Title: Estimating and decomposing disease-free life expectancies by sex and educational attainment for major groups of causes in Spain, 2012-17.

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Abstract:

Introduction and objective: Certain diseases tend to affect individuals at different stages of their lives. Those differences tend to vary by condition, sex, and educational attainment. This study intended to estimate the health burden of six major groups of chronic diseases (Back Pain, Cardiovascular conditions, Diabetes, Mental Disorders and Respiratory conditions) in Spain, by computing the Disease Free Life Expectancy at age 35. Furthermore, we decomposed gaps between health expectancies by sex and educational attainment. Methods: We used the 2012, 2014 and 2017 health surveys in Spain (Spanish and European Health Surveys) along with the mortality files provided by the Spanish National Institute of Statistics (Instituto Nacional de Estadística) for the same period, pooling the data in a cross-sectional analysis. We computed life expectancies, disease-free health expectancies and applied a decomposition procedure to disentangle mortality and morbidity effects in health expectancy differentials by sex (females minus males) and educational attainment (high educated minus low educated) for each group of diseases. Results: A clear educational and sex gradient in the morbidity component was found for mental disorders, favoring males and highly educated individuals. In the remaining diseases, differences in health expectancy by educational attainment were rarely explained by the morbidity component. However, such component was an important contributor to differences in Diabetes and Cardiovascular conditions when addressing sex gaps. Discussion: Decomposing differences in health expectancies separately by groups of causes may offer a better understanding of how inequalities in health (by sex and educational attainment) operate differently for each case.

Introduction

During the last 60 years, due to medical breakthroughs, nutritional improvements, a better sanitation and the adoption of healthier behaviors, life expectancy has increased substantially across the globe (Deaton, 2005; Fogel & Costa, 1997) Spain has been no exception to such trend, given that overall mortality has declined and life expectancy has increased as a result. However, this process has shown important disparities across different socioeconomic groups, favoring the wealthiest or more educated individuals in the population (Permanyer et al., 2018; Regidor et al., 2015, 2016). Along with the reduction of mortality, a stronger emphasis has been put in the quality of survival and the prevalence of chronic conditions and ailments, both lethal and non-lethal.

However, to this day the relationship between having a larger lifespan and a healthier lifespan (expressed in terms of disability, morbidity, prevalence of a disease or any other given indicator) is not entirely clear nor understood: diverse theories have been proposed to analyze the dynamics of such relationship. Up to this day, those frameworks have been used interchangeably to describe different situations in given populations (Gruenberg, 2005; Fries, 1984; Manton, 1999; Myers and Manton,1984), but without a single vision imposing over the others. However, it is clear that different diseases affect populations with a particular intensity at different stages of life. As Nusselder and Looman (2004) point out, knowing which age groups and diseases contribute most to differences in population health is helpful to identify drivers and determinants of such difference and to evaluate policies to mitigate those inequalities.

Demographers and public health researchers traditionally estimate aggregate indexes (that we broadly refer here as health expectancies) such as disease-free life expectancy (DFLE) or health adjusted life expectancy (HALE) to estimate the health burden of a given condition or a set of conditions in a population. Life expectancy is the aggregate indicator that synthetizes the overall period mortality in a given population. In a similar fashion as mortality, there are important differences in healthy life expectancy and perceptions of poor health by educational attainment in Spain (Gumà et al., 2019; Solé-Auró et al., 2020). This should not be surprising, given that most inequalities in health and mortality are, in essence, social inequalities as well (Cutler et al., 2006; Marmot, 2005). Traditionally, those "health expectancies" rely on aggregate, catch-all indicators, such as the Global Activity Limitation Indicator, better known as GALI (Van Oyen et al.,

2018), limitations in instrumental activities of daily living or IADL (Crimmins et al., 2009; Manton et al., 2006) or estimations based on the presence of one or multiple diseases (Zueras & Rentería, 2020, Voigt et al., 2020) to consider that an individual has a poor health status.

It has to be noted that using that kind of definitions may be hiding different cause-specific heterogeneities, given that different conditions present different prevalence by sex, age or other characteristics. For instance, it is known that psychiatric disorders such as chronic depression or anxiety tend to affect females more than males (Aziz & Steffens, 2013; Bell, 2014), but the opposite occurs for hypertension, a cardiovascular condition (Gao et al., 2019; Maas & Appelman, 2010). But having either condition could indicate having a "poor health" in a given definition of morbidity. Although on occasion, the estimation of differences in health expectancies separately for different major causes has been done, for other countries such as the US or Belgium (Nusselder et al., 2005; Nusselder & Looman, 2004).

Furthermore, health expectancies are reliant on age-specific mortality data for their construction (Sullivan, 1971). As a result, health expectancies are correlated with the life expectancies used for their calculation (Nusselder & Looman, 2004; van Raalte & Nepomuceno, 2020). Therefore, a given population A may present a higher disease or disability prevalence than population B, but in spite of that have a higher health expectancy. In that event, the reason for such differential in health expectancies may be due to a higher life expectancy in population A (a mortality differential), independently of the impact of the given condition on the health expectancy (which could be considered a morbidity differential).

Decomposition analysis has been used in Demography and other disciplines to disentangle the components that may be affecting a difference between two aggregate rates or measurements, such as health expectancies. Such decomposition may be applied for different moments in a given population (considering compositional change over time), or over two populations in a single moment (considering different compositions between compared groups). Such techniques disentangle the morbidity and mortality components (Andreev et al., 2002; van Raalte and Nepomuceno, 2020), allowing us to identify appropriately the contribution of a given component to the obtained difference in two health expectancies, and which age groups are responsible for that contribution. Therefore, this study will produce estimates of disease free life expectancies for different health conditions in contemporary Spain, considering sex and educational attainment, and

will decompose the age-specific contribution of those mortality and morbidity components of the difference across those groups.

Data source and methods.

Data Sources:

We relied on a combination of mortality and morbidity data sources in order to produce the necessary estimates for this study. For mortality data, we used both a mortality file and the population exposures provided by the National Institute of Statistics (Instituto Nacional de Estadística in Spanish, also known by its acronym INE) for the 2013-2017 period. INE used a matching algorithm linking registered deaths to population databases, including censuses, municipal population registers, the ministry of education, and the Public State Employment Service, in order to obtain and provide the deaths according to educational attainment, when possible. A similar data source has been used successfully previously to measure mortality in Spain (Permanyer et al., 2018). The INE also provided the total estimates of population by sex, age, and educational attainment (in a series of different categorical values) in Spain for the analyzed years. Those data are available upon request.

To obtain the prevalence of the chosen chronic conditions we took advantage of the Spanish National Health Survey (or ENSE, given its acronym in Spanish) has been done periodically during 1987 and 2017, and the Spanish data for the European Health Survey (or EESE, given its acronym in Spanish). Such information is freely available, provided by the Health and Social Well-being Ministry of Spain. The survey is representative at a national level and offers sociodemographic data of the population along with information regarding health conditions, health service use and other determinants. We worked with six major groups of chronic conditions for our estimations: Back Pain (indicating both Low Back Pain and Neck Pain), Cancer (Malignant Tumors), Cardiovascular diseases (High Blood Pressure, High Cholesterol, Myocardial Infarction, Stroke, and other Heart Diseases), Diabetes, Mental Disorders (Depression, Anxiety and other Mental Disorders), and Respiratory Diseases (Asthma and Chronic Pulmonar Obstructive Lung Disease). To consider if the respondent had the selected condition, we adopted a criterion similar to the one adopted by Zueras and Rentería (2020). This criterion considered that the respondent had to have the specific health condition in the last 12 months and it had to be

diagnosed by a physician as well (except for Cancer, when we also considered if the respondent claimed to had it ever). The details in the questionnaires for each category can be found in the supplementary material. As Zueras & Rentería (2020) noted, reporting on health conditions may be a problematic issue as a proxy, if access to health care is not even among the population. However, Spain has a low percentage of unmet medical needs in terms of diagnosis or treatment and a fairly good publich healthcare system (Zueras & Rentería, 2020), so underreporting errors may be small and non significant.

In order to make the data as robust as possible, we pooled the 2012 and 2017 ENSE survey waves and the 2014 EEES survey results, working with the assumption prevalence estimates were average for the analyzed period (in a similar fashion as the mortality data), and that abrupt changes in prevalence from year to year are unlikely, considering that demographic change is, by nature, slow. Coincidentally, we pooled mortality data as well in order to make a reasonable comparison.

Educational level was split between two groups: individuals with a lower educational attainment (who, **at most, completed the first cycle of secondary education** which is year 8 of mandatory school years, equivalent level 2 in the normalized ISCED-2011 classification) and individuals with a higher educational attainment (who had more than 8 years of education or ISCED-2011 level 3 and above). While is certainly possible to opt for a different choice of categories (with three or more educational categories), we believe that this particular decomposition analysis offers an easier interpretation when doing a comparison that involves two populations (in this case, the higher educated and the lower educated), and given the relatively small sample size in the survey (a total of almost 41.000 cases), offered us a better chance of seeing a socioeconomic gradient between the two groups.

Estimations and other considerations

We opted for age 35 as the starting point for the estimations, given that before that point the educational attainment cycle of the individuals may be incomplete (and that changes in educational attainment, while certainly possible, are unlikely past that point).

The majority of life tables that consider healthy life expectancy as an indicator tend to be top truncated at age 85 (given that sometimes prevalence is hard to estimate after that

point without some advanced modelling). We decided to smooth both the death rates and the prevalence by five age-groups using a one-dimensional Poisson P-spline, available in the *MortalitySmooth* package (Camarda, 2012).

The first exploratory measure was to determine if a prevalence gradient the chosen conditions was visible. In other words, it may be pointless to produce a decomposition and trust their results if the magnitude of the measured errors does not allow us to claim that a gradient by socioeconomic status or sex does, indeed, exist. For that reason, we produced a set of figures, using LOESS smoothing to visualize gaps in prevalence by educational attainment and sex.

Next, with the death rates and the corresponding population exposures, we produced a set of life tables (separately by sex and educational attainment), estimating the remaining life expectancy at age 35, using the classic textbook procedure (Preston et al., 2001). From that lifetable, and with the five-age group prevalence estimates, we also derived the disease-free life expectancies at age 35, using the well-known Sullivan method, whose purpose is to compute the proportion of time lived with or without a certain condition (Sullivan, 1971). We calculated 95% CI for life expectancy and the disease-free life expectancies by using the suggested procedure (Jagger et al., 2014). However, given the large population size used for mortality data, the range of estimates for life expectancy was expected to be minimal.

As mentioned previously, both life expectancy and disease-free life expectancy are aggregate measures that can be decomposed. Given that the disease-free life expectancy is derived from the life expectancy (which means they are correlated), a decomposition procedure is necessary to establish the difference attributed to health in two given disease-free life expectancies.

In this case, given that we are dealing with two populations in the same moment, we relied on the stepwise replacement algorithm decomposition, first described by Andreev et al. (2002). This technique alters the components sequentially, and recalculates the index function to obtain the contribution of each parameter to the aggregate result. The stepwise replacement algorithm procedure (Andreev et al., 2002) allows us to do an age-specific decomposition for aggregate demographic measures (health expectancy, life expectancy, parity-to-progression ratio, total fertility rate). In the case, it allows us to decompose the changes across two health expectancies as a mortality change and morbidity change.

Such procedure is already incorporated in the DemoDecomp package built by Riffe (2018). For a full mathematical proof, we recommend following Andreev et al. (2002).

Considering that both mortality and morbidity/disability components are the sum of the specific contributions by age group (and being w the final age group of an abridged life table, they could also be expressed in the following form, which makes them suitable for an age-specific decomposition to identify which age groups are the ones who are the responsible for the differences.

We presented the results of those decompositions considering two types of differences: we considered the educational gap (difference between the higher educated group minus the lower educated group) for each sex, and also the sex gap (females minus males) for individuals belonging in the same educational group, for a total of four decompositions for each of the six analyzed conditions. For practical reasons, we presented only the average decomposition differentials (given that we believe that the presence or absence of morbidity components is clear enough when presenting the estimates for life expectancy and disease-free life expectancy) to visualize the contribution of each component. All visualizations in this study were done using the ggplot2 package (Wickham, 2015) integrated in in R software.

Results:

Figures 1 and 2 indicate the prevalence (expressed in percentual terms) obtained by sex and educational attainment, respectively. Both for diabetes, and, specially, cardiovascular conditions, males have a higher prevalence than females, independently of their educational attainment. There is also a higher prevalence in cancer for males after age 60, but only for high educated individuals, and a higher prevalence in respiratory diseases at older ages for low educated males when compared to their female counterparts. Females, on the other hand, have a higher prevalence than males in mental disorders (the gap appears to be larger in the low educated groups) and a slightly higher prevalence of back pain in the low educated groups, focusing in the younger age categories.

In Figure 2, the only condition for males in that we found a clear gradient favoring the high educated individuals, were the mental disorders. On the other hand, high educated males presented higher cancer prevalence in comparison to their low educated counterparts. It also has to be noted that at older ages a small gradient in diabetes and in cardiovascular conditions was found, in detriment of the males with a higher educational

attainment. In the remaining conditions prevalence remained stable, without the presence of any obvious gradient and small variations across age.

In the case of females, again was the group of mental disorders the one who presented a clear educational gradient, in detriment of the low educated females. Diabetes also presented a similar educational gradient as well (although the gap was narrower compared to mental disorders). Cancer and (arguably, cardiovascular conditions as well) presented a small differential in older ages, in detriment of the higher educated females. In back pain and respiratory diseases, the age-specific prevalence was almost identical for both educational groups.

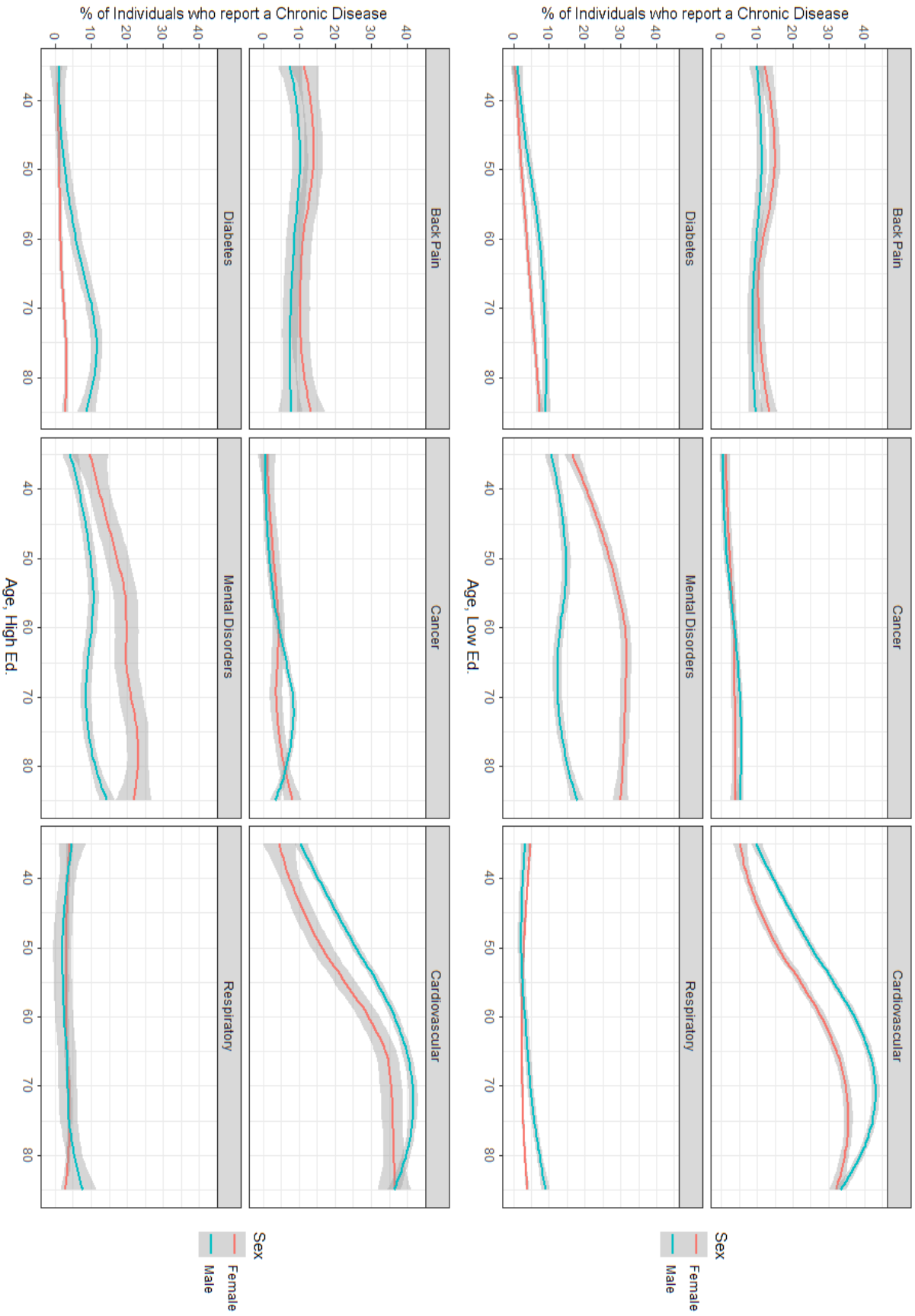

Figure 1: Proportion of individuals with a Major Chronic Disease by age and sex, separately by educational attainment (Lower on top, Higher on bottom), 2012-17

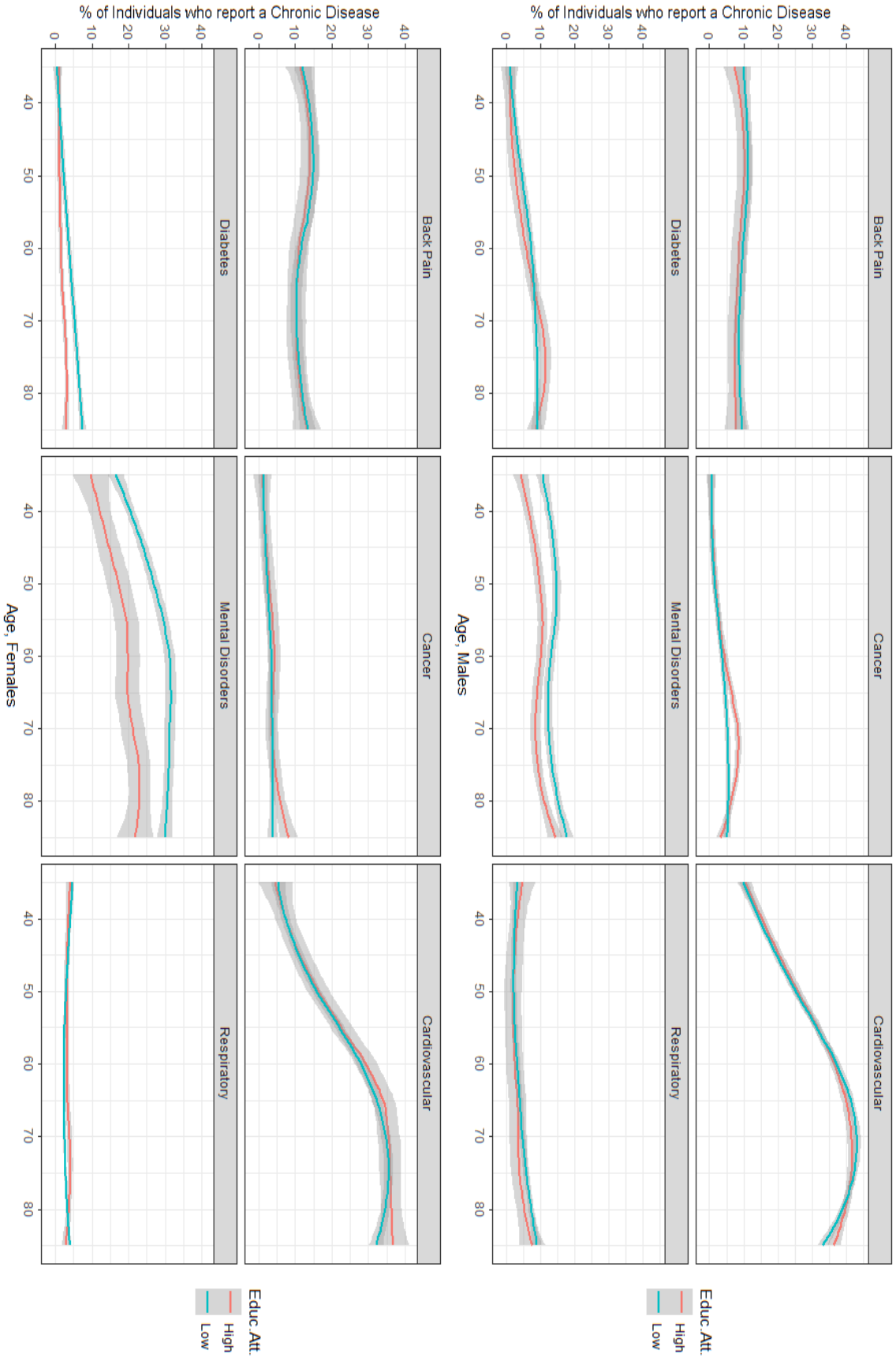

Figure 2: Proportion of individuals with a Major Chronic Disease in by age and educational attainment, separately by sex (Males on top, females on bottom), 2012-17

Figure 3 presents the five-age death rates by sex and educational attainment in the analyzed period. As expected, low educated males had the highest mortality rates, highly educated females had the lowest mortality, and at older ages mortality the differentials by educational attainment tended to converge.

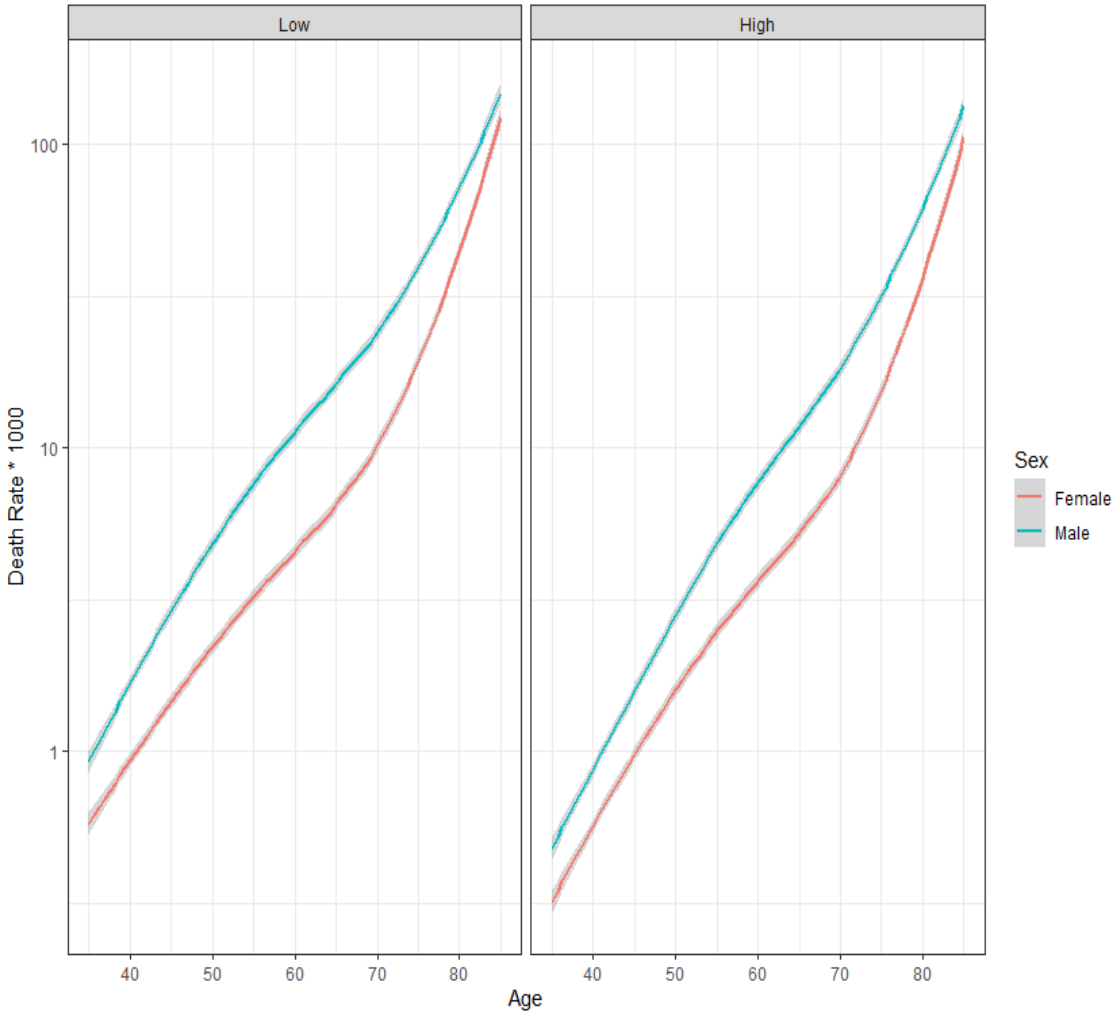

Figure 3: Death Rates (*1000) by Educational attainment from ages 35 to 85, Spain, 2012-17. Author's calculations.

Life expectancy and Disease-Free Life Expectancy at age 35:

Table 1 indicates the results of the estimations of the remaining life expectancy at age 35, and the disease-free life expectancy (DFLE) at age 35 for the six chosen conditions, by sex and by educational attainment. Females, expectedly, presented a higher life expectancy and, in general, a higher DFLE than males for the majority of conditions, the sole exception being the mental disorders.

It is no surprise either that individuals with a higher education presented a higher life expectancy at age 35 and a higher DFLE as well. The lowest DFLE for males was found in cardiovascular diseases, both for low educated and high educated males (with a staggering gap of 13 and 14 years lower than the correspondent remaining life expectancy). The lowest DFLE in low educated females was found in mental disorders (with a gap of almost 14 years between the DFLE and remaining life expectancy), while cardiovascular disorders presented the lowest DFLE at age 35 for their high educated counterparts (with a gap of 13 years).

Sex/ Indicator	Life expectancy at age 35 (95%CI)	DFLE, Back Pain (95%CI)	DFLE, Cancer (95%CI)	DFLE, Cardiovascular (95%CI)	DFLE, Diabetes (95%CI)	DFLE, Mental Disorders (95%CI)	DFLE, Respiratory (95%CI)
Males, Low Ed.	45.02 (45.01/45.03)	40.60 (40.37/40.83)	43.80 (43.68/43.91)	32.00 (31.68/32.33)	42.54 (42.38/42.71)	39.04 (38.78/39.30)	43.37 (43.23/43.51)
Males, High Ed.	47.97 (47.96/47.98)	43.90 (43.58/44.22)	46.23 (45.98/46.49)	33.67 (33.12/34.23)	45.36 (45.04/45.68)	43.73 (43.38/44.09)	46.34 (46.10/46.59)
Females, Low Ed.	51.05 (51.04/51.06)	44.69 (44.43/44.95)	49.66 (49.54/49.78)	39.47 (39.18/39.76)	49.25 (49.12/49.38)	37.14 (36.80/37.49)	49.52 (49.38/49.66)
Females, High Ed.	53.26 (53.25/53.27)	46.92 (46.41/47.43)	51.27 (50.89/51.65)	40.43 (39.69/41.17)	52.32 (52.05/52.59)	43.61 (42.95, 44.26)	51.46 (51.16/51.76)

Table 1: Life Expectancy at age 35 and Disease-Free Life Expectancy at age 35 by cause, sex and educational attainment. Author's calculations.

Table 2 presents both the results of the differentials by sex (females minus males) and educational attainment (high educated minus low educated) along with the aggregate results of the decomposition analyses (mortality and morbidity components) for each average differential. Since the life expectancy differentials were a difference of mortality measures, the morbidity component had no contribution for that indicator, obviously.

For individuals with a similar educational attainment, a clear sex gap (females minus males) is visible in certain conditions. On the one hand, the DFLE differential in cardiovascular conditions, favoring both low educated and high educated females is evenly split between the morbidity and mortality components. In diabetes, there was also a morbidity component favoring females, with the contribution of morbidity in the DFLE

sex gap being larger for the group with a higher education. On the other hand, the large negative values in the morbidity component for mental disorders indicate that, even with the existence of the mortality component, males would have had a higher DFLE than females for that particular condition, both for the low educated and high educated groups. For back pain, there was also a negative gradient favoring the male groups, but smaller than the mortality component. In case of Cancer and respiratory conditions, the DFLE differential the large majority of the sex gap is explained by the mortality component.

In the educational gap for males, only in mental disorders we identified a clear positive morbidity component, which indicates that the average DFLE gap of almost 4.7 years, can be explained by mortality and morbidity contributions of 2.57 and 2.12 years respectively. A small morbidity component could be present in the DFLE differential in back pain (although we have to keep in mind that given the results provided in Figure 2, a clear prevalence difference by educational attainment is not evident). In the remaining conditions, we could not identify a strong socioeconomic gradient present in the morbidity component (except for a negative contribution of almost 0.4 years in cancer in detriment of the high educated males), and therefore it can be argued that the majority of the estimated DFLE differentials are a product of, essentially, mortality differentials.

For females, the educational gradient on mental disorders is also evident: a DFLE gap of almost 6.5 years was predominantly explained by the morbidity component (approximately 4.8 years) while the contribution of the mortality component was minoritarian (1.64 years). This was also the case for diabetes: in a differential that, was slightly above of the 3-year mark in average, the contribution of the morbidity component was roughly of one year. For cardiovascular conditions, the slight reverse gradient is present in the negative morbidity component: the rather small DFLE differential by educational attainment in females indicated that the group with a lower education would have had a higher health expectancy if the mortality component was nonexistent.

Differential	LE 35	DFLE Back Pain	DFLE Cancer	DFLE Cardiovascular	DFLE Diabetes	DFLE Mental Disorders	DFLE Respiratory
Avg. Diff., Low Ed. (Females-Males)	**6.03**	**4.09**	**5.86**	**7.47**	**6.71**	**-1.90**	**6.15**
Contribution of Morbidity	0	-1.30	0.09	3.54	1.12	-6.55	0.41
Contribution of Mortality	6.03	5.39	5.77	3.92	5.59	4.65	5.74
Avg. Diff., High Ed. (Females-Males)	**5.29**	**3.02**	**5.04**	**6.76**	**6.96**	**-0.12**	**5.12**
Contribution of Morbidity	0	-1.76	0.06	3.42	2.01	-4.55	0.08
Contribution of Mortality	5.29	4.78	4.98	3.34	4.95	4.43	5.04
Avg. Diff., Males (High Ed.-Low Ed.)	**2.95**	**3.30**	**2.43**	**1.67**	**2.82**	**4.69**	**2.97**
Contribution of Morbidity	0	0.61	-0.36	-0.16	0.13	2.12	0.19
Contribution of Mortality	2.95	2.69	2.79	1.83	2.69	2.57	2.78
Avg. Diff., Females (High Ed-Low Ed.)	**2.21**	**2.23**	**1.61**	**0.96**	**3.07**	**6.47**	**1.94**
Contribution of Morbidity	0	0.29	-0.48	-0.51	0.97	4.83	-0.19
Contribution of Mortality	2.21	1.94	2.09	1.47	2.10	1.64	2.13

Table 2: Contribution to average differences in DFLE by sex and educational attainment for selected causes. Author's calculations.

Age-specific Decomposition results:

In Figure 4, the first half of the figure indicated the contribution of the two components of the DFLE sex gap (females minus males) for the low educated individuals. The negative values of the morbidity component (marked in red) for back pain suggested that females presented a higher contribution than males across all age-groups, but particularly at the youngest ones. This was the case as well for mental disorders, but the larger sex differentials in morbidity were present between ages 50 and 75. For cardiovascular conditions, the majority of the contribution morbidity component in the DFLE differential was found before age 80. Respiratory diseases presented a higher morbidity contribution at the oldest ages, and the majority of the contribution for the DFLE gap in diabetes was at the middle age groups.

The other half of the figure presented the age-specific contribution of morbidity and mortality of the DFLE sex gap for the high educated individuals. While the general pattern of the age-specific contribution of morbidity was somewhat similar to the one in the left half, there were some aspects that had to be noted. Mental disorders, apart from having a smaller contribution of morbidity overall, presented a larger age-specific contribution at older age groups. In diabetes, the age-specific contribution of morbidity to the DFLE gap was progressively higher as ages were older. In cancers, at the oldest age group the morbidity contribution was negative (possibly due to selection effects).

In Figure 5, the first half of the figure indicated the contribution of the two components of the DFLE educational gap (high educated minus low educated) for males. As mentioned before when presenting the overall decomposition, the condition with the highest morbidity contribution was mental disorders. The age-specific decomposition indicates that while in all ages the differential favors the highest educated males, is at youngest age groups where the contribution is slightly higher. And that in cardiovascular conditions, a small positive contribution favoring the higher educated between ages 60 and 70 appeared to be countered afterwards.

The right half of figure 5 presented the age-specific contribution of morbidity and mortality of the DFLE educational gap (high educated minus low educated) for females. Mental disorders presented a higher prevalence for lower educated females, but the age-specific contribution was similar for all age groups. For diabetes, like the right side of the figure 4, presented an age-specific morbidity contribution that grown larger by age, in an opposite trend with cardiovascular conditions, where at oldest ages the contribution favored the lower educated females, and something similar could be said about cancer at the final age group of 85 and above.

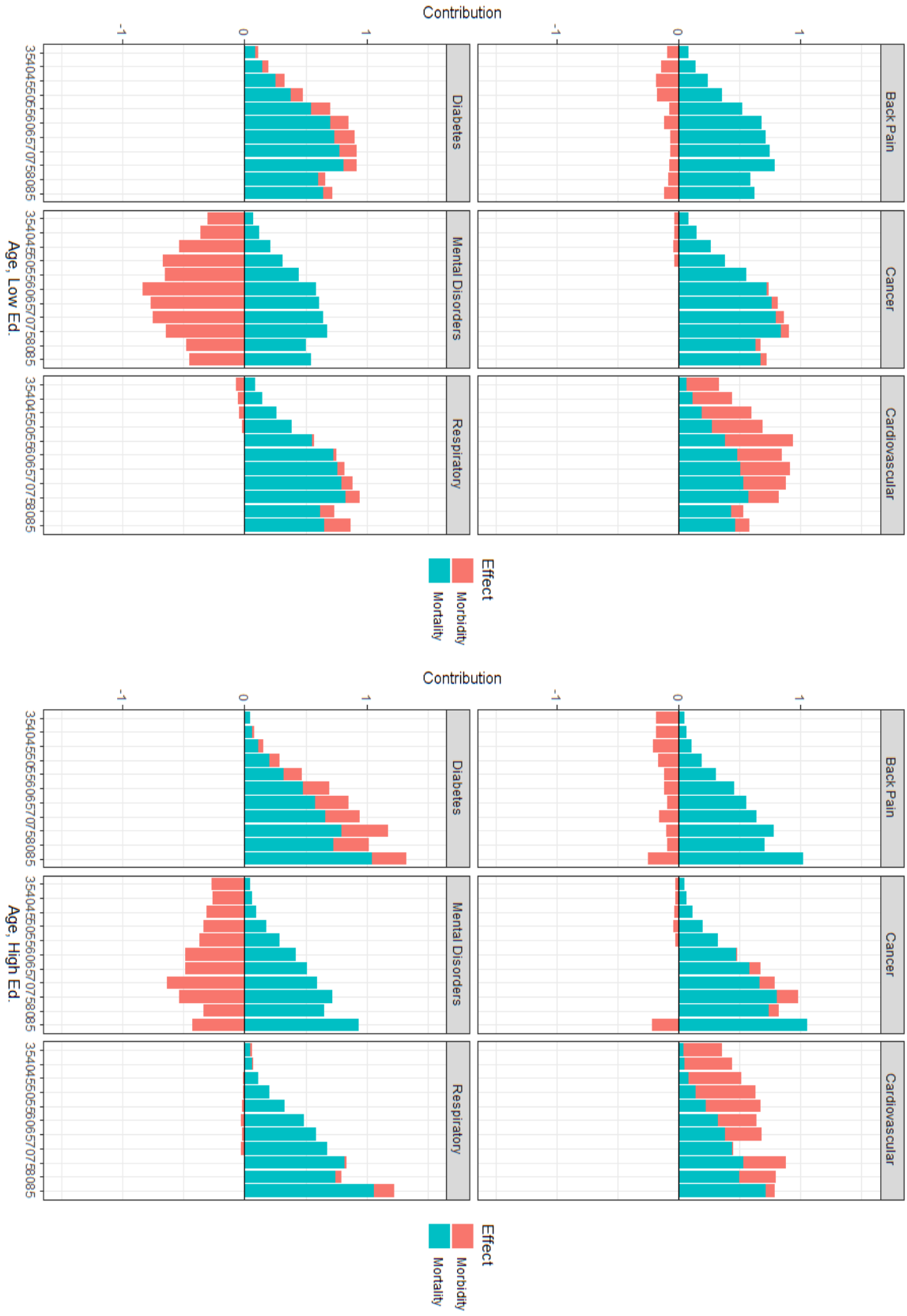

Figure 4: Age-specific decompositions of DFLE differentials by sex, separately by educational attainment (L = Lower, R = Higher), Spain, 2012-17. Author's calculations.

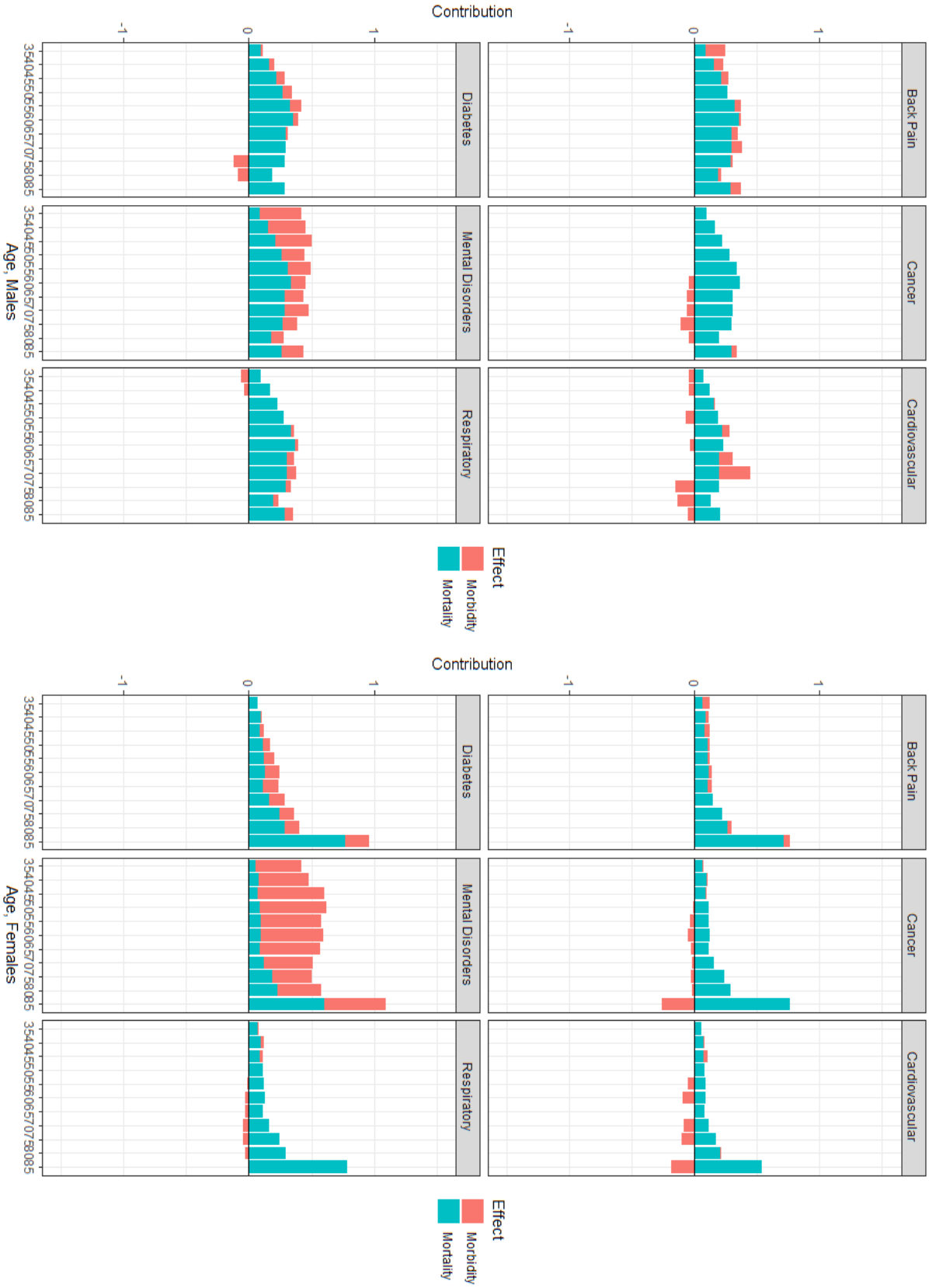

Figure 5: Age-specific decompositions of DFLE differentials by educational attainment, separately by sex (L = males, R = females), Spain, 2012-17. Author's calculations.

Discussion and final comments:

This study investigated the contribution to differences in DFLE (disease-free life expectancy) by sex and educational attainment for several groups of causes on health expectancies in Spain, while highlighting which age groups are the ones who contribute the most to such differences.

While the educational gradient in prevalence and DFLE was mild to nonexistent in the majority of the analyzed conditions, in mental disorders there was a clear and strong gradient across the life course, both for males and for females, favoring the most educated individuals. In this condition, a clear morbidity component was found there. Furthermore, there was an important sex gap as well in this particular condition, with females presenting a higher prevalence than their male counterparts, and this difference being larger for the low educated individuals. Therefore, while the DFLE for mental disorders in females is slightly lower than males, the net contribution of morbidity is more impactful, with values ranging between 6.4 years of "net"-DFLE for the lower educated individuals and 4.5 in the higher educated individuals, that are compensated by the mortality component.

For Back Pain, while we could not find an important educational gap in the health expectancies (although there is a small education gap in health for males), a sex gap in morbidity was present while estimating the respective DFLEs, favoring males over females, independently of their educational attainment. For respiratory diseases, the only gap in DFLE that presented morbidity components was for lower educated individuals, where males had a slightly higher morbidity than females.

For cardiovascular conditions, we found a slight gap in prevalence by educational attainment at the highest age groups, favoring the low educated individuals, both for males and females. We also visualized a strong sex gap, where the largest morbidity contribution (males had a higher prevalence than females) to the difference in DFLE was found in the youngest age groups.

For diabetes, we found an educational gap of DFLE for females (albeit not in males), where the low educated presented a higher morbidity at all age groups. A sex gap was also present, with a morbidity contribution in DFLE favoring females over males, and this difference being larger for the high educated groups. Finally, we failed to identify differentials of any kind for individuals who reported cancer/malignant tumors.

The fact that the majority of conditions did not present a strong socioeconomic gradient suggests that possibly aggregate measures (i.e. health expectancies based on the presence of one or multiple morbidities) may be masking certain heterogeneities in health (Voigt et al., 2020). Possibly, splitting mental disorders from physical conditions at the time of analyzing future health disparities could be an interesting approach in order to visualize social inequalities in health.

Furthermore, this study has put in perspective the additional burden that females with a lower education have when it comes to mental disorders: they not only have a higher prevalence, but also, they live more time with the condition than higher educated females and males. Therefore, any potential advantage on their health expectancy that they may present on males is purely based on a higher life expectancy and it is easily countered when considering the morbidity component. Given than depression, a mental disorder, is currently one of the worldwide leading causes of disability, it is important to investigate more about the determinants behind such differences, both from a gender and a social inequality perspective and develop policies that can mitigate the disparity.

This study was not exempt of limitations, that are openly acknowledge and address. First of all, even by pooling three health surveys, the relatively small sample size forced us into considering two categories for educational attainment, possibly ignoring more subtle layers of analysis if we applied more categories (although arguably it facilitated the interpretation of decomposition analysis given that is based on a difference). Furthermore, this study does not consider the institutionalized population. We also presented the results at a country level, and not by autonomous communities in Spain or any other type of spatial differentiation, although certainly it is something to consider for future studies. It has to be mentioned as well that while most of those conditions were diagnosed by a physician, the registered answers are still reliant on the veracity of the respondent. Furthermore, the ailments that formed the different conditions that we grouped may involve their own degree of heterogeneity as well. In spite of such limitations, we believe that the findings presented in this paper are a proof of the advantages of considering chronic conditions by separate when investigating the health burden in a population.

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Appendix:

Table 1: Classification of Chronic Conditions based on ENSE and EESE Questionnaires.

Group	Condition	Questions in ENSE 2012	Questions in ENSE 2017	Questions in EESE 2014
Cardiovascular	High Blood Pressure	G21b-1, G21c-1	G25b-1, G25c-1	G25b-1, G25c-1
	Myocardial Infarction	G21b-2, G21c-2	G25b-2, G25c-2	G25b-2, G25c-2
	Stroke	G21b-22, G21c-22	G21b-23, G21c-23	G21b-23, G21c-23
	Other Heart Diseases	G21b-3, G21c-3	G25b-3, G25c-3	G25b-3, G25c-3 G25c-4, G25-c4
	High Cholesterol	G21b-14, G21c-14	G25b-15, G25c-15	G25b-15, G25c-15
Back Pain	Neck Back Pain	G21b-6, G21c-6	G25b-7, G25c-7	G25b-7, G25c-7
	Low Back Pain	G21b-7, G21c-7	G25b-8, G25c-8	G25b-8, G25c-8
Respiratory	COPLD	G21b-10, G21c-10	G25b-11, G25c-11	G25b-11, G25c-11
	Ashtma	G21b-9, G21c-9	G25b-10, G25c-10	G25b-10, G25c-10
Diabetes	Diabetes	G21b-11, G21c-11	G25b-12, G25c-12	G25b-12, G25c-12
Cancer	Malignant Tumors	G21a-25, G21b-25, G21c-25	G25a-26, G25b-26, G25c-26	G25a-26, G25b-26, G25c-26
Mental Disorders	Depression	G21b-19, G21c-19	G25b-20, G25c-20	G25b-20, G25c-20
	Anxiety	G21b-20, G21c-20	G25b-21, G25c-21	G25b-21, G25c-21
	Other Mental Disorders	G21b-21, G21c-21	G25b-22, G25c-22	G25b-22, G25c-22

Source: Author's elaboration based on ENSE 2012, ENSE 2017 and EESE 2014