



UNIVERSITÀ DI PISA



Geographical and individual deprivation index to assess the risk of Sars-CoV-2 infection and disease severity in people at socioeconomic disadvantage

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At the beginning of the COVID-19 crisis the initial widespread opinion that the virus does not discriminate.

Coronavirus: Prime Minister Boris Johnson tests positive

11:17 March 2020



Coronavirus pandemic



High risk groups



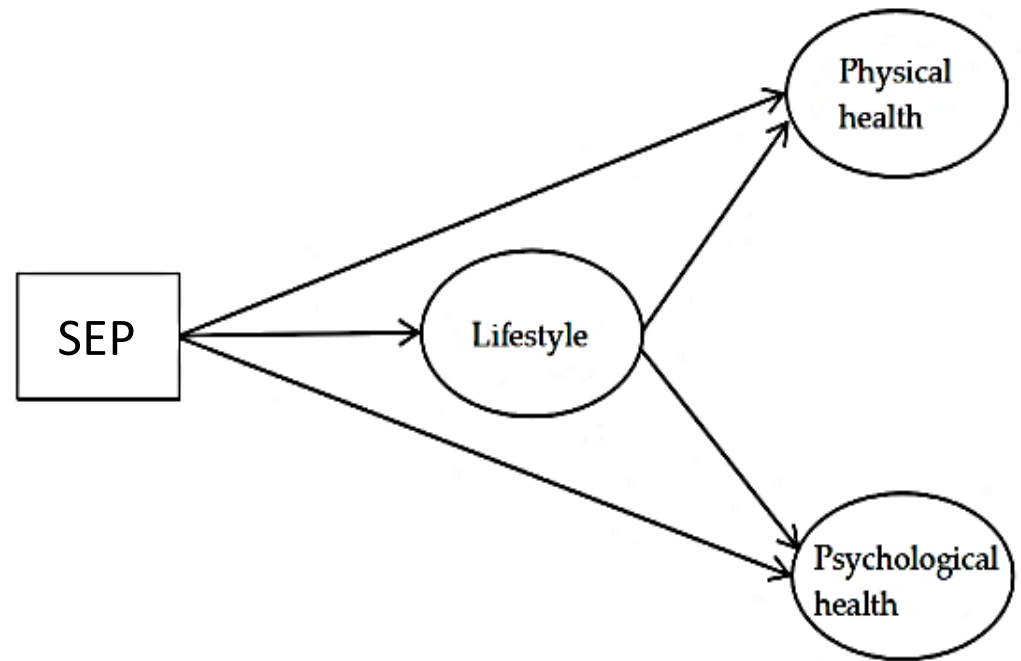
INTRODUCTION



PRIMARY HEALTH CARE

USSR · ALMA · ATA 1978

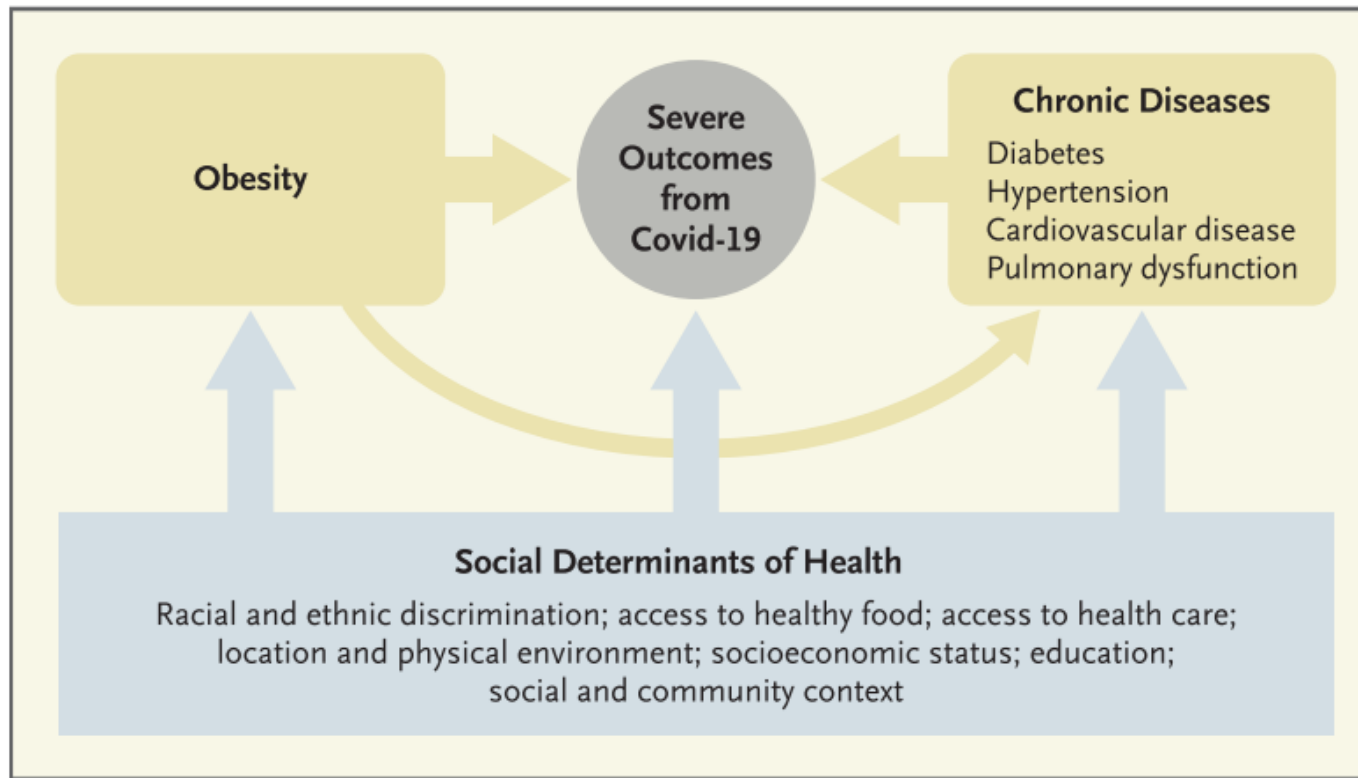
1978 Alma-Ata Conference



COVID-19 is not a pandemic

COVID-19 is a syndemic

The biological, economic, and social interactions between non-communicable diseases and COVID-19, increase a person's susceptibility to infection and worse health outcomes.



Social Determinants of Health as the Root Cause of Racial and Ethnic Health Disparities, Including Severe Negative Outcomes from Covid-19.

x_1 : Percentuale di popolazione con istruzione pari o inferiore alla licenza elementare

1. Dimensione Culturale

Numeratore $\frac{\text{Popolazione con istruzione pari alla licenza elementare, alfabeto o analfabeto}}{\text{Popolazione di 6 anni ed oltre}} \times 100$

Denominatore

x_2 : Percentuale di popolazione attiva disoccupata o in cerca di prima occupazione

2. Dimensione Lavorativa

Numeratore $\frac{\text{Forza lavoro - disoccupati o in cerca di prima occupazione}}{\text{Forza lavoro}} \times 100$

Denominatore

x_3 : Percentuale di abitazioni occupate in affitto

3. Dimensione Materiale

Numeratore $\frac{\text{Abitazioni occupate da persone residenti in affitto}}{\text{Abitazioni occupate da persone residenti}} \times 100$

Denominatore

x_4 : Densità abitativa (per 100 m²)

4. Dimensione Contesto

Numeratore $\frac{\text{Popolazione totale}}{\text{Superficie (m²) delle abitazioni occupate da persone residenti}} \times 100$

Denominatore

x_5 : Percentuale di famiglie monogenitoriali con figli dipendenti conviventi

5. Dimensione Rete di Supporto

Numeratore $\frac{\text{Padre o madre soli con figli (in famiglie mononucleari, con e senza membri isolati)}}{\text{Famiglie totale}} \times 100$

Denominatore

Indice di deprivazione

$$ID = \sum_{i=1}^5 z_i \quad z_i = \frac{x_i - m_{x_i}}{s_{x_i}} \quad x_i: \text{indicatore}; i=1, \dots, 5; \quad m_{x_i}: \text{media dell'indicatore}; \quad s_{x_i}: \text{deviazione standard dell'indicatore}$$

3. Individual Deprivation Index

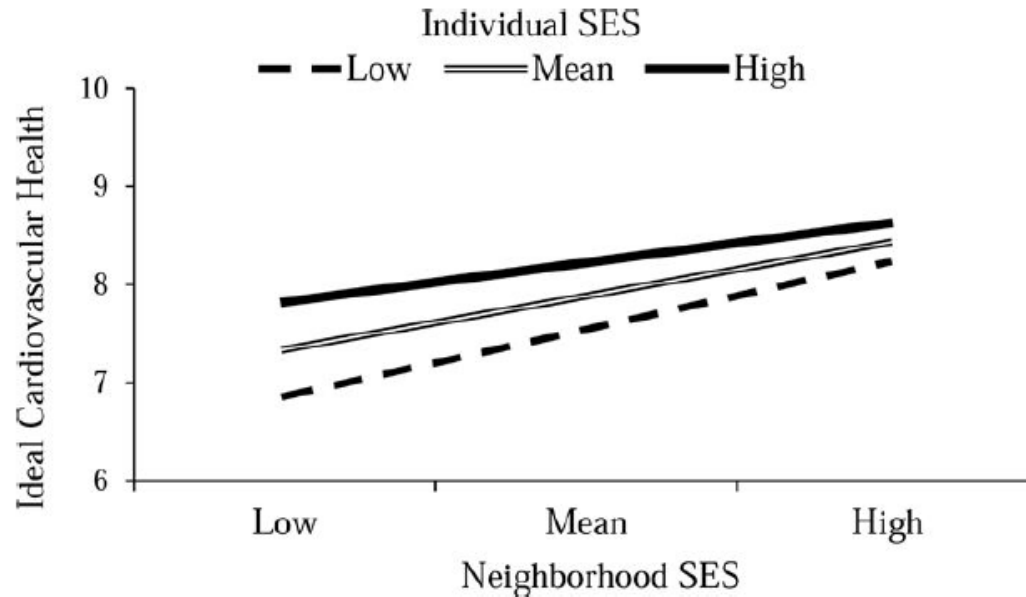


Figure 2.

Interaction between neighborhood and individual SES in the prospective prediction of cardiovascular health. Lines represent the association between neighborhood SES and cardiovascular health at the mean and plus and minus one standard deviation of individual SES. Simple slopes are significantly different from zero at low and mean levels of individual SES. Estimated values reflect statistical adjustment for age, gender, race, physical activity, smoking, chronic conditions, and hypertension, cholesterol, and diabetes medication at baseline.

Time period: (March - December 2020) -> Second wave (15 Sept – 31 Dec)

Place: Apulia Region, Italy

Data on tested individuals linked with deprivation index & census data

Statistical analysis

- PCA & K-mean cluster for reduce the dimensions (n of variables) of the census related with the SEP and calculating the individual DI
- GLM logistic to assess association among level of deprivation and COVID-19 related outcomes

RR for

- Being Positive
- Being Hospitalized
- Death



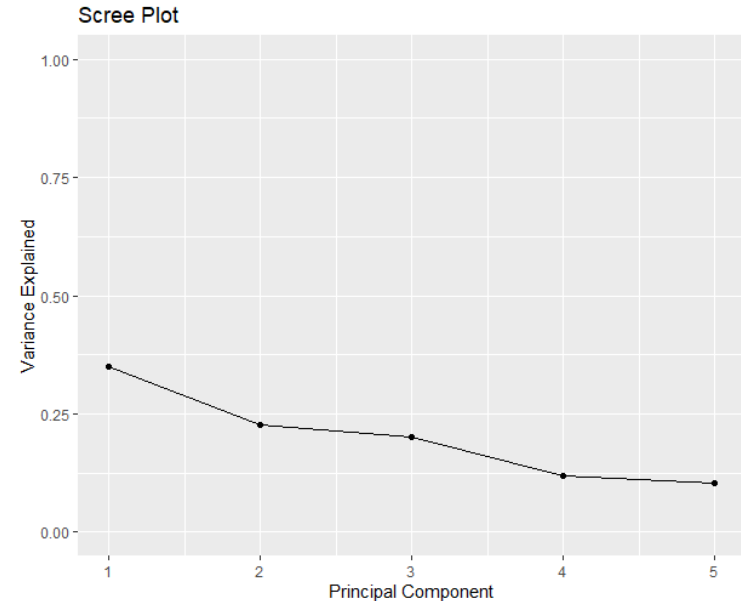
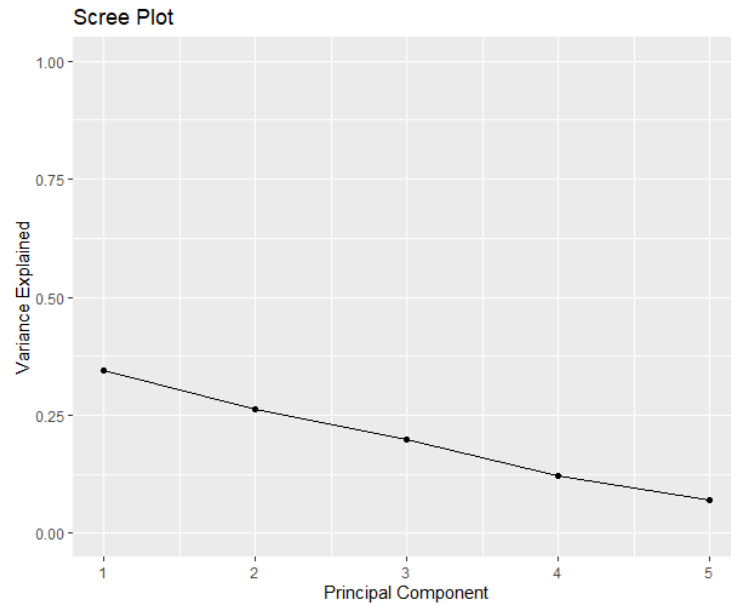
Variable used from census

1. Nationality: Italian, stranger.
 2. Level of education
 3. Number of people living together
 4. Type of family(nucleo familiare) + housing condition
 5. Work condition + type of job
- N = 244832 → median age 35 IQR: 21-58
 - N with the 1st set of census variables = 60593 → median age 45 IQR: 23-56
 - N with the 2nd set of census variables = 169841 → median age 42 IQR:25-59

	Geo DI 1	Geo DI 2	Geo DI 3	Geo DI 4	Geo DI 5
Total sample	0.19	0.19	0.2	0.21	0.21
Sample with the first selection of census variables	0.22	0.22	0.22	0.19	0.14
Sample with the second selection of census variables	0.19	0.19	0.20	0.21	0.21

RESULTS

Individual deprivation index with PCA

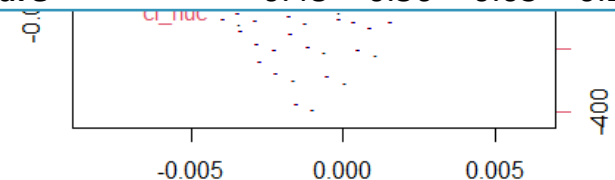


	PC1	PC2	PC3	PC4	PC5
Cittadinanza	0.11	-0.06	0.98	-0.14	-0.03
N componenti famiglia	0.29	0.64	-0.09	-0.70	0.02
Titolo di studio	0.65	-0.26	-0.10	0.02	-0.71
Tipo attività lavorativa	0.65	-0.27	-0.06	0.04	0.71
Tipo di nucleo familiare e convivenza con altri nuclei	0.25	0.66	0.11	0.70	-0.01

-0.010 0.000 0.005 0.010 0.015

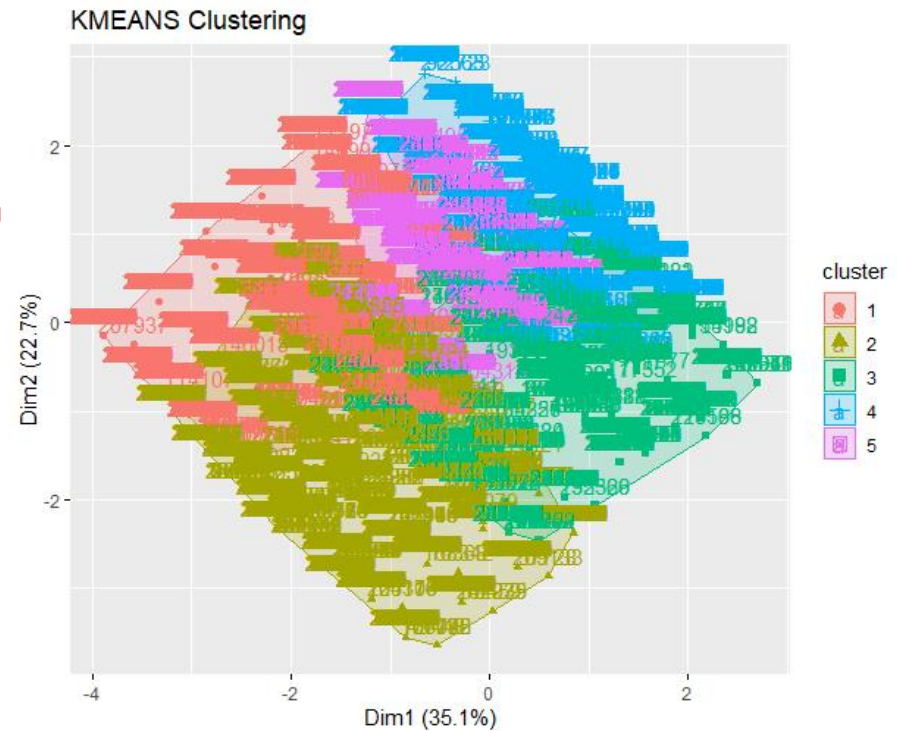
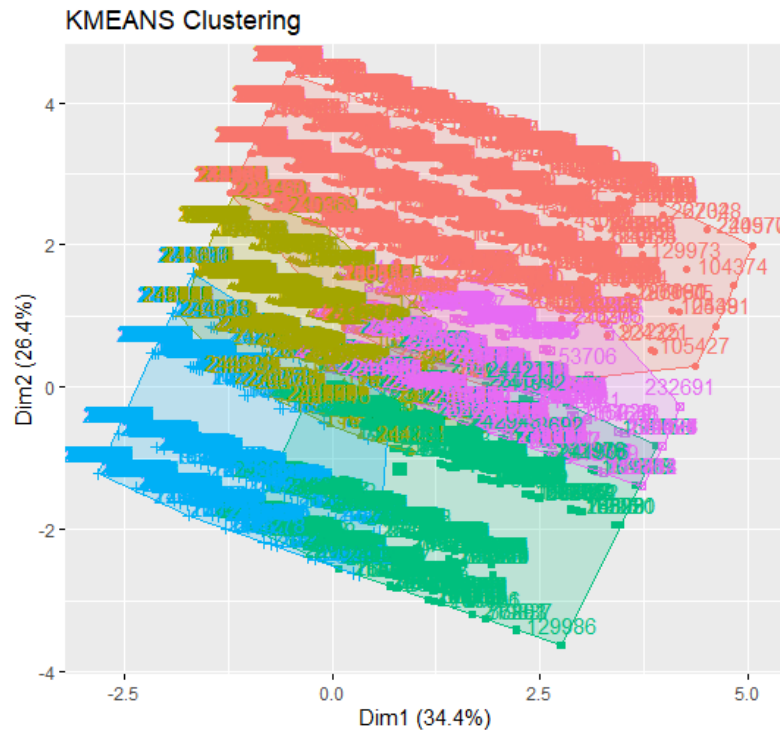
PC1

	PC1	PC2	PC3	PC4	PC5
Cittadinanza	0.02	-0.01	1.00	-0.05	0.01
N componenti famiglia	0.56	0.39	0.00	0.13	-0.72
Titolo di studio	-0.45	0.56	0.05	0.69	0.08
Condizione lavorativa	0.50	-0.47	0.02	0.68	0.26
Tipo di nucleo familiare	-0.48	-0.56	0.03	0.21	-0.64



PC1

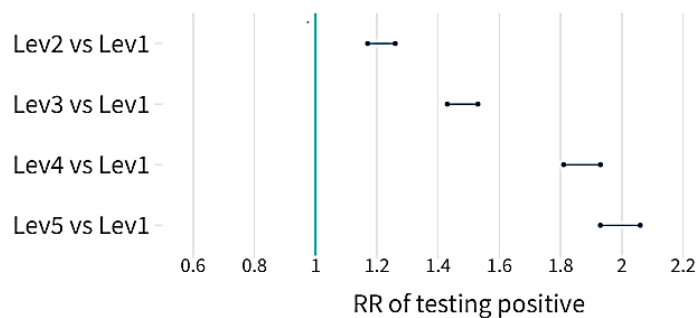
Individual deprivation with k-means



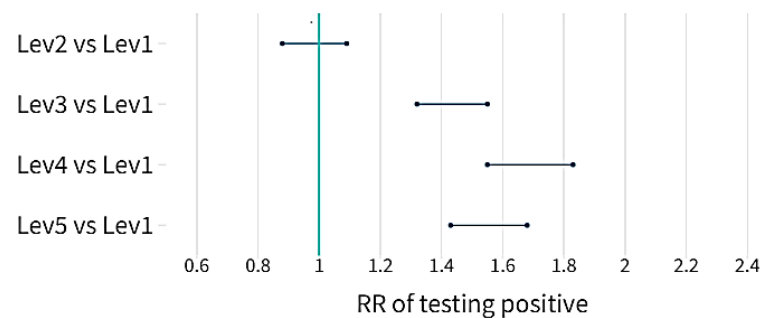
RESULTS

Adj. RR of testing positive

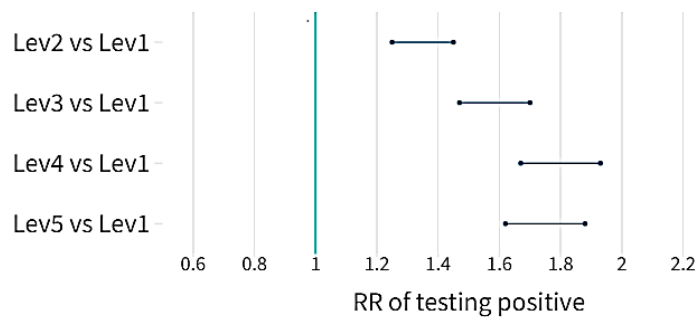
Geographical deprivation index



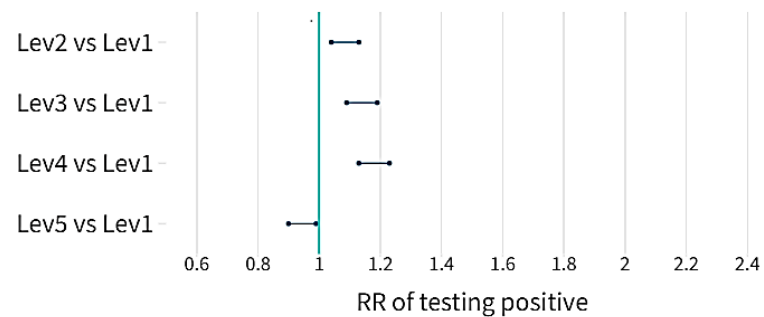
Z-score individual deprivation index



PCA1 individual deprivation index



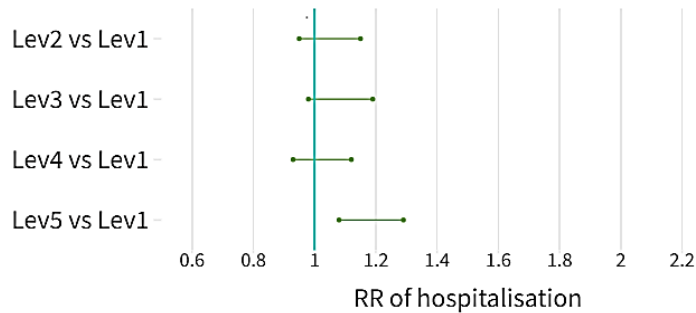
PCA2 individual deprivation index



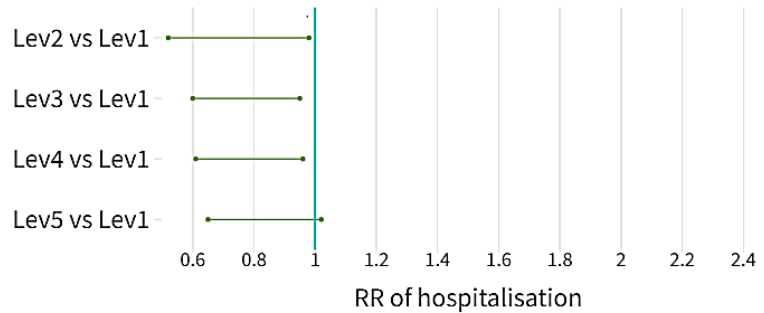
RESULTS

Adj. RR of being hospitalised if positive

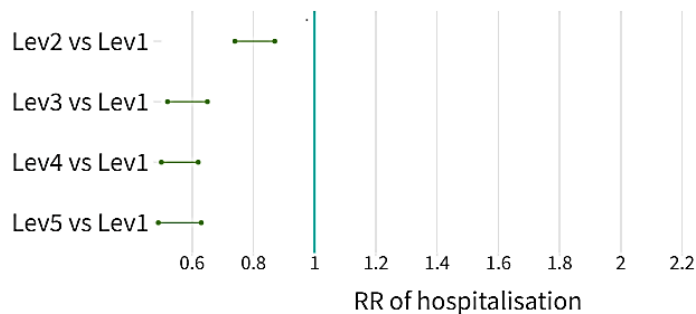
Geographical deprivation index



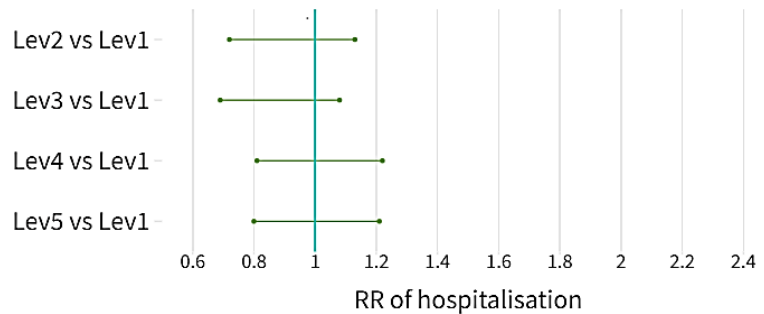
Z-score individual deprivation index



PCA1 individual deprivation index



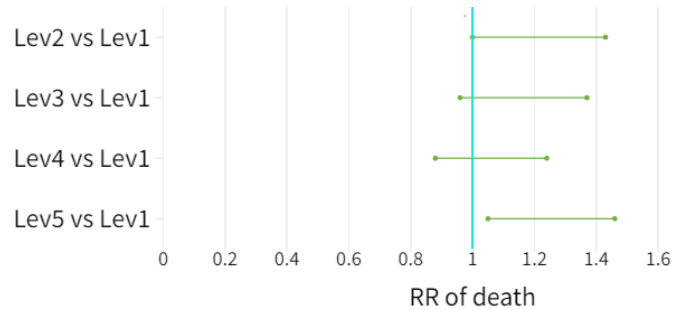
PCA2 individual deprivation index



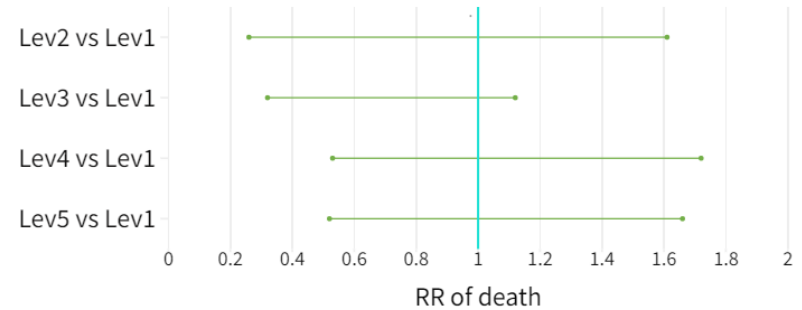
RESULTS

Adj. RR of death if positive

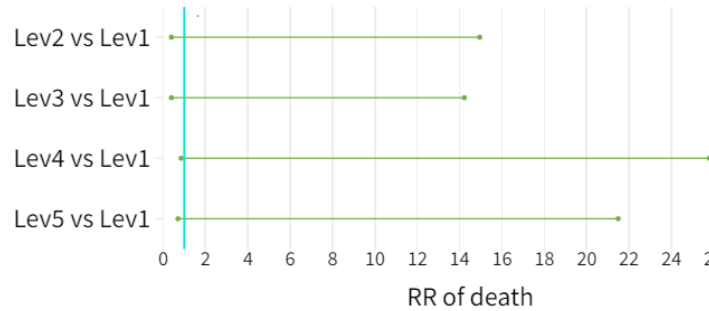
Geographical deprivation index



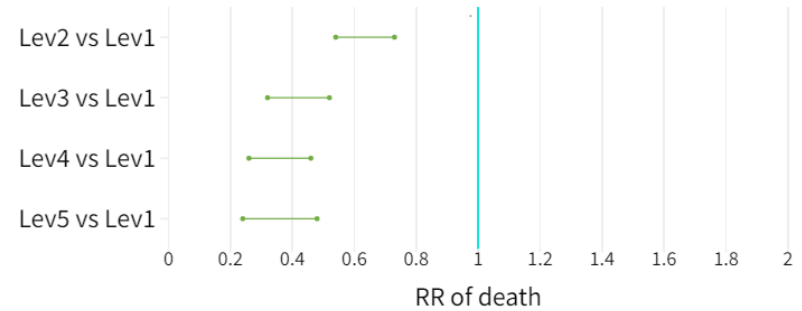
Z-score individual deprivation index



PCA1 individual deprivation index



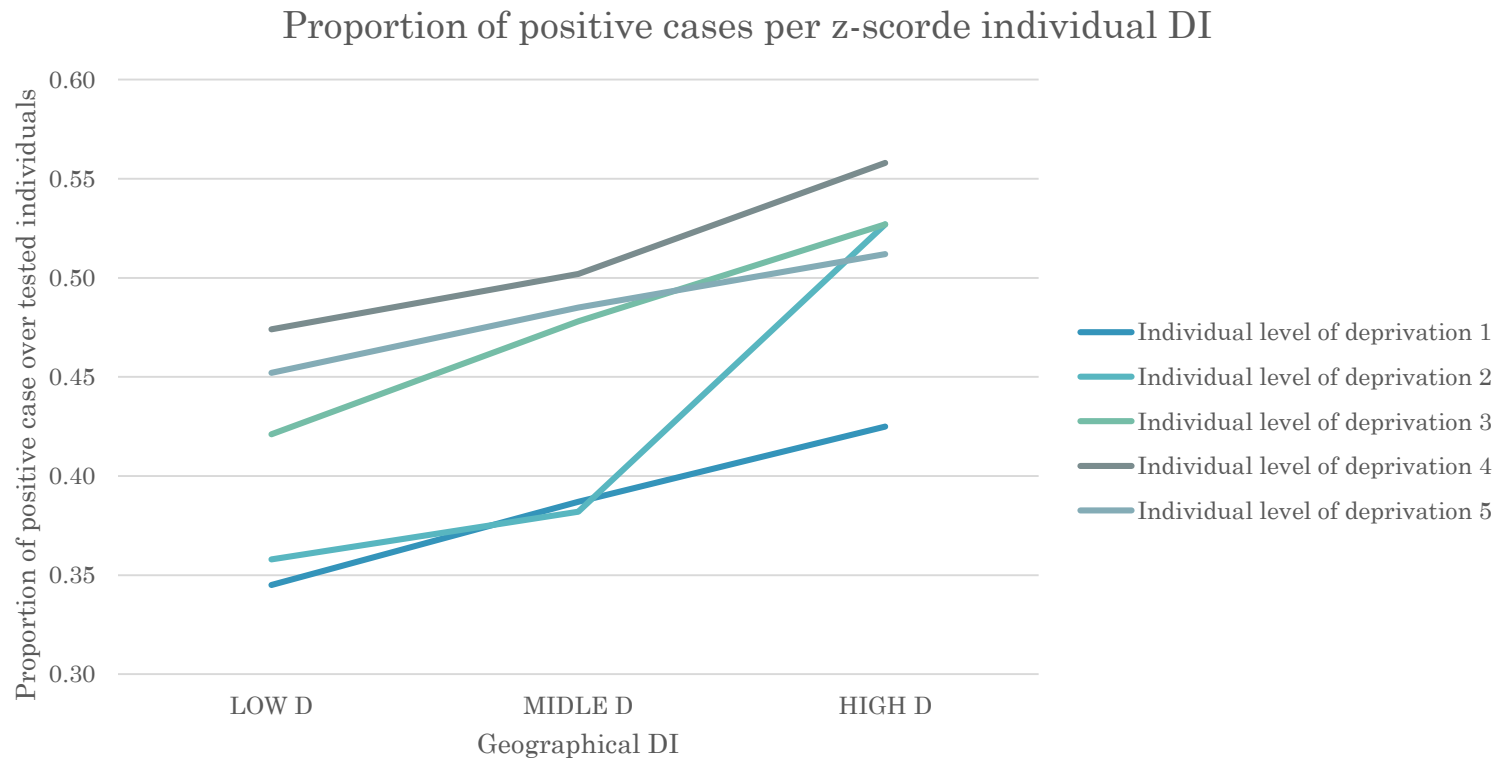
PCA2 individual deprivation index



CONCLUSION

- PCA may be an instrument to design individual deprivation index
- People living in socioeconomic deprived area and having a lower SEP have an increased risk of acquiring COVID-19
- Geographical and individual deprivation index give different results when used for assessing the risk of hospitalisation and death
- Sars-CoV-2 is not democratic

Need for hierarchical regression



Census data are not updated anymore

Need to rethink the way we can calculate the socioeconomic deprivation index



Geographical and individual deprivation index to assess the risk of Sars-CoV-2 infection and disease severity in people at socioeconomic disadvantage

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Supplemental material

Cross table:

geographical deprivation index X PCA1 individual deprivation index

df_merge\$deprindex	df_merge\$pcadixindi						
	1	2	3	4	5	Row Total	
1	4008 0.299	3209 0.239	2519 0.188	2103 0.157	1588 0.118	13427 0.222	
2	2731 0.206	3099 0.233	2556 0.192	2567 0.193	2334 0.176	13287 0.219	
3	2411 0.183	2786 0.211	2484 0.188	2879 0.218	2621 0.199	13181 0.218	
4	1959 0.167	2290 0.196	2244 0.192	2577 0.220	2628 0.225	11698 0.193	
5	1158 0.129	1418 0.158	1616 0.180	2048 0.228	2755 0.306	8995 0.148	
Column Total	12267	12802	11419	12174	11926	60588	

Supplemental material

Cross table:

geographical deprivation index X PCA2 individual deprivation index

df_merge2\$deprindex	df_merge2\$pcadix2					Row Total
	1	2	3	4	5	
1	6332 0.198	6033 0.189	6815 0.213	6102 0.191	6660 0.209	31942 0.188
2	6233 0.195	6049 0.189	7051 0.221	7092 0.222	5534 0.173	31959 0.188
3	6638 0.196	6552 0.193	7600 0.224	7653 0.226	5430 0.160	33873 0.199
4	6952 0.191	7214 0.198	8367 0.230	8287 0.228	5589 0.154	36409 0.214
5	7891 0.221	8047 0.226	7890 0.221	7552 0.212	4258 0.119	35638 0.210
Column Total	34046	33895	37723	36686	27471	169821

Supplemental material

Cross table:

geographical deprivation index X z-score individual deprivation index

df_merge2\$deprindex	df_merge2\$qindi					Row Total
	1	2	3	4	5	
1	2628 0.197	1936 0.145	4408 0.330	2351 0.176	2028 0.152	13351 0.222
2	1648 0.125	1698 0.128	4307 0.326	2830 0.214	2736 0.207	13219 0.220
3	1427 0.109	1535 0.117	4013 0.307	3031 0.232	3084 0.236	13090 0.218
4	1146 0.099	1312 0.113	3463 0.299	2764 0.238	2911 0.251	11596 0.193
5	659 0.074	765 0.086	2283 0.256	2121 0.238	3076 0.345	8904 0.148
Column Total	7508	7246	18474	13097	13835	60160

References

1. Belanger MJ, Hill MA, Angelidi AM, Dalamaga M, Sowers JR, Mantzoros CS, et al. Covid-19 and Disparities in Nutrition and Obesity. *N Engl J Med*. 2020;69(1):10–2.
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4. Boylan JM, Robert SA. Neighborhood SES is particularly important to the cardiovascular health of low SES individuals. *Soc Sci Med*. 2017;60–8.
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