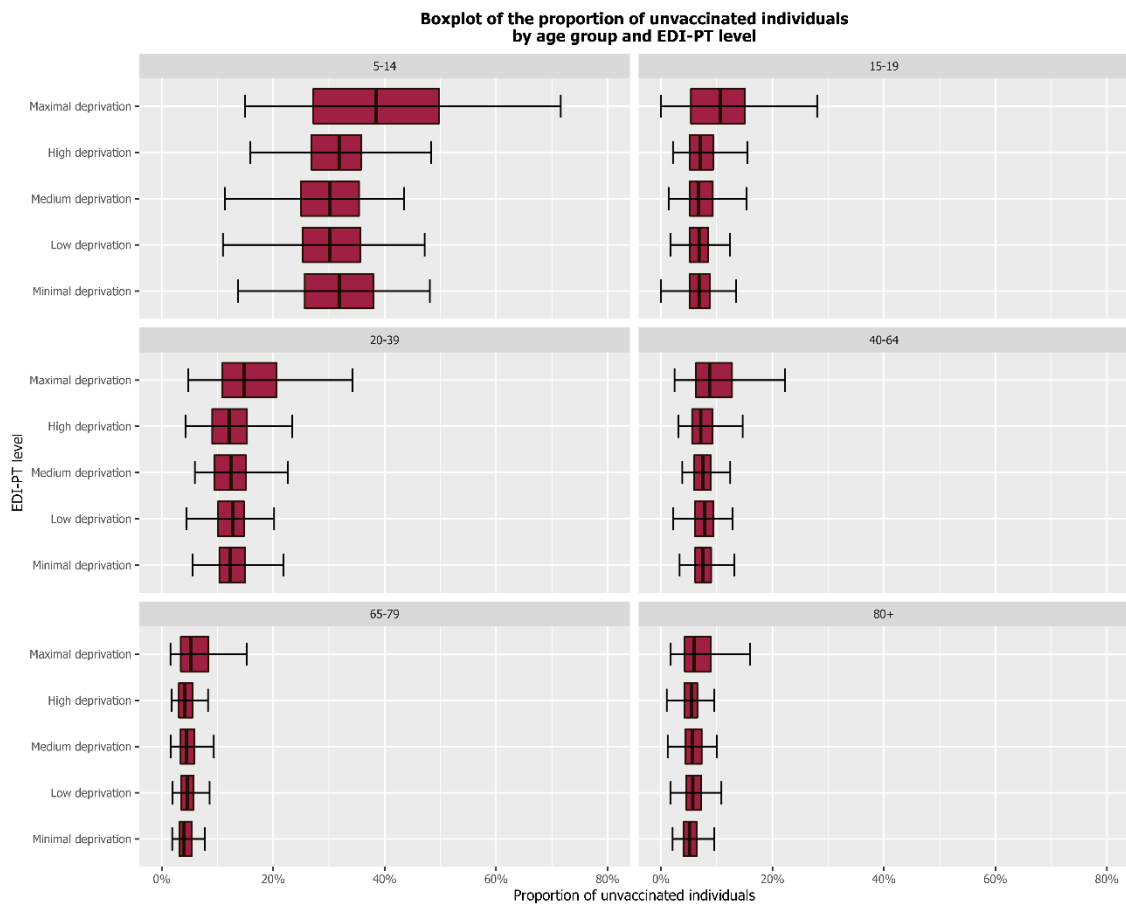
Figure S3. Boxplot of the proportion of unvaccinated individuals by sex.



*Figure S4. Boxplot of the proportion of unvaccinated individuals by sex and EDI-PT level.*

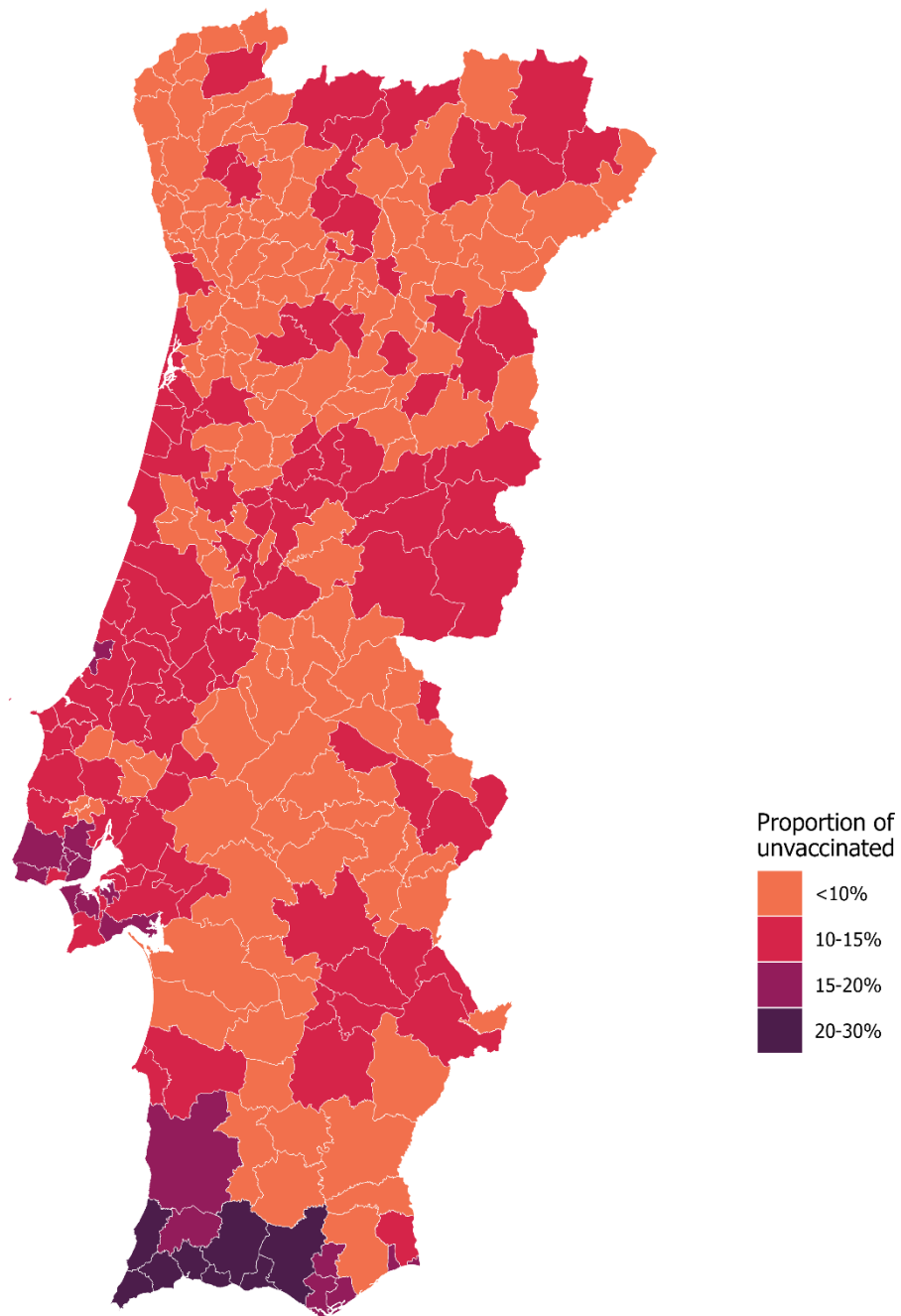


*Figure S5. Boxplot of the proportion of unvaccinated individuals by age group.*



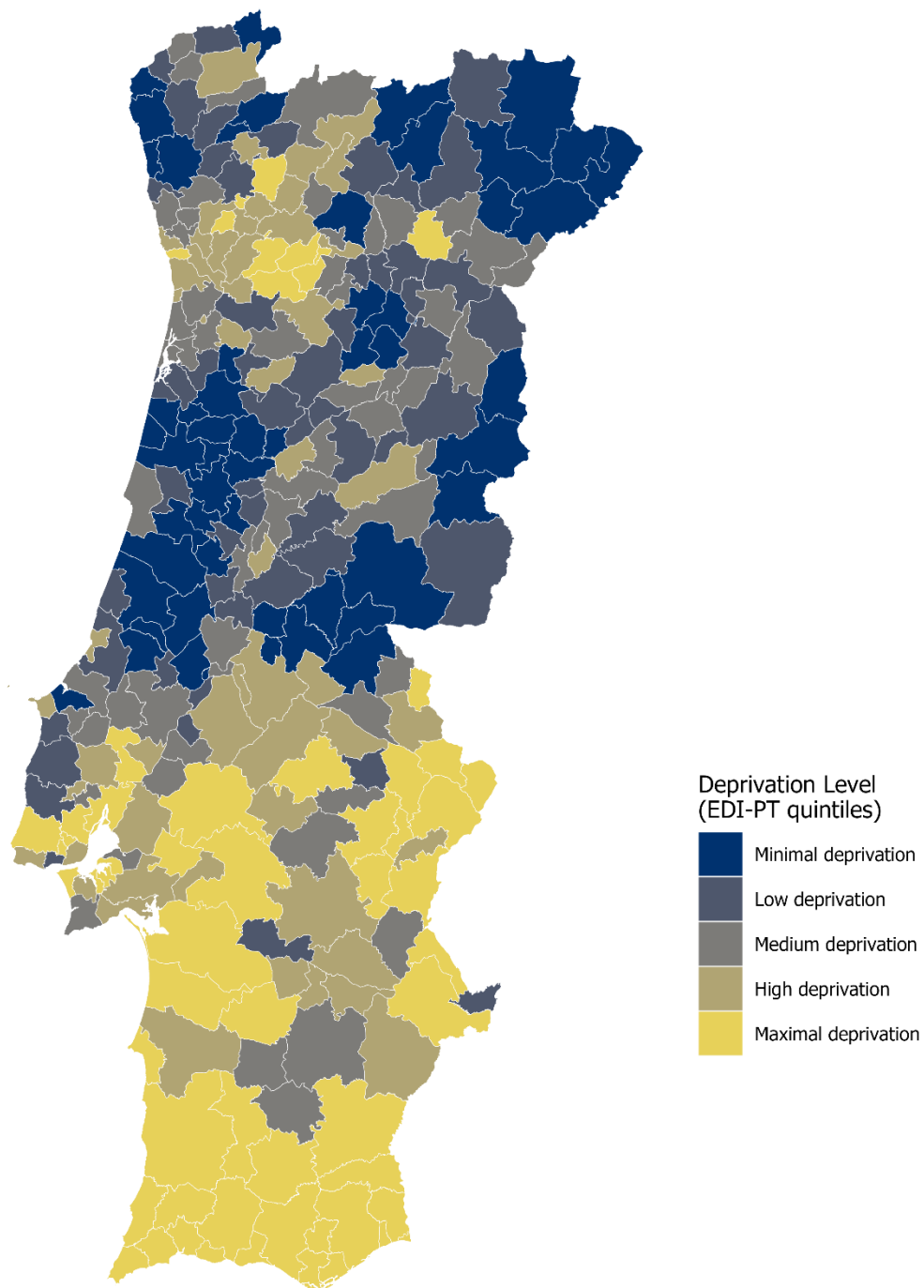
*Figure S6. Boxplot of the proportion of unvaccinated individuals by age group and EDI-PT level.*

**Proportion of individuals unvaccinated for COVID-19  
by municipality | March 31st 2022**

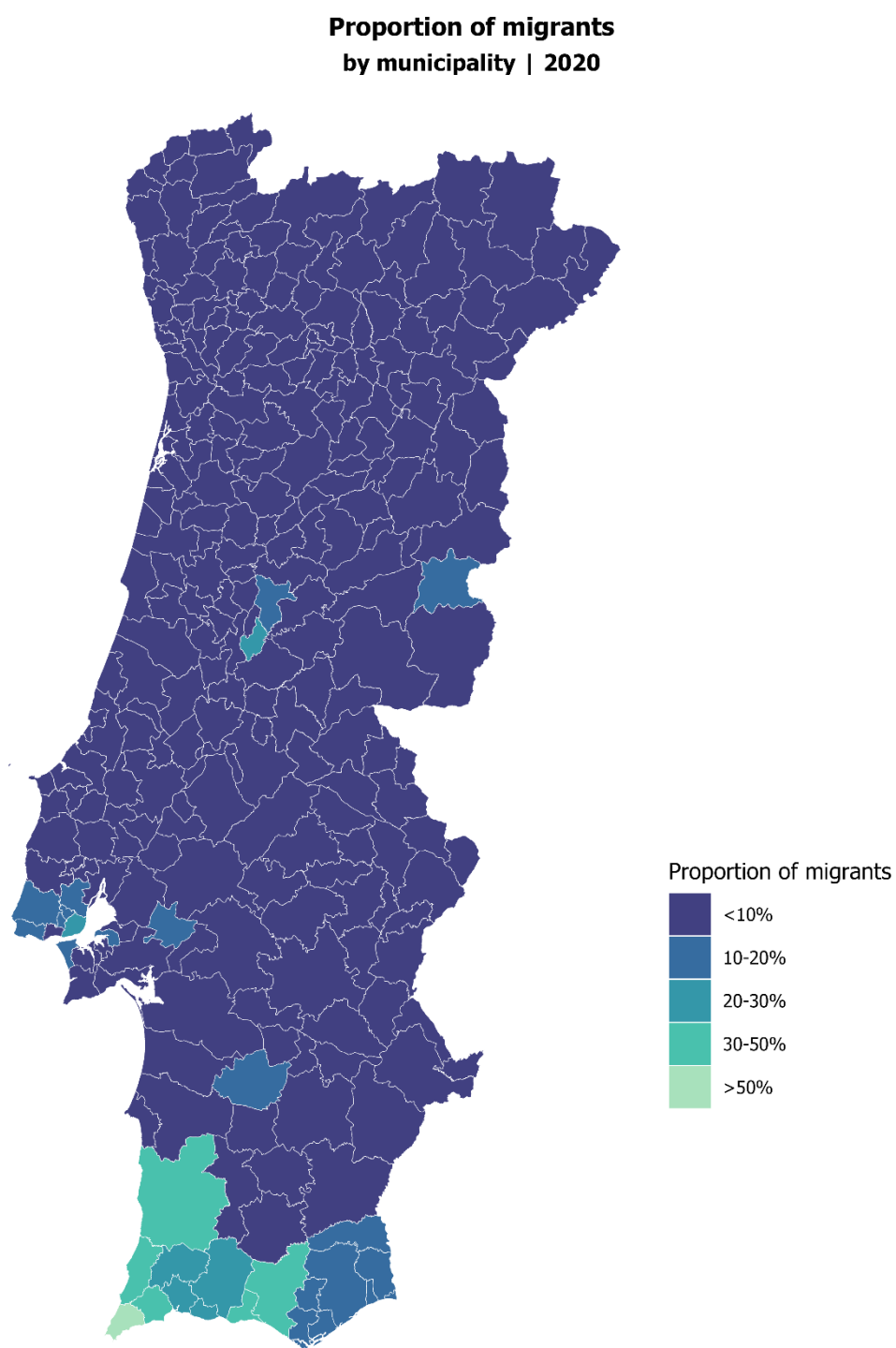


*Figure S7. Map of the distribution of the proportion of unvaccinated individuals by municipality.*

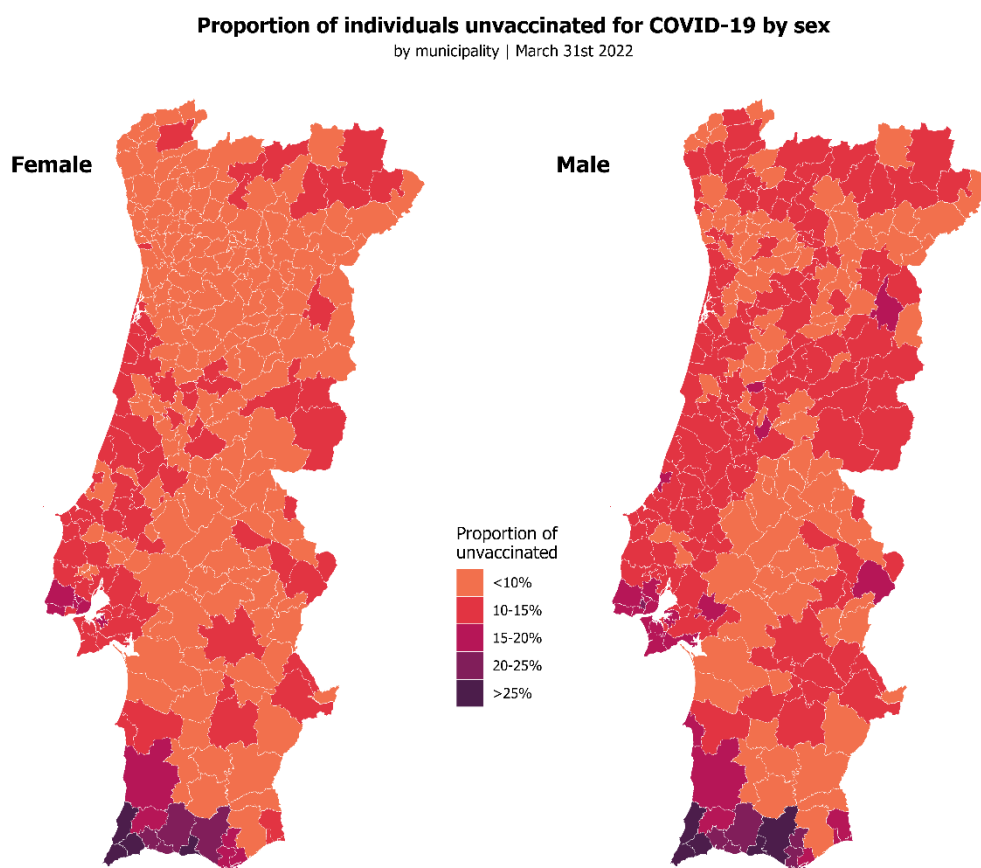
**Social Deprivation Level (EDI-PT quintiles)  
by municipality | 2020**



*Figure S8. Map of the distribution of the social deprivation levels (EDI-PT quintiles) by municipality.*



*Figure S9. Map of the distribution of the proportion of migrants by municipality.*



*Figure S10. Map of the distribution of the proportion of unvaccinated individuals by sex and municipality.*

## Proportion of individuals unvaccinated for COVID-19 by age group

by municipality | March 31st 2022

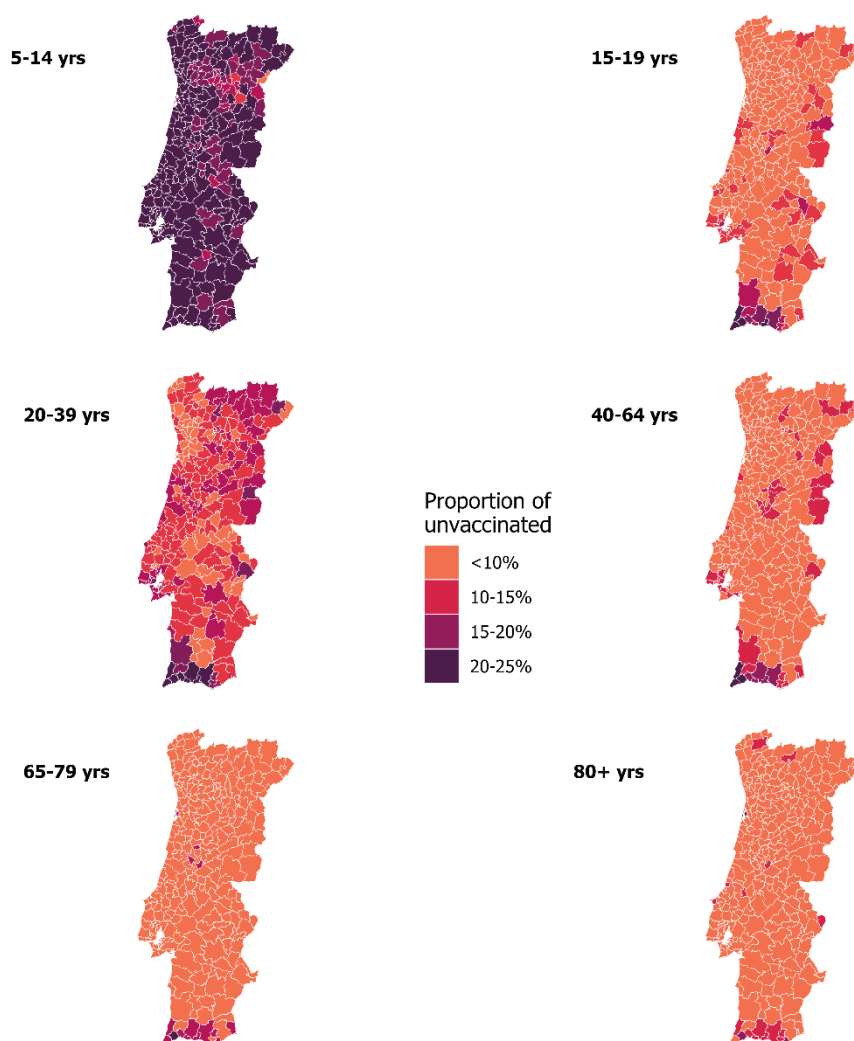


Figure S11. Map of the distribution of the proportion of unvaccinated individuals by age group and municipality.



**Table S1. Results from the univariate model with the EDI-PT score.**

	Mean	SD	0.025 quantile	0.5 quantile	0.975 quantile
<b>Intercept</b>	-0.153	0.046	-0.163	-0.153	-0.144
<b>EDI-PT score</b>	0.005	0.006	-0.007	0.005	0.017

**Table S2. Results from the univariate model with the EDI-PT quintiles.**

	Mean	SD	0.025 quantile	0.5 quantile	0.975 quantile
<b>Intercept</b>	-0.205	0.030	-0.263	-0.205	-0.147
<b>EDI-PT quintile 2</b>	0.011	0.036	-0.060	0.011	0.081
<b>EDI-PT quintile 3</b>	0.067	0.040	-0.011	0.067	0.146
<b>EDI-PT quintile 4</b>	0.093	0.044	0.006	0.093	0.180
<b>EDI-PT quintile 5</b>	0.085	0.051	-0.016	0.085	0.185

**Table S3. Results from the univariate model with the sex (proportion of women).**

	Mean	SD	0.025 quantile	0.5 quantile	0.975 quantile
<b>Intercept</b>	-1.385	0.734	-2.827	-1.384	0.055
<b>Prop. women</b>	0.024	0.014	-0.004	0.024	0.051

**Table S4. Results from the univariate model with the 5-14 years age group.**

	Mean	SD	0.025 quantile	0.5 quantile	0.975 quantile
<b>Intercept</b>	-0.449	0.094	-0.633	-0.449	-0.265
<b>5-14 yrs</b>	0.036	0.011	0.014	0.036	0.058

**Table S5. Results from the univariate model with the 15-19 years age group.**

	Mean	SD	0.025 quantile	0.5 quantile	0.975 quantile
<b>Intercept</b>	-0.325	0.010	-0.521	-0.325	-0.130
<b>15-19 yrs</b>	0.036	0.021	-0.005	0.036	0.076

**Table S6. Results from the univariate model with the 20-39 years age group.**

	<b>Mean</b>	<b>SD</b>	<b>0.025 quantile</b>	<b>0.5 quantile</b>	<b>0.975 quantile</b>
<b>Intercept</b>	-0.638	0.115	-0.863	-0.638	-0.412
<b>20-39 yrs</b>	0.023	0.005	0.012	0.023	0.033

**Table S7. Results from the univariate model with the 40-64 years age group.**

	<b>Mean</b>	<b>SD</b>	<b>0.025 quantile</b>	<b>0.5 quantile</b>	<b>0.975 quantile</b>
<b>Intercept</b>	0.219	0.297	-0.365	0.218	0.800
<b>40-64 yrs</b>	-0.010	0.008	-0.026	-0.010	0.006

**Table S8. Results from the univariate model with the 65-79 years age group.**

	<b>Mean</b>	<b>SD</b>	<b>0.025 quantile</b>	<b>0.5 quantile</b>	<b>0.975 quantile</b>
<b>Intercept</b>	0.048	0.099	-0.147	0.048	0.242
<b>65-79 yrs</b>	-0.010	0.005	-0.021	-0.010	0.000

**Table S9. Results from the univariate model with the 80 years or more age group.**

	<b>Mean</b>	<b>SD</b>	<b>0.025 quantile</b>	<b>0.5 quantile</b>	<b>0.975 quantile</b>
<b>Intercept</b>	0.007	0.053	-0.097	0.007	0.112
<b>80+ yrs</b>	-0.017	0.006	-0.028	-0.017	-0.006

**Table S10. Results from the univariate model with the proportion of migrants.**

	<b>Mean</b>	<b>SD</b>	<b>0.025 quantile</b>	<b>0.5 quantile</b>	<b>0.975 quantile</b>
<b>Intercept</b>	-0.274	0.016	-0.305	-0.274	-0.243
<b>Prop. migrants</b>	2.243	0.261	1.729	2.244	2.753

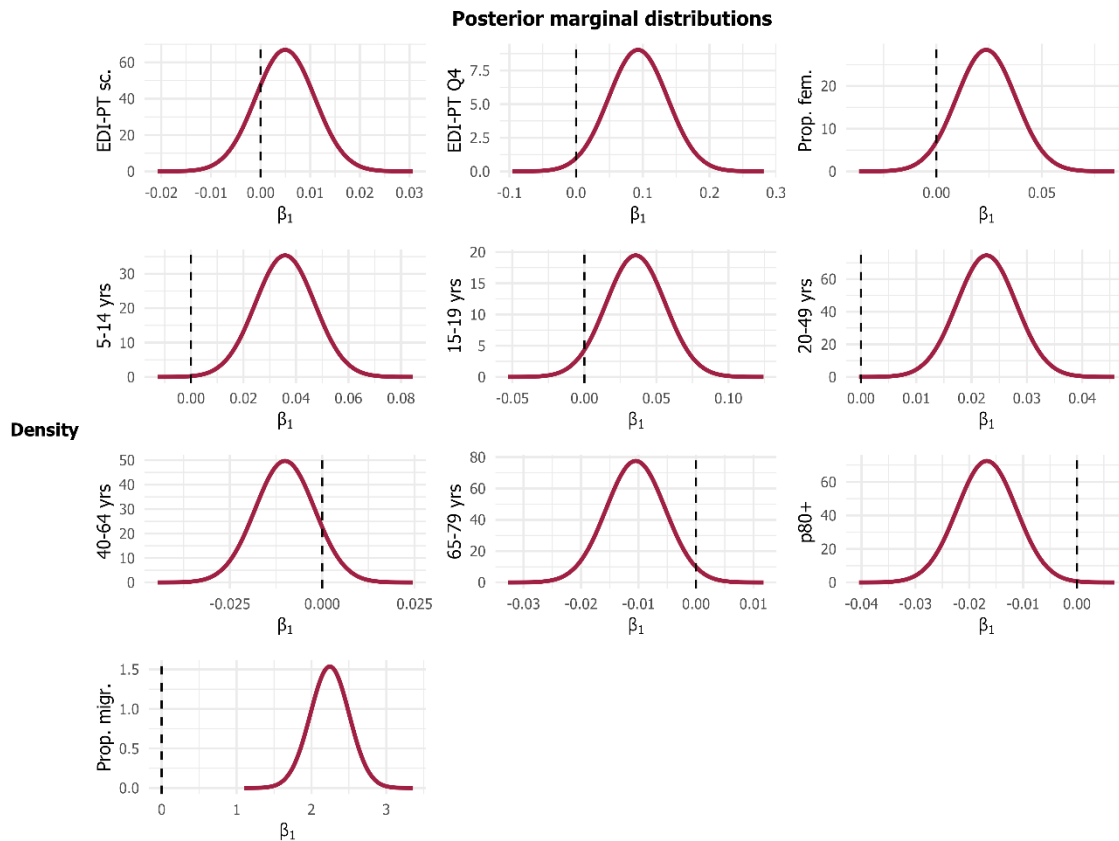


Figure S12. Plots showing the posterior marginal distributions of the univariate models.

### Collinearity tests between the EDI-PT and the proportion of migrants

Since the 2018 version of the EDI-PT included an item related to foreign residents, we ran collinearity tests between the EDI-PT variables (score and quintiles) and the proportion of migrants, to exclude the possibility of any interference.

#### Scatterplot between the EDI-PT score and the proportion of migrants

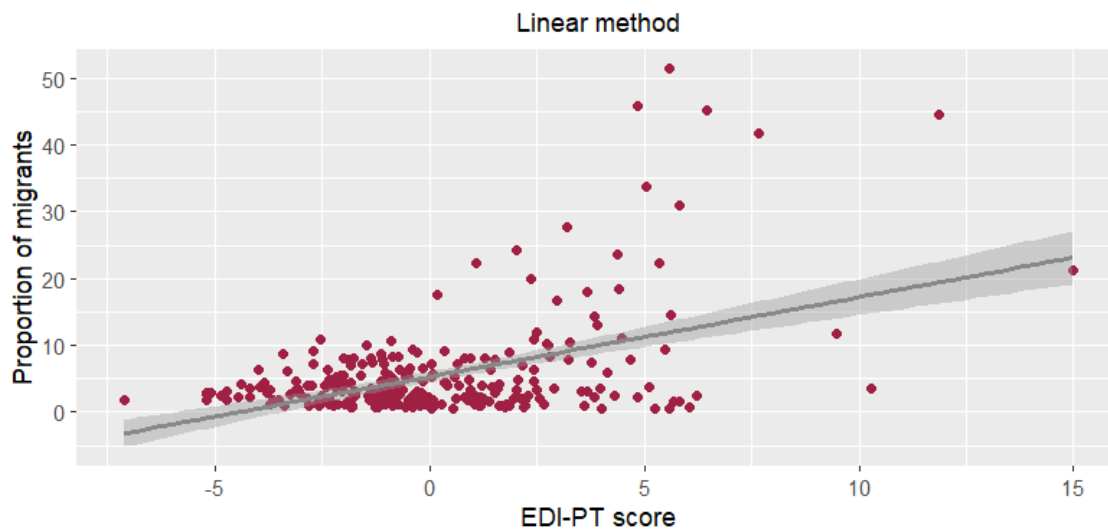


Figure S13. Scatterplot between the EDI-PT score and the proportion of migrants, linear method.

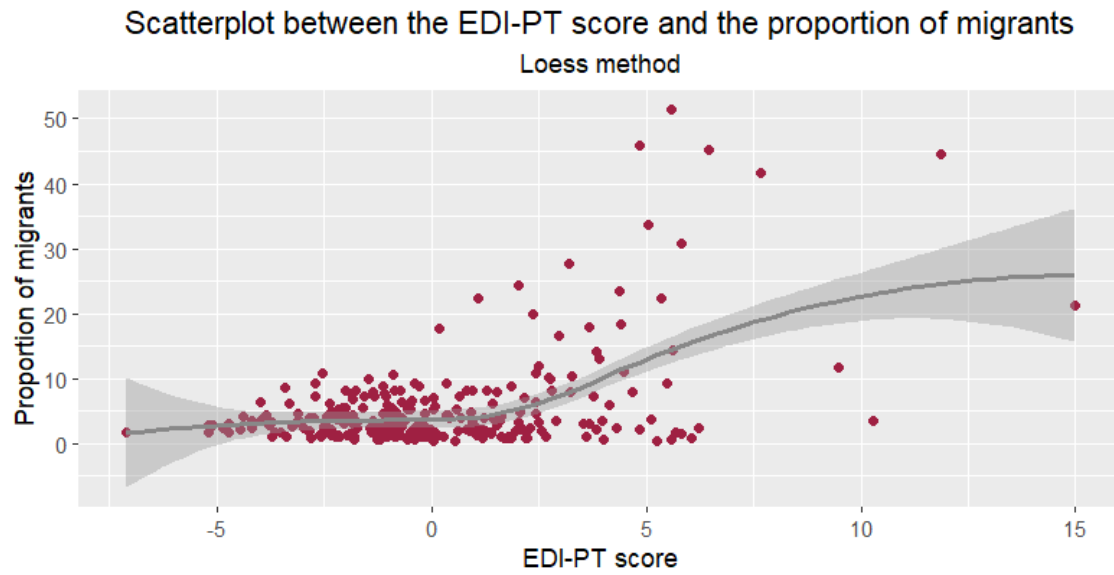


Figure S14. Scatterplot between the EDI-PT score and the proportion of migrants, loess method.

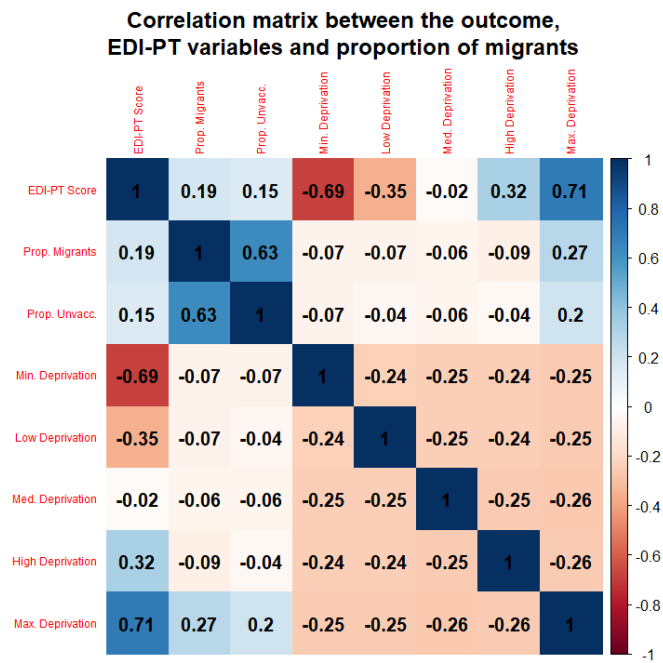


Figure S15. Correlation matrix between the proportion of unvaccinated individuals, EDI-PT variables, and proportion of migrants.

**Table S11. Generalized Variance Inflation Factor (GVIF) calculated on a linear model with the proportion of unvaccinated individuals as the dependent variable and the EDI-PT quintiles and the proportion of migrants as the independent variables.**

	<b>GVIF</b>	<b>Df</b>	<b>GVIF<sup>1/(2*Df)</sup></b>
<b>EDI-PT quintiles</b>	1.25	4	1.03
<b>Prop. migrants</b>	1.25	1	1.12

*Notes: GVIF – Generalized Variance Inflation Factor; Df – degrees of freedom*

**Table S12. Generalized Variance Inflation Factor (GVIF) calculated on a generalized linear model with a *Poisson* distribution with the proportion of unvaccinated individuals as the dependent variable and the EDI-PT quintiles and the proportion of migrants as the independent variables.**

	<b>GVIF</b>	<b>Df</b>	<b>GVIF<sup>1/(2*Df)</sup></b>
<b>EDI-PT quintiles</b>	1.44	4	1.05
<b>Prop. migrants</b>	1.44	1	1.20

*Notes: GVIF – Generalized Variance Inflation Factor; Df – degrees of freedom*

**Table S13. Generalized Variance Inflation Factor (GVIF) calculated on a generalized linear model with a *Poisson* distribution with the proportion of unvaccinated individuals as the dependent variable and the independent variables used on the multivariate model used in the paper (EDI-PT quintiles, proportion of migrants and 20-39 years age group).**

	<b>GVIF</b>	<b>Df</b>	<b>GVIF<sup>1/(2*Df)</sup></b>
<b>20-39 yrs</b>	1.67	1	1.29
<b>EDI-PT quintiles</b>	1.57	4	1.06
<b>Prop. migrants</b>	1.96	1	1.40

*Notes: GVIF – Generalized Variance Inflation Factor; Df – degrees of freedom*

## Equations from the models included in the paper

- (1) Null model without spatial component

$$\log(O) = \beta_0 + \log(E) + v$$

- (2) Null model with spatial component

$$\log(O) = \beta_0 + \log(E) + u + v$$

- (3) Univariate model – EDI-PT score

$$\log(O) = \beta_0 + \beta_1 * edis + \log(E) + u + v$$

- (4) Univariate model – EDI-PT quintiles

$$\log(O) = \beta_0 + \beta_1 * ediq + \log(E) + u + v$$

- (5) Univariate model – Sex

$$\log(O) = \beta_0 + \beta_1 * sexo + \log(E) + u + v$$

- (6) Univariate model – Age groups

5-14 years

$$\log(O) = \beta_0 + \beta_1 * ge1 + \log(E) + u + v, ge1 = \% pop\ 5 - 14$$

15-19 years

$$\log(O) = \beta_0 + \beta_1 * ge2 + \log(E) + u + v, ge2 = \% pop\ 15 - 19$$

20-39 years

$$\log(O) = \beta_0 + \beta_1 * ge3 + \log(E) + u + v, ge3 = \% pop\ 20 - 39$$

40-64 years

$$\log(O) = \beta_0 + \beta_1 * ge4 + \log(E) + u + v, ge4 = \% pop\ 40 - 64$$

65-79 years

$$\log(o) = \beta_0 + \beta_1 * ge5 + \log(e) + u + v, ge5 = \% pop\ 65 - 79$$

80+ years

$$\log(o) = \beta_0 + \beta_1 * ge6 + \log(e) + u + v, ge6 = \% pop\ 80 +$$

- (7) Univariate model – Proportion of migrants

$$\log(O) = \beta_0 + \beta_1 * pmid + \log(E) + u + v$$

- (8) Multivariate model

$$\log(O) = \beta_0 + \beta_1 * ediq + \beta_2 * ge6 + \beta_3 * pmid + \log(E) + u + v$$