Syndemic Pandemic in Portugal: Social Inequality in Risk Factors Associated With COVID-19 Mortality

Pandemia Sindémica em Portugal: Desigualdade Social nos Fatores de Risco Associados à Mortalidade por COVID-19

ARTIGO ORIGINAL

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ABSTRACT

Introduction: International evidence has unveiled the existence of social inequalities in the risk of death associated with SARS-CoV-2 (COVID-19). In Portugal, the impossibility to identify the socioeconomic condition of deceased people hinders this evaluation. This study analyzes the social inequalities in the risk factors of COVID-19 mortality in Portugal.

Material and Methods: We used data from the sixth National Health Survey, carried out between September 2019 and December 2019, for the subgroup of people aged between 25 and 79 years old (n = 12 052). We considered the comorbidities with demonstrated link to COVID-19 mortality: asthma, chronic bronchitis, cardiovascular (CVD) and cerebrovascular disease, diabetes, hypertension, chronic renal disease (CRD), and obesity. The inequality, stratified by sex, was measured in terms of education and income, using logistic regression (odds ratios and relative index of inequality).

Results: Compared to men with the lowest level of formal education, we measured a risk reduction, among men with tertiary education, of CVD (-90%), chronic bronchitis (-75%), stroke (-70%), diabetes (-62%), hypertension (-41%), and obesity (-43%). Among tertiary-educated women, we observed a reduced risk of CRD (-77%), hypertension, diabetes, stroke (-70%), obesity (-64%), and CVD (-55%). Except for obesity among men, the risk of disease was always significantly lower in the highest income quintile, compared with the lowest.

Conclusion: In 2019, we observed socioeconomic inequalities of high magnitude for the eight diseases with demonstrated link to COVID-19 mortality.

Keywords: COVID-19; Healthcare Disparities; Mortality; Portugal; SARS-CoV-2; Socioeconomic Factors

RESUMO

Introdução: A evidência internacional tem demonstrado desigualdades sociais no risco de morte por SARS-CoV-2 (COVID-19). Em Portugal, a impossibilidade de identificar a condição socioeconómica dos indivíduos falecidos impede esta medição. Este estudo analisa as desigualdades sociais nos fatores de risco de morte por COVID-19 em Portugal.

Material e Métodos: Foram utilizados dados do sexto Inquérito Nacional de Saúde, conduzido entre setembro e dezembro de 2019, para pessoas entre 25 e 79 anos (n = 12 052). Foram consideradas as morbilidades com ligação demonstrada à morte por COVID-19: asma, bronquite crónica, doenças cardiovasculares (DCV) e cerebrovasculares (AVC), diabetes, hipertensão, doença renal crónica (DRC) e obesidade. A desigualdade, estratificada por sexo, foi medida em termos de educação e rendimento, através de regressões logísticas (odds ratios e índice relativo de desigualdade).

Resultados: Em comparação com os homens com o nível de educação mais baixo, foi medido um risco inferior, para os homens com educação terciária, de DCV (-90%), bronquite crónica (-75%), AVC (-70%), diabetes (-62%), hipertensão (-41%) e obesidade (-43%). Nas mulheres com educação terciária, foi observada uma redução de risco de DRC (-77%), hipertensão, diabetes e AVC (-70%), obesidade (-64%) e DCV (-55%). Exceto no caso da obesidade nos homens, o risco de doença foi sempre estatisticamente inferior no quinto quintil de rendimento, comparado com o primeiro.

Conclusão: Existiam, em 2019, desigualdades socioeconómicas de grande magnitude para oito doenças cuja ligação à mortalidade por COVID-19 foi amplamente identificada.

Palavras-chave: COVID-19; Disparidades em Assistência à Saúde; Factores Socioeconómicos; Mortalidade; Portugal; SARS-CoV-19

INTRODUCTION

Socioeconomic status has been argued by different authors as 'the cause of all causes' of health status, with an impact on the risk of different diseases, regardless of time and place.[1] SARS-CoV-2 (COVID-19) pandemic seems a quite good example of this theory. This is a new, totally unknown health issue, which in a few weeks has spread across the world and, while the population was equally affected throughout the first brief phase of the pandemic, it soon came to hit the most disadvantaged populations mainly in terms of risk of infection and death, confirming in a new pathology the pattern so often found with other diseases.[2] Evidence is becoming increasingly relevant that infection affects the most disadvantaged population, already with a higher risk of complications and death.[3]

The mechanisms underlying inequalities regarding the risk of infection and death are common to other diseases. In particular, the risk of death from COVID-19 is related to several chronic diseases (hypertension, diabetes, chronic obstructive pulmonary disease - COPD, etc.),[4] whose socioeconomic causes are well established. Cardio-metabolic diseases are particularly associated with working conditions (insecurity, low wages, repetitive and stressful work, long

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working hours, etc.); financial resources to access quality healthcare and healthy lifestyles; the quality of housing (overcrowding, dampness, etc.) and of the neighbourhoods where people live (insecurity, lack of green spaces and transport, etc.); or social position (stress and anxiety related to lack of autonomy, power and social and material capital). In turn, there is also evidence that socio-economic inequalities in health have their causes early in life, when children's own health depends on the socio-economic status of their parents, with an impact on their health and status as adults.[5] The inequality in the risk of infection is a simple interpretation as regards COVID-19, as the most affected people are those with the worst jobs and salaries, who are least likely to telework or miss work, putting themselves at risk in their daily lives. It was this combination of factors that led to talk of a syndemic pandemic, that is, the idea that social inequalities in COVID-19 are related to pre-existing inequalities in chronic diseases and social determinants in health.

There is already some evidence on social inequalities regarding the risk of COVID-19 in Portugal,[6] based on ecological studies, with the bias underlying this type of study; social inequalities regarding the risk of hospitalisation and death also seem difficult to be obtained, due to the absence of individual data on socioeconomic conditions of hospitalised and/or deceased patients. However, in 2019, the year before the pandemic, the sixth National Health Survey had been applied in Portugal, involving a representative sample of the Portuguese population, with data on socioeconomic status and multimorbidity. This study is aimed at assessing the relationship between socioeconomic status and prevalence of chronic diseases associated with the risk of severe COVID-19 and death from COVID-19 in Portugal.

MATERIAL AND METHODS

This was a retrospective cross-sectional analysis based on data from the sixth National Health Survey (*Inquérito Nacional de Saúde - INS*), carried out in Portugal between September and December 2019, in person and online, with a sample of 22,191 households. Sampling was stratified and multistage type - with a random selection of NUTS II sub-regions, in a first stage, and of households, in a second stage - to ensure the representativeness of the national population. As the explanatory variables were education and income, our sample was limited to people aged over 25 who were more likely to have completed their education. It was also limited to people aged under 80, as institutionalised population was not considered by the INS; therefore, the analysis of the older population could have been biased.

All chronic diseases whose association with the risk of aggravation and death by COVID-19 was found in literature were considered as outcome variables. Four systematic reviews with meta-analysis were published in international peer-reviewed journals. According to a systematic review and meta-analysis of studies carried out within the early stage of the pandemic, the risk of severe COVID-19 was associated with the following comorbidities: diabetes, high blood pressure (hypertension), cancer and cerebrovascular disease.[7] Diabetes, hypertension, cardiovascular disease, chronic kidney disease, chronic liver disease and chronic obstructive pulmonary disease (COPD) were considered in a different review as risk factors for severe disease,[8] while cerebrovascular disease, COPD, cardiovascular disease, chronic kidney disease, hypertension, diabetes, obesity, dementia and cancer were considered as risk factors for mortality associated with COVID-19 by a more recent meta-analysis.[9] Finally, hypertension, coronary or cerebrovascular disease, diabetes, chronic kidney disease and COPD were considered as the leading risk factors for mortality by a systematic review and meta-analysis.[10] Therefore, socio-economic inequalities regarding the following diseases (included in the INS) were considered in our study:

- COPD
- Cardiovascular disease
- Cerebrovascular disease
- Diabetes
- Hypertension
- Chronic kidney disease
- Obesity.

The lack of data on cancer in this survey (INS) is worth mentioning, as this has been considered as related to mortality by COVID-19.

The respondents' education was considered as a socio-economic variable, and four categories were considered (no education/illiteracy, including people who have completed up to three years of basic education, primary education, including those who had completed 4th to 11th grade, secondary education (those who had completed 12th grade and those who had attended a post-secondary course) and higher education. The respondents' household net monthly income was also considered as a socio-economic variable; an item including all sources of income (salary, social benefits, capital income, transfers) was considered. Data regarding this variable were ranked into quintiles for confidentiality reasons and was therefore used in the analyses.

Logistic regressions were obtained for each morbidity, with education or income as explanatory variables, and age as a covariate. All analyses were stratified by gender. Five age groups were considered, in line with the INS database. Inequality was measured by odds ratio of the highest category of education and income compared to the lowest category.

The relative index of inequality (RII) is used in the assessment of the concentration of disease within specific categories, considering the complete distribution of education and income groups and their size.[11] The ratio is interpreted as the relative difference in prevalence between people in the highest *vs.* lowest category in terms of education and income. A value of less than 1 corresponds to higher prevalence in most disadvantaged *vs.* less disadvantaged groups.

RESULTS

A final sample of 12,052 individuals (56.3% female) was included in the study (Table 1). It is worth mentioning a higher representation of respondents aged 55 to 70, and the fact that more than 80% of male respondents had not completed secondary education, compared to 71% of female respondents. Diabetes (13.4% in male and 12.5% in female respondents) and hypertension (31.3% and 35.4%, respectively) were mostly found as comorbidities.

Except for asthma in male respondents, the risk of disease was statistically lower in people having completed higher education when compared to people with no education (Table 2). A 90% lower risk of cardiovascular disease has been found in male respondents (OR = 0.10; 95% CI: 0.01; 0.71), 75% of bronchitis (OR = 0.25; 95% CI: 0.12; 0.56), 70% of stroke (OR = 0.30; 95% CI: 0.13; 0.69), 62% lower risk of diabetes (OR = 0.38; 95% CI: 0.25; 0.59), 41% of hypertension (OR = 0.59; 95% CI: 0.47; 0.75) and 43% lower risk of obesity (OR = 0.57; 95% CI: 0.43; 0.75), while a 77% lower risk of chronic kidney disease has been found in female respondents (OR = 0.23; 95% CI: 0.13; 0.39), around 70% lower risk of hypertension, diabetes and stroke, 64% lower risk of obesity (OR = 0.36; 95% CI: 0.29; 0.47) and 55% of cardiovascular disease (OR = 0.45; 95% CI: 0.21; 0.96). When looking at these (unadjusted) percentages, the presence of a social gradient seems obvious in many cases, with a decrease in prevalence as the level of education gets higher. Finally, the relative inequality index

Table 1 – Characteristics of respondents (n = 12,052)

	Male	Female
Total	5,267 (43.70%)	6,785 (56.30%)
Age group		
25 - 29	232 (4.40%)	270 (3.98%)
30 - 34	246 (4.67%)	353 (5.20%)
35 - 39	388 (7.37%)	474 (6.99%)
40 - 44	510 (9.68%)	636 (9.37%)
45 - 49	510 (9.68%)	640 (9.43%)
50 - 54	526 (9.99%)	681 (10.04%)
55 - 59	637 (12.09%)	715 (10.54%)
60 - 64	602 (11.43%)	814 (12.00%)
65 - 69	657 (12.47%)	730 (10.76%)
70 - 74	548 (10.40%)	785 (11.57%)
75 - 79	411 (7.80%)	687 (10.13%)
Education		
Illiteracy	2,368 (56.95%)	2,621 (50.98%)
Primary	1,005 (24.17%)	1,111 (21.61%)
Secundary	252 (6.06%)	380 (7.39%)
Higher	533 (12.82%)	1,029 (20.02%)
Income		
First quintile	633 (12.02%)	1,519 (22.39%)
Second quintile	705 (13.39%)	1,930 (28.45%)
Third quintile	1,486 (28.21%)	1,040 (15.33%)
Fourth quintile	1,255 (23.83%)	1,087 (16.02%)
Fifth quintile	1,188 (22.56%)	1,209 (17.82%)
Morbidities		
Asthma	258 (4.90%)	499 (7.35%)
Chronic bronchitis	254 (4.82%)	471 (6.94%)
Stroke	117 (2.22%)	143 (2.11%)
Cardiovascular disease	238 (4.52%)	324 (4.78%)
Diabetes	704 (13.37%)	847 (12.48%)
Hypertension	1,647 (31.27%)	2,399 (35.36%)
Chronic kidney disease	246 (4.67%)	392 (5.78%)
Obesity	1,001 (19.01%)	1,461 (21.53%)

Table 2 – Prevalence by level of education, adjusted odds ratio (OR) (95% CI) of higher education *vs.* illiteracy and adjusted relative index of inequality (RII) (95% CI), by gender

	Illiteracy	Primary	Secundary	Higher	OR of higher education *vs.* illiteracy	RII
Asthma						
M	5.57	4.28	2.38	3.75	0.73 (0.44; 1.19)	0.49 (0.22; 1.08)
F	9.27	4.86	5.53	5.44	0.62 (0.44; 0.86)	0.28 (0.15; 0.53)
Chronic bronchitis						
M	6.63	3.38	3.57	1.31	0.25 (0.12; 0.56)	0.16 (0.06; 0.40)
F	9.46	3.96	4.74	3.89	0.61 (0.42; 0.88)	0.29 (0.14; 0.57)
Stroke						
M	6.42	3.88	0.79	1.13	0.30 (0.13; 0.69)	0.30 (0.12; 0.73)
F	7.78	2.61	1.05	1.07	0.31 (0.17; 0.58)	0.08 (0.03; 0.22)
Cardiovascular disease						
M	3.42	1.39	0.40	0.19	0.10 (0.01; 0.71)	0.10 (0.02; 0.43)
F	3.01	0.44	0.53	0.78	0.45 (0.21; 0.96)	0.17 (0.05; 0.63)
Diabetes						
M	19.13	11.44	5.56	4.69	0.38 (0.25; 0.59)	0.35 (0.21; 0.59)
F	19.57	7.47	3.42	3.79	0.33 (0.23; 0.47)	0.09 (0.05; 0.16)
Hypertension						
M	41.39	24.78	18.25	18.76	0.59 (0.47; 0.75)	0.42 (0.29; 0.61)
F	51.47	28.53	15.26	13.31	0.30 (0.24; 0.37)	0.10 (0.07; 0.14)
Chronic kidney disease						
M	6.80	3.38	2.38	2.06	0.48 (0.25; 0.90)	0.32 (0.13; 0.75)
F	8.47	4.32	2.89	1.55	0.23 (0.13; 0.39)	0.08 (0.04; 0.19)
Obesity						
M	21.62	19.80	11.90	12.38	0.57 (0.43; 0.75)	0.48 (0.31; 0.73)
F	28.46	19.26	11.05	11.37	0.36 (0.29; 0.47)	0.13 (0.09; 0.20)

M: male; F: female

was significantly less than 1 in all measurements with only one exception (asthma in male respondents), showing inequality favourable to the more educated, with a 90% lower prevalence in female respondents regarding stroke, diabetes, hypertension and chronic kidney disease.

As regards the association with income, except for obesity in male respondents, the risk of disease was always statistically lower in the fifth quintile (corresponding to the highest income level) when compared to the first (Table 3). A 76% reduction has been found in male respondents as regards cardiovascular disease (OR = 0.24; 95% CI: 0.11; 0.53), 67% for stroke (OR = 0.33; 95% CI: 0.19; 0.57) and 62% for chronic bronchitis (OR = 0.38; 95% CI: 0.23; 0.64), with a 26% lowest reduction in the risk of hypertension (OR = 0.74; 95% CI: 0.59; 0.94). A 74% reduction has been found in female respondents as regards stroke (OR = 0.26; 95% CI: 0.16; 0.42), and between 60 and 70% for chronic kidney disease, diabetes and hypertension; a 44% lowest reduction has been found in the risk of chronic bronchitis (OR = 0.56; 95% CI: 0.40; 0.79). A significant gradient for different diseases has been found, like what has been found for education. Finally, the relative inequality index was also significantly lower than 1 in all assessments with only one exception (cardiovascular disease in female respondents), showing the presence of inequality favourable to higher income holders, with always 10 to 90% lower prevalence.

DISCUSSION

Main Results

This study was aimed at assessing socioeconomic inequalities in risk factors for mortality associated with COVID-19 in Portugal, in the months prior to the first case. In fact, the data used in this study were collected between September and December 2019, and the first case of COVID-19 was identified on 2 March 2020. Significant socioeconomic inequalities have been found in male and female respondents as regards eight diseases clearly associated with COVID-19 mortality.

Interpretation

Socioeconomic inequalities in the prevalence of these diseases had already been identified in Portugal, regarding the risk of respiratory disease,[12] cardiovascular disease,[13] diabetes and hypertension[14-16] and obesity.[17,18] The causal

Table 3 – Prevalence by levels of income, adjusted odds ratio (95% CI) of the fifth *vs*. the first quintile and adjusted relative index of inequality (RII) (95% CI), per gender

	1st quintile	2nd quintile	3rd quintile	4th quintile	5th quintile	OR 5th *vs*. 1st quintile	RII
Asthma							
M	6.48	5.11	5.92	3.90	3.70	0.52 (0.34; 0.81)	0.49 (0.31;0.77)
F	8.69	8.96	6.25	6.53	4.80	0.52 (0.38; 0.72)	0.50 (0.35;0.70)
Chronic bronchitis							
M	5.21	4.68	6.93	4.38	2.53	0.38 (0.23 ;0.64)	0.43 (0.26; 0.70)
F	7.37	9.53	7.12	4.23	4.55	0.56 (0.40; 0.79)	0.49 (0.34; 0.70)
Stroke							
M	4.74	4.68	6.80	3.82	2.19	0.33 (0.19; 0.57)	0.35 (0.21; 0.59)
F	5.60	7.77	4.13	2.39	1.65	0.26 (0.16; 0.42)	0.24 (0.15; 0.39)
Cardiovascular disease							
M	2.53	2.27	3.43	1.83	0.93	0.24 (0.11; 0.53)	0.28 (0.13; 0.60)
F	2.37	2.38	2.31	2.02	1.24	0.47 (0.25; 0.86)	0.64 (0.34; 1.21)
Diabetes							
M	10.43	13.05	19.85	12.43	8.00	0.56 (0.40; 0.80)	0.52 (0.38; 0.72)
F	14.35	18.03	11.44	7.73	6.45	0.35 (0.26; 0.46)	0.33 (0.25; 0.44)
Hypertension							
M	26.38	31.77	39.64	29.16	25.34	0.74 (0.59; 0.94)	0.69 (0.55; 0.87)
F	36.14	49.64	35.96	23.64	21.59	0.37 (0.31; 0.45)	0.32 (0.26; 0.39)
Chronic kidney disease							
M	3.95	5.67	7.13	3.27	2.86	0.54 (0.32; 0.93)	0.41 (0.24; 0.67)
F	7.77	7.67	6.15	2.48	2.89	0.33 (0.23; 0.49)	0.26 (0.17; 0.38)
Obesity							
M	17.85	16.17	22.14	20.48	15.82	0.86 (0.66; 1.11)	0.89 (0.69; 1.13)
F	26.46	25.60	21.25	16.84	13.32	0.40 (0.33; 0.49)	0.36 (0.29; 0.44)

M: male; F: female

mechanisms of inequality have also been widely identified. There is an evidence, for example, of a link between working conditions (stress, lack of autonomy) and cardiovascular diseases,[19] between exposure to certain occupational hazards and respiratory diseases,[20] between unemployment (poverty, exclusion, low self-esteem) and cardiovascular disease,[21] hypertension[22] and diabetes.[23] The link between housing conditions and slums and higher risk of hypertension and obesity has also been found,[24] as well as higher risk of asthma, cardiovascular disease and obesity.[25] It is worth mentioning the presence of a robust evidence that socioeconomic factors have an impact on cardiovascular and metabolic diseases, regardless of lifestyles (smoking, physical activity, alcohol, diet).[26]

Greater inequalities were found in education than in income. This result may seem surprising when education and income are strongly linked. However, education may have greater discretionary power as it is less exposed to reporting errors or misconceptions by respondents, when compared to income. We may suspect that respondents found it more difficult to identify their income based on their monthly salary more easily than other sources. It is also worth mentioning that the household income was not adjusted to the household dimension, representing a clear limitation, while the aggregation in quintiles meant a loss of potentially relevant information. Finally, unlike education, which is defined and remain unchanged since early adulthood, the association with income is more prone to bias because of reverse causality, i.e., income being affected by health status.

Another relevant result was the greater inequality found in female respondents, particularly as regards education. Ambiguous results have been found in literature as regards social vulnerability in health.[27] However, the greater impact of education on women's health has been theorised and measured: as women face greater difficulty in obtaining better jobs, high wages and power, their dependence on the level of education is greater, particularly when gender discriminations are greater.[28] Another explanation may be the insufficient adjustment for age, with the level of education of older women being much lower than that of younger women.

Finally, a simple observation of European data shows how much Portugal is exposed to low socioeconomic conditions and, therefore, to the diseases that are associated

with these.[29] In Portugal, 47.6% of the population had not completed secondary education in 2019, when compared to 25.7% in the EU-27 as a whole; the average annual salary of a couple, both working and with two children, was €21,450, compared to €36,650 in the EU-27; 21.6% of the population lived at the risk of poverty and social exclusion and 8.4% lived in material and social deprivation, compared to 20.9% and 7.8%, respectively, in the EU-27; 18.9% of the Portuguese population described that they could not keep their house adequately heated and 24.4% lived in houses with dampness problems, compared to 6.9% and 12.7%, respectively, in the EU-27. This reality shows that unfavourable socioeconomic conditions, if unchanged, will keep related to health consequences, with a significant prevalence of chronic diseases whose effects on mortality in general, and associated with COVID-19, are widely known.

Limitations

The usual limitations of self-reported health studies were found in this study, i.e., leading to underestimated inequalities, considering the lower reporting of illness by the most disadvantaged due to lack of literacy or access to healthcare. However, this underestimation was not systematically found in a recent study comparing the INS results with a survey based on physical examination.[30]

Another limitation was related to the measurement of income, which was not adjusted to the household size and was only obtained in the form of quintiles. However, despite the limitation of the indicator, the results were in line with those obtained for education.

Finally, the use of cross-sectional data, with generic socioeconomic indicators, does not allow the identification of causality mechanisms. However, it is worth mentioning that the study was aimed at the assessment of health inequalities and their consequences, the establishment of causal mechanisms being beyond the scope of our data.

The management of this and future pandemics requires social and health policies aimed at reducing not only the burden of disease but also its socially unequal character. Recent literature reviews described possible and effective strategies for reducing social inequalities in health,[31-33] including tax policies (increased alcohol prices, food allowances for disadvantaged populations, allowances for fruit and vegetables, taxes on unhealthy foods, tax benefits for child vaccination), social policies (income support and improvement of housing conditions, social support for poverty reduction), or labour policies (greater participation of workers in the organisation of work, greater regulation of shifts, reduction of job insecurity).

CONCLUSION

This study was based on data from the National Health Survey (INS) that was held a few months before the first case of COVID-19 in Portugal and showed significant socioeconomic inequality in risk factors for mortality related to COVID-19. A significantly higher prevalence of all the eight diseases that were assessed was found in populations with lower education and income levels, in all genders. This socioeconomic inequality in risk factors has contributed to higher mortality associated with COVID-19 in the most socially vulnerable populations, in the countries where this relationship was measured. Therefore, these data suggest that, at the onset of the pandemic in Portugal, there could be a real threat of a 'syndemic pandemic', i.e., that the risk of infection combined with pre-existing inequalities could lead to higher mortality in socially disadvantaged groups.

HUMAN AND ANIMAL PROTECTION

The authors declare that this project complied with the regulations that were established by the Ethics and Clinical Research Committee, according to the 2013 update of the Helsinki Declaration of the World Medical Association.

DATA CONFIDENTIALITY

The authors declare that they have followed the protocols of their work centre on the publication of patient data.

CONFLICTS OF INTEREST

The authors declare that there were no conflicts of interest in writing this manuscript.

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