

Differences in the risk of premature cancer mortality between natives and immigrants in Spain

Rafael Grande ¹, Juan Manuel García-González², Mikolaj Stanek ³

¹ Department of Sociology, Universidad de Málaga, Málaga, Spain

² Department of Sociology, Universidad Pablo de Olavide, Sevilla, Spain

³ Department of Sociology, Universidad de Salamanca, Salamanca, Spain

Correspondence: Rafael Grande, Department of Sociology, Facultad de Estudios Sociales y del Trabajo de la Universidad de Málaga, Avenida Francisco Trujillo Villanueva, 1, 29010 Málaga, Spain, Tel: +34 (0) 951 952 715, e-mail: rgrande@uma.es

Background: The healthy immigrant paradox has found wide support in the literature. To evaluate this hypothesis that immigrants have better health outcomes than the native population, this study aimed to compare the premature cancer mortality between the native and immigrant populations in Spain. **Methods:** We obtained the 2012–15 cause-specific mortality estimates from administrative records and participant characteristics data from the 2011 Spanish census. Using Cox proportional hazards regression models, we calculated the risks of mortality of the native and immigrant populations, and the latter populations' risk based on their regions of origin, and determined the effects of covariates of interest on the calculated risk. **Results:** Our results show that the risk of premature cancer mortality is lower among immigrants than among natives, and this gap is higher among men than among women. There is a lower mortality rate among Latin American immigrants (Latino men are 81% less likely to die prematurely from cancer than native-born men, and Latino women are 54% less). Moreover, despite social class disparities, immigrants' advantage in cancer mortality remained constant and decreased with increasing length of residence in the host country. **Conclusions:** This study provided novel evidence on the 'healthy immigrant paradox', associated with the fact that migrants are favorably selected at origin, cultural patterns of the societies of origin and, in the case of men, there is some convergence or an 'unhealthy' integration that explains the fact that this advantage over natives is lost with more years of residence in Spain.

Introduction

The significant, constant and general increase in life expectancy over the last century has markedly decreased the risk of premature mortality, i.e. death that occurs before 65 years of age. In recent decades, this increase in longevity has been accompanied by a new epidemiological transition characterized by a significant reduction in cardiovascular diseases as the main cause of death and an increase in cancer mortality, both in European countries and worldwide,¹ but particularly in Spain.² Thus, cancer has become one of the main causes of premature mortality even in the most developed countries.³ In Spain, circulatory system diseases and cancer are currently the first and second leading causes of death in the overall population; however, cancer precedes circulatory system diseases as the leading cause of premature mortality. Data from the Spanish National Statistical Office show that lung tumors, followed by colon tumors, are the most lethal among men, whereas breast tumors, followed by lung and colon tumors, are the most lethal among women. Despite this, during the past few decades, significant improvements in the early diagnosis and treatment of patients with tumors have been achieved in Spain and globally, leading to a significant decrease in tumor lethality.⁴

This study aimed to compare the risk of premature cancer mortality between the native and immigrant populations in Spain. We assessed whether the risk of premature cancer mortality is lower in the immigrant population than in the native population, despite many immigrants having socioeconomically disadvantaged backgrounds and experiencing social inequalities in Spain. Thus, we aimed to test whether an 'immigrant disadvantage' effect is observed when controlling for covariates or if, on the contrary, there exists an

'immigrant advantage' effect that causes immigrants to have better health profiles and a lower risk of mortality than natives. Much of the interest and novelty of this research lies in the fact that Spain has relatively recent immigrants with significant heterogeneity, i.e. diversity of origin, reasons for migration, times of arrival with respect to stage of life and unequal geographical distribution in Spain. Thus, it is of great interest to discern whether there are differences in the incidence of premature cancer mortality among immigrants in Spain in terms of sex, regions of origin, time of immigration and socio-economic status. Furthermore, the association between cancer mortality and lifestyle has substantial implications for the integration of immigrants into a country.

Background

The literature on migration studies extensively describes the 'healthy immigrant paradox' or 'epidemiological paradox', a phenomenon observed in many developed countries wherein immigrants have better health outcomes than natives. This phenomenon is considered paradoxical because migrants coming from less developed countries are exposed to more adverse conditions in the host countries, which may have a negative impact on their health.^{5,6} However, studies have reported that the rates of mortality among immigrants are lower than those among the natives.^{7–10} For example, in the USA, there appears to be a 'Hispanic mortality paradox': immigrants of Hispanic origin have a lower average educational level, worse jobs or less access to health insurance than the non-Hispanic white population but have a higher life expectancy and lower prevalence of chronic diseases.^{11–13} Some studies have compared the cancer mortality of different immigrant groups and reported a general trend of lower immigrant

lethality, dependent on the cancer type and origin group characteristics.^{14,15}

This apparently paradoxical effect has been attributed to several factors. First, it has been suggested that migration is subject to a positive selection effect (more intensely in international migration), such that younger people in good health are more likely to migrate and also more successful in the often physically and mentally difficult migration process than older people in poor health.^{16–18} Second, some studies on migration have found that immigrants have healthier lifestyles and behaviors than natives, which may be linked to the cultural norms of the immigrants' countries of origin.^{19,20} Third, the literature has explored the existence of what is known as the 'salmon bias' hypothesis^{7,21,22}; that is, the higher probability that the immigrant population chooses to return to their country of origin when they retire, grow old, or become seriously ill, which would cause measurement bias due to an underreporting of immigrant mortality.²³ However, others have found that the salmon bias is weak²⁴ and is affected by other factors, e.g. access to health care in the host country and the country of origin,^{25,26} family integration at the destination and the intensity of transnational ties maintained with the society of origin (with age at the time of migration and length of stay in the destination country having intermediary effects).²⁷

The healthy immigrant paradox has been observed in recent immigrants to Spain in relation to not only mortality patterns²⁸ but also morbidity and health care,²⁹ quality of life³⁰ and reproductive health.^{31,32} Despite this, the healthy immigrant paradox remains less studied in Spain, especially in terms of specific causes of death, owing to the scarcity of data. Previous studies have highlighted that there are slightly better mortality indicators for immigrants than for natives in the Spanish region of Andalusia, with significant differences according to the region of birth.²⁸ However, other studies have concluded that the worse socioeconomic conditions of immigrants than natives in Spain translate into poorer health perception and mental health, although immigrants have a lower risk of suffering from chronic diseases than natives³³ and thus impose less of a burden on health care services, especially specialist care.³⁴

Methods

Participants

Data were extracted from administrative records (mortality data by cause) and from the 2011 Spanish census. The Spanish census dataset, available on special request from the Spanish National Statistical Office, associates the 2011 Spanish census microdata with those from the Vital Statistics (2012–15) and the Municipal Registry (2012 and 2016). Census data include individuals' personal and household characteristics such as sex, age, country of origin, marital status, educational level, labor market status, migration status and living conditions. Vital Statistics include data on the month and year of death, in addition to the cause of death. The Municipal Registry data reports whether an individual was listed in the register in 2012 and 2016. Overall, based on the 2011 population census, these datasets included approximately 10% of the resident population of Spain, excluding those who died and were not registered during that census.

Using the abovementioned dataset, we selected the study sample based on the following criteria: persons aged from 20 to 64 years with their data recorded in the 2011 Spanish census, the 2012 registry and in the 2016 registry if their death was not registered in that period (censored cases). This afforded a total of 2 276 491 persons for our analysis (49.6% men and 50.4% women; 93.6% natives and 6.4% immigrants).

Measures

Premature mortality denotes deaths at an age lower than the life expectancy of a given population or before an age that is considered 'normal' or 'acceptable'. Thus, given the aim of our study, we estimated the number of premature deaths by cancer in people aged

from 20 to 65 years. All deaths due to cancer (tumors; *International Classification of Diseases* 10th Revision code: C00-D48) were considered, which resulted in a set of 10 512 cancer-related deaths (6624 in men and 3888 in women) over the study period (2012–15).

Owing to heterogeneity in recent immigration to Spain, the characteristics of the natives and immigrants were compared based on the following major regions of origin: the EU15 and other developed countries, Eastern Europe, Latin America and the Caribbean, the Maghreb, sub-Saharan Africa, and Asia and Oceania.

Analysis

A survival analysis (event-time) was performed using a longitudinal model with *Stata 14*, whereby the data were transformed into person-years to yield a total of 9 162 373 observations. For descriptive purposes, Kaplan–Meier survival curves were used to determine the risk of premature cancer mortality as a function of individuals' age. A Cox proportional hazards regression model was then used to generate a survival function that predicted the probability of cancer-related deaths at a given time 't' for certain predictor variable values. These models were age-adjusted in which age was introduced as a continuously time-varying parameter. Separate models were used for men and women for all analyses, and hazard ratios (HRs) were also obtained, which are interpreted similarly to incidence rate ratios.

This method allowed us to evaluate, as a function of exposure time, the risk of premature cancer mortality associated with immigrant status, by controlling for sociodemographic traits (model 1) and by observing the effects of socioeconomic characteristics (model 2: educational level and occupational social class) and migration characteristics (model 3: years of stay, age at arrival, nationality, and mixed couple). Finally, we linked native or immigrant status with individuals' socioeconomic characteristics to evaluate the various social class gradients in the compared groups (model 4).

Results

Descriptive analysis shows a significant difference in age-standardized premature cancer mortality rates between natives and immigrants in Spain. During the period studied, the rate for native men was 129.9 per 100 000, whereas the rate for immigrant men was 78.1. In relative terms, tumors account for 48.2% of total premature mortality in native-born men, while they account for 40.4% in immigrants. Among women, the premature mortality rate due to cancer is 80.3 per 100 000 for native-born women and 60.6 for immigrants. As in men, tumors account for a greater proportion of total premature mortality in native-born women (61.3%) than in immigrant women (54.3%).

Figure 1 presents the cumulative probability of cancer survival vs. time (age of individuals) for natives and immigrants. The incidence of premature cancer mortality was low and concentrated at 45–65 years of age; moreover, the incidence was higher in men than in women. After 50 years of age, immigrants had a lower risk of premature cancer mortality than natives; this decrease in risk was large in immigrant men and very small in immigrant women.

Table 1 presents premature cancer mortality estimated using Cox proportional hazards regression models with the region of origin as the main exposure variable and incorporating different covariates. After controlling for sociodemographic (model 1), socioeconomic (model 2) and migratory (model 3) characteristics, we observed that male immigrants had a lower risk of cancer mortality than male natives: 73% lower for those from the EU15 and other highly developed countries [HR = 0.275; 95% confidence interval (CI) = 0.09–0.82], 56% lower for those from Eastern Europe (HR = 0.44; 95% CI = 0.16–1.16), 74% lower for those from the Maghreb (HR = 0.26; 95% CI = 0.08–0.78) and 81% lower for those from Latin America and the Caribbean (HR = 0.19; 95% CI = 0.06–0.53). However, Asian and sub-Saharan African immigrants did not exhibit any significant cancer mortality differences with respect to natives. In the case of women, only immigrants from Latin

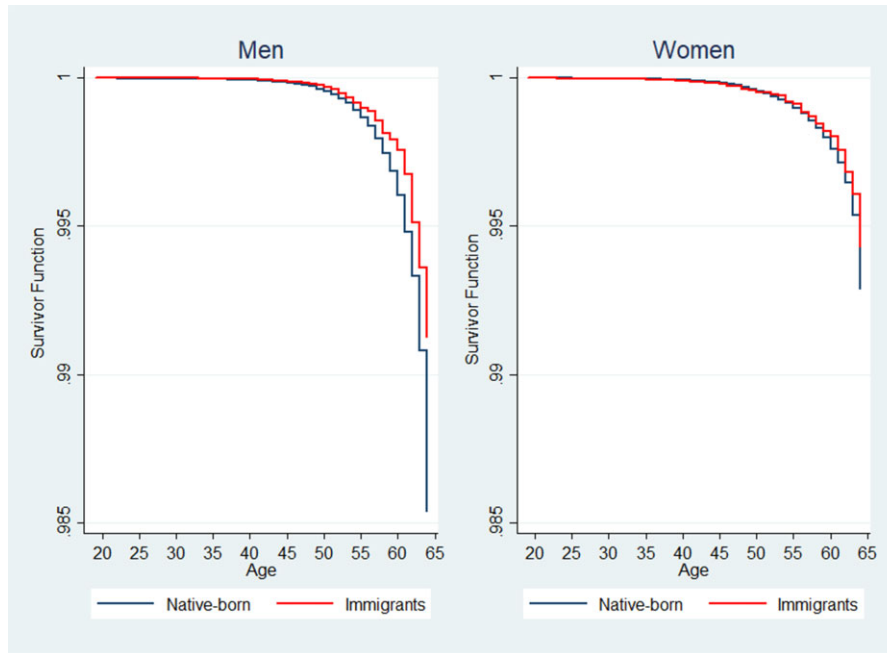


Figure 1 Kaplan–Meier survival curves of the risk of premature cancer mortality for natives and immigrants based on sex

Table 1 Results of multiple Cox proportional hazards regression models for premature cancer mortality among men: adjusted HRs (and associated 95% CIs)

	Model 1 + sociodemographic characteristics		Model 2 + Socioeconomic characteristics		Model 3 + migratory characteristics	
	HR	RSE	HR	RSE	HR	RSE
Origin						
Native-born residents	1.00		1.00		1.00	
EU15 and highly developed countries	0.66 (0.46–0.93)	0.12	0.58 (0.41–0.83)	0.11	0.28 (0.09–0.82)	0.15
Eastern Europe	0.73 (0.47–1.13)	0.16	0.74 (0.47–1.15)	0.17	0.44 (0.16–1.17)	0.22
Latin America and Caribbean	0.30 (0.19–0.46)	0.07	0.32 (0.21–0.50)	0.07	0.19 (0.06–0.53)	0.10
Maghreb	0.65 (0.40–1.05)	0.16	0.60 (0.37–0.98)	0.15	0.26 (0.08–0.77)	0.15
Sub-Saharan Africa	0.92 (0.34–2.45)	0.46	0.89 (0.33–2.38)	0.45	0.51 (0.12–2.17)	0.38
Asia and Oceania	0.71 (0.29–1.70)	0.32	0.75 (0.31–1.81)	0.34	0.34 (0.08–1.31)	0.23
Education						
Primary or less			1.00			
Secondary			0.88 (0.81–0.94)	0.03	0.88 (0.81–0.95)	0.03
University			0.72 (0.64–0.80)	0.04	0.71 (0.64–0.79)	0.04
Occupational class						
I			1.00			
II			1.02 (0.88–1.17)	0.07	1.02 (0.89–1.17)	0.07
III			1.05 (0.92–1.20)	0.07	1.06 (0.92–1.20)	0.07
IV			1.24 (1.05–1.48)	0.11	1.25 (1.05–1.48)	0.11
Out of labor force			3.13 (2.75–3.57)	0.21	3.15 (2.76–3.58)	0.21
Age at migration						
Native-born residents					1.00	
<25					0.27 (0.09–0.82)	0.15
25–44					0.28 (0.11–0.75)	0.14
45 or more					0.45 (0.22–0.91)	0.16
Years in Spain						
Native-born residents					1.00	
<5					0.28 (0.09–0.82)	0.15
5–9					0.36 (0.15–0.86)	0.16
10–14					0.439 (0.19–1.03)	0.19
15 or more					0.71	0.25
Mixed couple						
Native-born residents					1.00	
Migrant endogamous couple					0.50 (0.21–1.19)	0.22
Migrant mixed couple					0.41 (0.17–1.02)	0.19
Citizenship						
Native-born residents					1.00	
Yes					0.41 (0.16–1.03)	0.19
No					0.59 (0.27–1.28)	0.23

Notes: Control variables in all models: age, rural/urban habitat, marital status, and childbearing. HR, hazard ratio; RSE, robust standard error.

*** $P < 0.01$, ** $P < 0.05$, * $P < 0.1$.

Table 2 Results of multiple Cox proportional hazards regression models for premature cancer mortality among women: adjusted HRs (and associated 95% CIs)

	Model 1 + sociodemographic characteristics		Model 2 + socioeconomic characteristics		Model 3 + migratory characteristics	
	HR	RSE	HR	RSE	HR	RSE
Origin						
Native-born residents	1.00		1.00		1.00	
EU15 and highly developed countries	1.22 (0.89–1.67)	0.20	1.09 (0.79–1.50)	0.18	0.88 (0.41–1.87)	0.34
Eastern Europe	0.70 (0.43–1.14)	0.18	0.67 (0.41–1.10)	0.17	0.70 (0.31–1.59)	0.29
Latin America and Caribbean	0.60 (0.43–0.81)	0.09	0.61 (0.45–0.83)	0.10	0.46 (0.21–0.96)	0.17
Maghreb	1.06 (0.62–1.78)	0.28	0.93 (0.55–1.57)	0.25	0.58 (0.22–1.52)	0.29
Sub-Saharan Africa	0.45 (0.06–3.21)	0.45	0.44 (0.062–3.15)	0.44	0.36 (0.04–2.99)	0.39
Asia and Oceania	0.49 (0.12–1.94)	0.34	0.45 (0.11–1.81)	0.32	0.37 (0.07–1.71)	0.29
Education						
Primary or less			1.00		1.00	
Secondary			1.16 (1.05–1.28)	0.06	1.16 (1.05–1.28)	0.06
University			1.10 (0.95–1.26)	0.08	1.10 (0.95–1.26)	0.08
Occupational class						
I			1.00		1.00	
II			0.97 (0.82–1.15)	0.08	0.96 (0.81–1.14)	0.08
III			1.03 (0.86–1.23)	0.09	1.03 (0.86–1.23)	0.09
IV			1.04 (0.85–1.27)	0.10	1.05 (0.86–1.27)	0.11
Out of labor force			2.18 (1.84–2.59)	0.19	2.19 (1.84–2.59)	0.19
Age at migration						
Native-born residents					1.00	
<25					0.88 (0.41–1.87)	0.34
25–44					1.24 (0.63–2.42)	0.43
45 or more					0.79 (0.38–1.59)	0.28
Years in Spain						
Native-born residents					1.00	
<5					0.88 (0.41–1.87)	0.34
5–9					0.32 (0.14–0.71)	0.13
10–14					1.01 (1.01–2.03)	0.36
15 or more					0.88 (0.49–1.57)	0.26
Mixed couple						
Native-born residents					1.00	
Migrant endogamous couple					1.03 (0.52–2.03)	0.36
Migrant mixed couple					1.51 (0.86–2.63)	0.43
Citizenship						
Native-born residents					1.00	
Yes					1.50 (0.56–2.63)	0.43
No					1.28 (0.77–2.13)	0.33

Notes: Control variables in all models: age, rural/urban habitat, marital status and childbearing. HR, hazard ratio; RSE, robust standard error.

America and the Caribbean were less likely (54%) to die from cancer than native women (HR = 0.457; 95% CI = 0.22–0.96) (table 2).

For men, the risk of premature cancer mortality followed a clear social gradient: the higher the educational level and the occupational social class, the lower the risk of premature cancer mortality (table 1). This effect was not as clear among women; premature cancer mortality was the highest among those with secondary education and those out of labor force (table 2). Table 3 presents the interaction effects between socioeconomic characteristics and immigrant status. Immigrant status showed no significant effects with respect to the educational level. On the one hand, compared with the native males belonging to higher social classes (directors and managers and university professionals), immigrants had a lower rate of premature cancer mortality, although the social class of the immigrants was lower. On the other hand, for women, this observation was specific to unskilled immigrant workers (class IV), who had a 65% lower rate of premature cancer mortality than native women belonging to higher social classes (HR = 0.45; 95% CI = 0.24–0.82); no such differences were observed upon comparison with native women of lower social classes. Finally, out of labor force posed a higher risk of premature cancer mortality for native men and women but not for immigrants.

The Cox proportional hazards regression models showed the effects of different variables on the age at the time of immigration

and immigrants' integration. Table 1 shows that the older the age of men at the time of immigration to Spain, the lower their risk of cancer mortality compared with natives. Moreover, more years of residence in Spain reduced this gap with respect to the natives, i.e. no significant differences in cancer mortality were noted between the natives and immigrants who had been residents for 15 or more years in Spain. Furthermore, for immigrant men, with respect to the native-born population, having Spanish nationality and a mixed partner significantly reduced the risk of premature mortality due to cancer but not having Spanish nationality and not having endogamous partner did not. In the case of women (table 2), the variables of migratory characteristics had insignificant effects in the model; they only highlighted the lower risk of cancer mortality in immigrants who had been resident in Spain for 5–9 years compared with native women.

Discussion

This study analyzed differences in the risk of premature cancer mortality between natives and immigrants in Spain. Our results corroborate those of previous studies^{7–10} that have shown that there is a 'healthy immigrant paradox' in terms of premature cancer mortality among recent immigrants in Spain. However, the differences in the risk of premature cancer mortality between natives and immigrants

Table 3 Interaction effects in the multiple Cox proportional hazards regression analysis of premature cancer mortality between immigrant status and socioeconomic characteristics: adjusted HRs (and associated 95% CIs)

	Men		Women	
	HR	RSE	HR	RSE
Education				
Primary or less # natives	1.00		1.00	
Primary or less # immigrants	1.12 (0.62–2.04)	0.34	1.08 (0.55–2.12)	0.37
Secondary # natives	0.88 (0.81–0.95)	0.03	1.15 (1.03–1.27)	0.06
Secondary # immigrants	0.86 (0.45–1.65)	0.29	1.47 (0.79–2.71)	0.46
University # natives	0.71 (0.63–0.79)	0.04	1.11 (0.96–1.28)	0.08
University # immigrants	1.26 (0.68–2.31)	0.29	0.84 (0.42–1.67)	0.30
Occupational class				
I # natives	1.00		1.00	
I # immigrants	0.18 (0.06–0.53)	0.10	0.62 (0.25–1.49)	0.28
II # natives	1.01 (0.88–1.16)	0.07	0.97 (0.82–1.16)	0.09
II # immigrants	0.33 (0.14–0.77)	0.14	0.55 (0.28–1.07)	0.19
III # natives	1.05 (0.91–1.20)	0.07	1.04 (0.87–1.25)	0.10
III # immigrants	0.33 (0.18–0.60)	0.10	0.62 (0.37–1.05)	0.17
IV # natives	1.23 (1.03–1.46)	0.11	1.07 (0.87–1.31)	0.11
IV # immigrants	0.46 (0.23–0.93)	0.16	0.45 (0.24–0.82)	0.14
Out of labor force # natives	3.112 (2.73–3.55)	0.21	2.22 (1.86–2.64)	0.20
Out of labor force # immigrants	1.82 (0.60–5.54)	1.03	0.72 (0.30–1.79)	0.33

Notes: Control variables in all models: age, rural/urban habitat, marital status and childbearing, region of origin, years of stay, age at arrival in Spain, endogamous/mixed couple, nationality. RSE, robust standard error.

depend on sex, immigrants' region of origin, socioeconomic status and age at the time of migration. First, according to our results, the immigrant advantage of a lower risk of premature cancer mortality was observed mainly in men, confirming that this phenomenon is affected by sex-related patterns of selectivity for migration.

Second, our results show that this phenomenon was particularly significant among both male and female Latin American and Caribbean immigrants, confirming that the 'Hispanic mortality paradox'^{11–13} applies in the Spanish context. This also supports the migration selectivity hypothesis¹⁸ that is particularly intense among labor migrants, as demonstrated by the disappearance of the over-served gap for out-of-labor-force immigrants. Moreover, the differences in immigrants' rates of premature cancer mortality between regions of origin may be associated with peoples' cultural patterns and lifestyles¹⁹ or with ethnic factors.³⁵

Third, the lower risk of cancer mortality of immigrants compared with natives is maintained independently of occupational social class, which shows how that segmentation of the labor market, in line with theories on the social determinants of health, does not account for immigrants having better health outcomes than natives.

Fourth, our study shows how, in the case of the premature cancer mortality in men, the 'immigrant advantage' is reduced based on the length of residence in Spain, which is consistent with both a convergence hypothesis^{36,37} and an unhealthy integration hypothesis.³⁸ However, compared with previous findings that a younger age at immigration implies a higher mortality risk because of the adoption of risky behaviors,^{39,40} our results appear to confirm there is higher positive selectivity for male migrants than for female migrants, which may be determined by a better health status at the time of migration for men than for women. Accordingly, the fact that immigrant men with Spanish nationality and with a mixed-race partner have a lower risk of premature cancer mortality than other immigrants and natives may be because these aspects are positively selected for.

Conclusions

Our study has several strengths. First, our study's data allowed us to analyze premature cancer mortality, which is currently an understudied phenomenon in investigations of the health advantages of immigrant populations, despite being the main cause of premature

deaths in highly developed countries. Second, we obtained empirical evidence supporting the healthy immigrant hypothesis in the Spanish context of recent immigrants with the heterogeneity of origin and reasons for migration. Moreover, we found that immigrants from Latin American and the Caribbean had the most decreased risk of premature mortality due to cancer, in agreement with studies on Hispanics in the United States. Third, the covariates incorporated into the models allowed us to assess the effects of socioeconomic status and age at the time of immigration, so we could test the convergence hypothesis. Future lines of research should delve more deeply into immigrants' life trajectories linked to age at arrival in a destination country and the labor trajectories that mark the processes of integration and exposure to health risks.

This study has some limitations. First, our sample size was limited (10% of the 2011 Spanish census and mortality data by cause), which prevented us from fully analyzing the extent of heterogeneity based on immigrants' region of origin (e.g. analyzing individual countries of origin versus the assigned grouping by large regions); moreover, we could not independently study the different types of tumors result in differing levels of mortality. Second, the death registry dataset lacks potentially relevant data on health-related habits and behaviors; thus, we could not control for the effects of exposure to potentially important cancer risk factors.

This study provided novel evidence on the 'healthy immigrant paradox' with respect to immigrants in Spain. First, some immigrant groups, especially Latin American men and women but also European and Maghreb men—but not other men (i.e. Asians and sub-Saharan Africans)—were found to have an advantage over natives in terms of the risk of premature cancer mortality. These results are related to the fact that migrants experience favorable selection in their country of origin and maintain healthier cultural patterns (e.g. less alcohol consumption among Maghrebis or less tobacco consumption among Latin Americans). In addition, there is some convergence or 'unhealthy' integration in the host country among men, which explains that this advantage over natives is lost as the length of stay in Spain increases. Our findings also demonstrate that this health advantage of immigrants over natives is not affected by immigrants' lower levels of education or lower social class than natives.

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Conflicts of interest: None declared.

Data availability

Data supporting the results of this study are available to the public under request and provided by the Spanish Statistical Office (INE) and computing code is available upon request to the corresponding author.

Key points

- In premature cancer mortality in Spain, there is evidence of the existence of the ‘paradox of the healthy immigrant’, especially among Latin American migrants.
- The process of unhealthy integration in the host country of the immigrant population, assuming risk behaviors, reduces the differences between native and immigrant men in premature mortality from cancer.
- With regard to the social determinants of health associated with labor market segmentation, evidence is provided in favor of the selectivity hypothesis.

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