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Research Article

Adult mortality among second-generation immigrants in France: Results from a nationally representative record linkage study

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Abstract

BACKGROUND
France has a large population of second-generation immigrants (i.e., native-born children of immigrants) who are known to experience important socioeconomic disparities by country of origin. The extent to which they also experience disparities in mortality, however, has not been previously examined.

METHODS
We used a nationally representative sample of individuals 18 to 64 years old in 1999 with mortality follow-up via linked death records until 2010. We compared mortality levels for second-generation immigrants with their first-generation counterparts and with the reference (neither first- nor second-generation) population using mortality hazard ratios as well as probabilities of dying between age 18 and 65. We also adjusted hazard ratios using educational attainment reported at baseline.

RESULTS
We found a large amount of excess mortality among second-generation males of North African origin compared to the reference population with no migrant background. This excess mortality was not present among second-generation males of southern European origin, for whom we instead found a mortality advantage, nor among North African–origin males of the first-generation. This excess mortality remained large and significant after adjusting for educational attainment.

CONTRIBUTION
In these first estimates of mortality among second-generation immigrants in France, males of North African origin stood out as a subgroup experiencing a large amount of excess mortality. This finding adds a public health dimension to the various

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disadvantages already documented for this subgroup. Overall, our results highlight the importance of second-generation status as a significant and previously unknown source of health disparity in France.

1. Introduction

The native-born children of immigrants, also called second-generation immigrants, constitute a growing and increasingly diverse population in many countries of the European Union. In the EU as a whole, the population of second-generation immigrants with at least one foreign-born parent increased by 21.0% between 2008 and 2014, with larger increases (33.4%) for those of non-EU origin (Agafiţei and Ivan 2017). In proportionate terms, second-generation immigrants represented 6.0% of the total EU population in 2014, up from 5.2% in 2008 (Agafiţei and Ivan 2017). Although research is sparse, second-generation status has been identified in previous studies as an important source of health disparities in EU countries, with important disadvantages in mortality outcomes for certain second-generation subgroups, especially those of non-EU origin (Harding and Balarajan 1996; Razum et al. 1998; Tarnutzer, Bopp, and Grp 2012; Scott and Timæus 2013; De Grande et al. 2014; Manhica et al. 2015; Vandenheede et al. 2015; Wallace 2016; Jervelund et al. 2017).

Explanations for these mortality disadvantages include lower socioeconomic status, detrimental health behaviors, and chronic stress arising from perceived discrimination (Scott and Timæus 2013; De Grande et al. 2014; Manhica et al. 2015; Vandenheede et al. 2015; Wallace 2016; Jervelund et al. 2017). These patterns of excess mortality contrast with the situation of immigrants per se (i.e., the first generation) who tend to experience a mortality advantage despite lower socioeconomic status, a well-known paradox explained in part by migration selection effects (also referred to as the “healthy migrant effect”) (Razum et al. 1998; Palloni and Morenoff 2001; Bourbeau 2002; Khlat and Darmon 2003; Crimmins et al. 2005; Gushulak 2007; Riosmena, Wong, and Palloni 2013; Vang et al. 2017).

Among EU countries with populations greater than 1 million, France is the country with the largest second-generation population in both absolute and relative terms. In 2014, France’s population of second-generation immigrants with a least one foreign-born parent reached 9.5 million, representing 14.3% of the total population (Agafiţei and Ivan 2017). This high proportion is the product of France’s specific immigration history. Although not considered a ‘classic’ country of immigration, France stands out in Europe as the oldest country of immigration and the one that has received the largest cumulative number of immigrants. The earlier migration flows to France involved primarily immigrants from European countries (Italy, Spain, Portugal, Belgium, and Poland), followed after 1945 by large waves of 'colonial' migrants (mostly from North Africa). Despite a decrease in labor migration after 1973, immigration to France continued, mostly via family reunification, and the diversity of immigrants continued to increase, with larger proportions of immigrants from sub-Saharan Africa and Asia. This immigration history has generated a second-generation population that, today, is both large and diverse. The regions of origin most represented among second-generation immigrants are southern Europe (Portugal, Italy, or Spain) and North Africa (Algeria, Morocco, or Tunisia), which each region totaling about one-third. The last third comprises a very diverse set of parental countries of origin, including countries in sub-Saharan Africa, Europe, and Asia.

Previous studies have shown that in France, second-generation immigrants of non-EU origin, particularly those of North African origin, experience systematic disadvantages in important areas such as educational attainment, employment, and income (Silberman and Fournier 1999; Canaméro, Canceill, and Cloarec 2000; Meurs, Pailhé, and Simon 2006; INSEE 2012; Brinbaum, Primon, and Meurs 2016). The extent to which they also experience disadvantages in the area of mortality, however, has not been previously examined. This is a significant gap given the size of the second-generation population in France and the importance of documenting health disparities for informing evidence-based public health policies.

In this paper, we take advantage of a unique data source to estimate mortality by second-generation status in France. We focus on adults ages 18 to 64 and on the two main regions of origin of second-generation immigrants in the French context: southern Europe (Italy, Spain, and Portugal) and North Africa (Algeria, Morocco, and Tunisia). We compare adult mortality levels for second-generation immigrants with their first-generation counterparts and with the reference (neither first- nor second-generation) population. We also examine whether mortality differentials for second-generation adults remain after adjusting for educational attainment. To our knowledge, this is the first time that adult mortality patterns among second-generation immigrants in France are examined.

2. Methods

2.1 Data sources

The identification of second-generation immigrants in statistical sources is notoriously difficult as it requires information on parental place of birth, a variable that is rarely collected in surveys. In France, difficulties are compounded by the fact that a significant portion of the North Africa–born population is made up of 'repatriates' – a group of mostly European-origin individuals who were born in Algeria during the colonial period and relocated to France following Algeria's independence in 1962 – rather than immigrants per se. This makes parental place of birth an insufficient variable for identifying second-generation immigrants of North African origin. Moreover, the French constitution prohibits the collection of information on ethnicity in official statistical sources, leaving few options for identifying second-generation immigrants, particularly those of North African origin (Simon 2015).

Nonetheless, we identified one data source that provides solutions to these identification issues while also containing mortality information. This source, called *Echantillon Longitudinal de Mortalité* (ELM; Longitudinal Mortality Sample), combines a baseline survey of the adult population living in France in 1999 with linked death records through 2010. The baseline 1999 survey, called *Etude de l'Histoire Familiale* (EHF; Family History Survey), is a random sample of approximately 380,000 individuals ages 18 and older who, as part of the 1999 census in France, were requested to fill in an additional questionnaire documenting their family history, including parental place of birth and languages used by parents to speak with the respondent when the respondent was age 5. The EHF information for these individuals was then matched, using identifying information on the respondent's name, date, and place of birth, with France's National Directory for the Identification of Natural Persons (RNIPP), an exhaustive population register that tracks identification information as well as civil status information of all residents of France. Survival status information (dead vs. alive) at the end of the observation period (15 April 2010), as well as the date of death for those who died during the observation period, was provided for the EHF individuals who were matched with the RNIPP. Information on causes of death was not included. The ELM did not track international out-migrations; individuals who were matched with the RNIPP but left France permanently during the period of observation thus appear in the ELM sample as 'alive' in 2010.

2.2 Study parameters

We focus on the two main regions of origin of immigrants and their native-born children in France: southern Europe (Italy, Portugal, and Spain) and North Africa (Algeria, Morocco, and Tunisia). First-generation (G1) immigrants were defined as individuals born abroad, and second-generation (G2) immigrants were defined as individuals born in France to two parents born abroad. We also identified individuals born in France to one parent born in France and one parent born abroad, called 'mixed second generation' (G2m). The reference population were those respondents born in

France to two parents born in France. For individuals born in North Africa or born in France to two parents born in North Africa, we took one extra step to better identify North African–origin immigrants and their native-born children as opposed to repatriates and their native-born children. Those reporting that at least one parent spoke to them in Arabic or Berber, alone or in combination with other languages, when they were age 5, or those reporting that their parents spoke to them exclusively in French but were either foreign nationals or naturalized French nationals at the time of the 1999 survey, were identified as North African–origin G1 or G2 immigrants. Individuals who were born in North Africa or born in France to two parents born in North Africa who did not meet these criteria were considered G1 or G2 repatriates and were removed from the analysis. This approach is based on the observation that the vast majority (about 80%) of repatriates were of European descent (Moumen 2010) and were unlikely to have had parents that spoke to them in Arabic or Berber when they were age 5. France-born children of repatriates were thus also unlikely to have had parents that spoke to them in Arabic or Berber when they were age 5. Conversely, immigrants from North Africa and their France-born children were unlikely to have had parents that spoke to them only in French when they were age 5 (Condon and Régnard 2016). Our use of nationality information is based on the fact that repatriates and children of repatriates had by definition a French nationality at birth. The categories 'foreign' or 'French by acquisition' in the ELM are thus markers of G1 or G2 immigrant status even for those who report that their parents spoke to them only in French. This approach combining language and nationality information is consistent with previous attempts to identify the North African–origin population in France using the EHF data (Tribalat 2004). (See Appendix Section 6 for further details about this approach and a sensitivity analysis.)

In addition to first- and second-generation status, the main sociodemographic characteristic included in this study was educational attainment, measured at baseline in 1999. We used categories following the International Standard Classification of Education (ISCED): 'primary' (less than primary and primary); 'secondary' (secondary 1^{st} and 2^{nd} cycle); and 'tertiary' (post-secondary to pre-university and beyond). Although the ELM included additional socioeconomic background variables, they were all measured at baseline in 1999. Neither retrospective nor prospective measures of socioeconomic status were available. Given these data constraints, we decided to focus on educational attainment as it is the most permanent variable of socioeconomic status and is less subject to reverse causation than variables such as employment status or occupation (Elo 2009).

Our analysis focused on individuals 18 to 64 years old at baseline. The upper age limit was chosen because there were few G2 immigrants above that age in the EHF in 1999, due to the timing of immigration to France from southern Europe and, particularly, North Africa. Substantively, this upper age truncation allowed us to focus on mortality among adults of working ages (18 to 64), a specific age segment associated with the concept of premature mortality.

The overall response rate in the EHF was 79.4%. Among individuals ages 18 to 64 in the EHF, 11.4% had missing information on variables necessary for subgroup attribution (place of birth, parental place of birth, languages, and/or nationality at birth); they were excluded as their first- or second-generation status could not be ascertained. Among those for whom the population subgroup was known, 18.9% could not be matched with the RNIPP and were excluded from the study, as their vital status in 2010 could not be determined. Within the final sample, 2.3% of the individuals had missing information for educational attainment and were assigned to a separate 'missing' education category in our models adjusting for educational attainment. (See Appendix Sections 1–3 for more details on missing data and a sensitivity analysis.)

2.3 Mortality estimation

We estimated mortality at ages 18 to 64 separately for males and females using a hazard model with age as the duration variable, assuming a Gompertz baseline hazard for the reference population and proportional hazards for our subgroups of interest (G1, G2, and G2m by region of origin). Individuals who reached age 65 prior to the end of the observation period and those whose survival status was 'alive' at the end of the observation period were right censored. We converted model parameters into expected probabilities of dying between age 18 and 65 ($q_{18–65}$) for each subgroup of interest using standard life table equations (Preston, Heuveline, and Guillot 2001). We also estimated adjusted hazard ratios for our subgroups of interest, using educational attainment as a covariate.

3. Results

Table 1 presents sample sizes at baseline for each subgroup of interest and corresponding deaths occurring prior to age 65 during the observation period. Table 1 also shows how each subgroup is distributed according to background characteristics. Within the age range 18 to 64, G2 subgroups were younger than G1 subgroups for both southern European– and North African–origin individuals. Also, North African–origin subgroups were younger than southern European–origin ones for both G1 and G2, which is expected given that migration flows from North Africa have been more recent than those from southern Europe. G1 southern European–origin males and females tended to be less educated than the reference population. Levels of education for southern European–origin G2 were higher than for their G1 counterparts but still lower than for the reference population. G2 North African–origin males and females had generally lower levels of educational attainment than both their southern European counterparts and the reference population.

Table 2 shows mortality hazard ratios (HR, with 95% CI) for subgroups of interest, based on our Gompertz hazard model. (See Appendix Tables A-1 and A-2 for an unabridged version of this table.) The unadjusted HRs compare each subgroup with the reference population of individuals born in France to two parents born in France. For ease of interpretation, we show in Figure 1 the corresponding probabilities of dying between age 18 and 65 ($q_{18\text{-}65}$), with 95% confidence intervals.

Table 1: Baseline characteristics of first- and second-generation immigrant subgroups by region of origin in the Echantillon Longitudinal de Mortalité (ELM)

Males	**Ref**	**Southern European origin**			**North African origin**		
		G1	**G2**	**G2m**	**G1**	**G2**	**G2m**
Population							
N 18–64	74,096	1,788	1,715	2,144	1,640	763	1,810
Deaths 18–64	2,897	64	36	69	55	22	38
Age (%)							
18–24	12.9	2.5	15.9	14.2	8.5	43.8	29.2
25–34	23.7	14.3	31.1	23.7	22.7	36.2	41.3
35–44	24.8	26.2	23.0	23.0	25.2	16.5	17.2
45–54	23.2	27.9	16.9	24.2	23.4	2.6	9.0
55–64	15.4	29.1	13.2	14.9	20.2	0.9	3.3
ISCED education level							
18–34 (%)							
Primary	10.7	36.5	14.8	12.1	23.1	23.2	11.3
Secondary	63.8	51.4	67.6	70.2	54.2	64.1	58.3
Tertiary	25.6	12.1	17.6	17.7	22.7	12.7	30.4
35–44 (%)							
Primary	16.3	39.3	20.6	21.7	25.4	25.2	15.9
Secondary	63.9	51.0	63.5	60.3	41.6	52.9	60.9
Tertiary	19.9	9.7	15.9	18.0	33.0	21.9	23.2
45–64 (%)							
Primary	29.6	68.3	33.1	32.9	62.0	36.0	22.7
Secondary	53.3	27.2	54.1	54.4	27.8	52.0	54.6
Tertiary	17.1	4.5	12.9	12.8	10.2	12.0	22.7

Table 1: (Continued)

Females	Ref	Southern European–origin			North African–origin		
		G1	G2	G2m	G1	G2	G2m
Population							
N 18–64	101,620	2,094	2,408	3,057	1,594	1,045	2,635
Deaths 18–64	1,630	24	22	45	30	7	27
Age (%)							
18–24	14.1	3.0	16.1	15.8	14.6	45.6	32.2
25–34	25.2	15.4	35.2	24.8	25.2	38.7	40.6
35–44	24.7	28.6	22.6	24.8	29.1	13.4	17.3
45–54	21.4	28.2	13.3	21.2	19.2	2.1	7.4
55–64	14.6	24.8	12.9	13.4	12.0	0.3	2.5
ISCED education level							
18–34 (%)							
Primary	9.4	26.5	12.2	11.6	26.8	16.5	11.6
Secondary	58.2	52.3	63.3	59.6	52.3	65.4	59.6
Tertiary	32.4	21.2	24.5	28.8	20.9	18.1	28.8
35–44 (%)							
Primary	17.7	44.8	18.8	19.4	48.4	21.4	14.2
Secondary	58.6	44.8	65.1	52.6	35.6	61.8	56.4
Tertiary	23.7	10.4	16.1	28.1	16.0	16.8	29.4
45–64 (%)							
Primary	40.0	76.3	47.3	37.5	67.8	54.6	28.6
Secondary	46.2	19.4	46.3	50.3	23.2	31.8	49.6
Tertiary	13.9	4.4	6.5	12.1	9.0	13.6	21.8

Note: Ref = individuals born in France to two parents born in France. G1 = first generation. G2 = second generation. G2m = mixed second generation. The education level distributions show percentages among individuals with a non-missing education.

For males (Figure 1, panel a), the estimated level of $q_{18–65}$ for the reference population was 162 per 1,000, a level comparable to results from official vital registration data for a similar period. (See Appendix Section 5 for the details of this comparison.) Results for G1 and G2 subgroups have wide confidence intervals due to small sample sizes. Nonetheless, we observe a strong contrast between generational trajectories for southern European– vs. North African–origin males. For the first generation, we observe low mortality relative to the reference population for both southern European– and North African–origin immigrants, though only marginally significant for North African–origin immigrants. This is consistent with the well-known observation, including in France (Khlat and Courbage 1996; Boulogne et al. 2012), that first-generation immigrants typically experience a mortality advantage. For the second generation, however, a strong contrast appears between southern European– vs. North African–origin individuals. For southern European–origin G2 males, we find a mortality advantage similar to what was observed for their G1 counterparts, with an estimated $q_{18–65}$ level of about 106 per 1,000. For North African–origin G2 males, however, we observe a large amount of excess mortality, with an estimated $q_{18–65}$ level of about 276 per 1,000, which is 1.70 times larger than for the reference population. (As shown in Table 2, this corresponds to a HR of 1.83, with a 95% CI of 1.20 to 2.79.) G2m subgroups have mortality levels closer to the reference population, with differences that are not statistically significant.

Table 2: Mortality hazard ratios (ages 18–64) for first- and second-generation immigrant subgroups by region of origin, France, 1999–2010

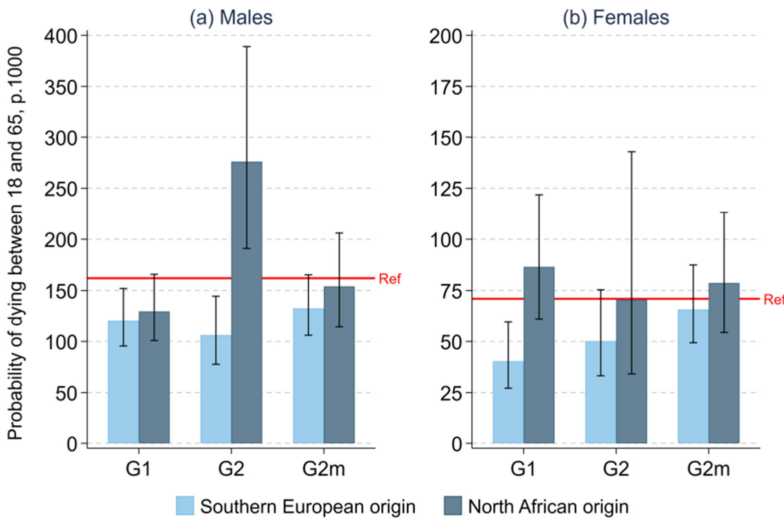
	Males				**Females**			
	Unadjusted HR[1] (95% CI)		**Adjusted HR[2] (95% CI)**		**Unadjusted HR[1] (95% CI)**		**Adjusted HR[2] (95% CI)**	
Reference population	1		1		1		1	
G1 southern European origin	0.73*	(0.57–0.93)	0.61**	(0.47–0.78)	0.56**	(0.37–0.84)	0.49**	(0.33–0.73)
G1 North African origin	0.79	(0.60–1.03)	0.69**	(0.53–0.90)	1.23	(0.85–1.76)	1.08	(0.75–1.56)
G2 southern European origin	0.64**	(0.46–0.88)	0.62**	(0.44–0.86)	0.70	(0.46–1.06)	0.67	(0.44–1.02)
G2 North African origin	1.83**	(1.20–2.79)	1.68*	(1.10–2.56)	0.99	(0.47–2.09)	0.93	(0.44–1.95)
G2m southern European origin	0.81	(0.63–1.02)	0.78*	(0.61–0.99)	0.92	(0.69–1.24)	0.91	(0.68–1.23)
G2m North African origin	0.95	(0.69–1.31)	0.98	(0.71–1.35)	1.11	(0.76–1.63)	1.14	(0.78–1.67)

Note: HR = hazard ratio. CI = confidence interval. *p<0.05. **p<0.01. [1]without adjustment for educational attainment. [2]with adjustment for educational attainment, using ISCED categories. Reference population = individuals born in France to two parents born in France. G1 = first generation. G2 = second generation. G2m = mixed second generation. Models are estimated including residual G1/G2/G2m 'other regions of origin' categories. See Table A-1 for an unabridged version of the models' results.
Source: Echantillon Longitudinal de Mortalité (ELM).

Panel b of Figure 1 shows results for females. Confidence intervals are relatively wider than for males, in part because of small numbers of deaths arising from the combination of small sample sizes and lower overall mortality levels for females vs. males. The only subgroup for which we observe a statistically significant difference with the reference population is southern European–origin G1 females, who experience a mortality advantage similar to their male counterparts.

Table 2 also shows how hazard ratios for the different population subgroups change once we adjust for educational attainment. Results for G2 males show that the hazard ratio for those of North African origin decreases somewhat, from 1.83 to 1.68, but remains significant with a 95% confidence interval of 1.10 to 2.56. This suggests that the excess mortality for this subgroup does not simply reflect educational differences. G2 southern European–origin males preserve their mortality advantage once adjusting for education. Results for G2 females remain insignificant after adjusting for education.

Figure 1: Probability of dying between ages 18 and 65 ($q_{18–65}$) for first- and second-generation immigrant subgroups by region of origin, France, 1999–2010



Note: Legend: G1 = first generation; G2 = second generation; G2m = mixed second generation; Ref = reference population (individuals born in France to two parents born in France).
Source: Echantillon Longitudinal de Mortalité (ELM).

4. Discussion

Among large EU countries, France stands out as the country with the largest population of second-generation immigrants. Our study documents the existence of a large amount of health disparity by second-generation status in the French context. Specifically, we found a large amount of excess mortality at adult ages among second-generation males of North African origin for the period 1999–2010. This excess mortality is particularly striking for several reasons: it has a large magnitude; it is not present among second-generation males of southern European origin, the other major second-generation subgroup in France, for whom we instead found a mortality advantage; it is not present among North African–origin males of the first generation; and it remains large and significant after taking differences in educational attainment into account. This excess mortality appears to be present only among males; we detect no significant excess among second-generation North African–origin females or indeed in the mixed-second-generation subgroups. To our knowledge, our study is the first one to document these mortality disparities in the French context.

What could explain the excess mortality among second-generation North African–origin males? Differential access to health care is unlikely to be an important explanation, as studies have shown no difference in health care utilization between second-generation immigrants and the reference population in France (Berchet and Jusot 2012). Lack of data on health behaviors and causes of death prevents us from evaluating other proximate determinants, including the role of smoking and alcohol. It is worth noting, however, that the sample of second-generation North African–origin males is quite young, with most individuals at less than 45 years old at the time of the survey. If we top truncate longitudinal follow-up in the sample at age 45, the hazard ratio for this subgroup increases to 2.02 and remains strongly significant (Table A-13). Given that the dominant causes of death among young adult males in a low-mortality country like France are external causes, such as motor vehicle accidents, poisoning, and suicides (Aouba et al. 2011), these causes may be key to understanding the proximate determinants of this excess mortality. The likely importance of external causes of death for this group is corroborated by a study of mortality patterns in Belgium, which found that second-generation North African–origin males had elevated risks of death from drug- and alcohol-related causes (De Grande 2015).

As for distal factors such as socioeconomic status, our model adjusting for education suggests that excess mortality for second-generation North African–origin males is not simply explained by differences in educational attainment. This pattern of excess mortality can perhaps be best understood as part of a broad set of disadvantages for this subgroup in areas including labor market outcomes and income levels (INSEE 2012; Brinbaum, Primon, and Meurs 2016). These disadvantages, which remain after taking background characteristics into account and do not occur for southern European counterparts, have been interpreted as arising in part from discriminatory practices, particularly in the labor market (Silberman and Fournier 1999; Brinbaum, Primon, and Meurs 2016). Our finding of excess mortality among second-generation North African–origin males is consistent with these conditions and raises concerns about their public health consequences in the French context. It is notable that such excess mortality is not found among North African–origin males of the first generation, even though they also experience strong socioeconomic disadvantages (Meurs, Pailhé, and Simon 2006; Brinbaum, Primon, and Meurs 2016). This paradox is well known in the literature and is most convincingly explained by the fact that for first-generation immigrants, the effect of socioeconomic disadvantage on mortality is counteracted by strong migration selection forces – the "healthy migrant effect" – acting in the other direction (Razum et al. 1998; Palloni and Morenoff 2001; Bourbeau 2002; Khlat and Darmon 2003; Crimmins et al. 2005; Gushulak 2007; Riosmena, Wong, and Palloni 2013; Vang et al.

2017). Another factor which may explain the first- vs. second-generation contrast is the fact that first-generation immigrants may retain their country of origin as a frame of reference and from that standpoint may assess their labor market outcomes more favorably than second-generation immigrants for whom the frame of reference is the host country (Heath and Li 2008). Moreover, first-generation immigrants may be more likely to accept labor market disadvantages as part of the “cost” of immigration (Anson 2004). Second-generation immigrants, by contrast, did not decide to immigrate and are likely to be less accepting of such labor market disadvantages. These psychosocial differences may generate poorer health outcomes for second-generation immigrants (Lynch et al. 2000). In the French context, studies have shown that the perception of labor market discrimination is indeed more prevalent among second-generation than first-generation immigrants of the same origin (Meurs, Lhommeau, and Okba 2016), which may translate into worse psychosocial functioning and health outcomes (Paradies 2006; Cobbinah and Lewis 2018).

Although we stress here the pattern of excess mortality among second-generation males of North African origin, we also take note of the mortality advantage we found among those of southern European origin. This new result is surprising and somewhat paradoxical given that this subgroup does not appear to be particularly favored in terms of socioeconomic factors, including education (Table 1), relative to the reference population (Beauchemin, Hamel, and Simon 2016). One possible explanation is the role of social networks. Studies have shown that, for example, second-generation immigrants of Portuguese origin have better labor market outcomes than would be expected on the basis of their educational attainment (Brinbaum, Primon, and Meurs 2016). These labor market advantages have been explained by the role of active social networks facilitating access to jobs (Lebeaux and Degenne 1991; Marry, Fournier-Mearelli, and Kieffer 1995) and could generate better health outcomes. The positive role of social support has also been raised to explain favorable labor and health outcomes among the children of Spanish and Italian immigrants in Switzerland (Bolzman, Fibbi, and Vial 2003; Zufferey 2016). Overall, our results highlight the importance of second-generation status as a significant and previously unknown source of health disparities in France.

This study has some limitations. First, our sample sizes are relatively small. The study’s most important result – a statistically significant ($p<.01$) excess mortality among second-generation North African–origin adult males – is based on only 22 deaths in the ELM. Even though this result is consistent with other European studies (Scott and Timæus 2013; De Grande et al. 2014; Manhica et al. 2015; Vandenheede et al. 2015; Wallace 2016; Jervelund et al. 2017), our study calls for replication in the French context. However, we are not aware of any alternative source of mortality data in France with variables allowing the proper identification of second-generation immigrants. This current lack of alternative sources makes our results all the more significant, but it also highlights the need for new data collection efforts in France in this area of research. Second, a sizeable proportion (18.9%) of individuals in the sample could not have their vital status ascertained and were thus excluded from the study. To understand the impact of this exclusion on our results, we estimated the effect of background characteristics on the probability of being unmatched using logistic regression. We found that the probability of being unmatched was strongly associated with characteristics indicating lower socioeconomic status, including lower educational attainment and lower occupational status (Table A-8). These associations, combined with the fact that the proportions unmatched were higher among second-generation North African–origin males (24.5%) than among males in the reference population (9.1%), suggest that the high hazard ratios for the former group may in fact be conservative. (See Appendix Section 3 for more details and additional evidence.) Finally, our study lacks proper censoring of individuals who left France permanently during the follow-up period, producing a downward bias in mortality rates. This lack of censoring, however, cannot explain our finding that second-generation North African–origin males experience excess mortality because studies have shown that second-generation immigrants are somewhat more likely to out-migrate – and thus more likely to be affected by a downward bias in mortality estimates – than the reference population with no immigration background (Richard 2004). If anything, this lack of censoring generates conservative estimates of the true amount of excess mortality for this group. (See Appendix Section 4 for an illustration of this mechanism using simulations.)

Despite these limitations, our study provides the first estimates of adult mortality for second-generation immigrants in France. In its 2017 country-specific recommendations for France, the Council of the European Union pointed out that second-generation immigrants in France "face adverse employment outcomes that are not explained by differences in age, education and skills" and that they were only partially closing gaps in educational outcomes. The council recommended "action against discriminatory practices affecting the hiring of non-EU born and second-generation immigrants" (European Commission 2017). Our results for mortality show that the adverse outcomes experienced by second-generation North African–origin males in France also have an important, previously unknown public health dimension. Similar mortality patterns have been found among second-generation males of North African or Middle Eastern origin in other European countries, including Belgium and Sweden (Manhica et al. 2015; Vandenheede et al. 2015). The results for France presented here add to this literature and are particularly significant given the size of the North African–origin population in France and current concerns about the specific conditions they face, including socioeconomic disadvantage and discrimination.

Additional research is urgently needed to further document and understand the causes of these alarming mortality patterns, including the collection of larger mortality samples with variables allowing proper identification of second-generation immigrants together with information on their socioeconomic conditions, health behaviors, morbidity outcomes, and causes of death.

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Appendix

This appendix presents supplementary information for assessing the robustness of the paper's results to various data quality issues (Sections 1–5) and model specifications (Sections 6–7).

The overall conclusion of this sensitivity analysis is that despite various data quality issues inherent to the *Echantillon Longitudinal de Mortalité* (ELM), this data set appears as a reliable source for mortality estimation (Section 5). Moreover, patterns of case exclusion resulting from missing data and other issues suggest that the paper's main result is conservative, that is, that the excess mortality we find among second-generation (G2) immigrant males of North African origin likely underestimates the true amount of excess mortality for this group (Sections 3–4).

1. Response rate in the EHF

The *Etude de l'Histoire Familiale* (EHF) was conducted at the same time as the 1999 census with an average sampling rate of 1/170 for males and 1/110 for females. (Females were oversampled as they were the focus of many of the planned analyses in the EHF.) Eligible individuals were provided with the EHF questionnaire along with the usual census questionnaire. The overall response rate in the EHF (i.e., the proportion of EHF-eligible individuals who completed the census form and also answered the EHF questionnaire) was 79.4%, a response rate that is on par with other large sample surveys commonly used in this literature. An analysis of the probability of response using census variables as explanatory variables shows a lower response among individuals ages 85 and older, individuals who were unmarried, individuals born abroad, or individuals who did not report their level of education in the census (Lefèvre and Filhon 2005).

In order to address these nonresponses, post-stratification weights were provided in the EHF data set, based on the following seven variables: sex, age, education, country of birth, date of arrival in France, region of residence, and size of the place of residence. The results of our paper are based on the unweighted data, because as we show below, our final sample differs from the EHF sample since it excludes individuals for whom survival status is unknown (see Section 3 in this appendix). Nonetheless, an analysis comparing hazard ratios in unweighted vs. weighted models (Tables A-1 and A-2) shows that results for G2 subgroups are robust to the use of post-stratification weights. This suggests that nonresponses in the EHF are unlikely to be the main explanation for the paper's results.

Table A-1: Mortality hazard ratios (ages 18–64) for first- and second-generation immigrant subgroups by region of origin, France, males, 1999–2010; unweighted vs. weighted sample

Males	Model 1 *(baseline)*								Model 2 *(+ education level)*							
	Unweighted				Weighted				Unweighted				Weighted			
	Haz. ratio	SE	Sig	95% CIs	Haz. ratio	SE	Sig	95% CIs	Haz. ratio	SE	Sig	95% CIs	Haz. ratio	SE	Sig	95% CIs
Generation by region																
Reference	1				1				1				1			
G1																
North Africa	0.79	0.11	†	*0.60 - 1.03*	0.84	0.13		*0.62 - 1.14*	0.69	0.09	**	*0.53 - 0.90*	0.74	0.11	*	*0.54 - 1.00*
Southern Europe	0.73	0.09	*	*0.57 - 0.93*	0.82	0.13		*0.60 - 1.12*	0.61	0.08	**	*0.47 - 0.78*	0.67	0.11	**	*0.49 - 0.82*
Other regions	0.80	0.09	†	*0.64 - 1.00*	0.83	0.11		*0.63 - 1.09*	0.84	0.10		*0.67 - 1.06*	0.88	0.12		*0.67 - 1.15*
G2																
North Africa	1.83	0.39	**	*1.20 - 2.79*	1.75	0.43	*	*1.09 - 2.82*	1.68	0.36	*	*1.10 - 2.56*	1.60	0.36	†	*1.00 - 2.57*
Southern Europe	0.64	0.11	**	*0.46 - 0.88*	0.65	0.13	*	*0.43 - 0.97*	0.62	0.10	**	*0.44 - 0.86*	0.63	0.10	*	*0.42 - 0.84*
Other regions	1.05	0.16		*0.76 - 1.42*	1.08	0.19		*0.76 - 1.52*	1.04	0.16		*0.77 - 1.40*	1.07	0.16		*0.76 - 1.52*
G2 mixed																
North Africa	0.95	0.16		*0.69 - 1.31*	0.86	0.17		*0.58 - 1.28*	0.98	0.16		*0.71 - 1.35*	0.90	0.18		*0.60 - 1.33*
Southern Europe	0.81	0.10	†	*0.63 - 1.02*	0.97	0.14		*0.73 - 1.28*	0.78	0.10	*	*0.61 - 0.99*	0.94	0.14		*0.71 - 1.24*
Other regions	1.01	0.10		*0.83 - 1.22*	1.13	0.13		*0.91 - 1.42*	1.04	0.10		*0.87 - 1.26*	1.19	0.14		*0.85 - 1.49*
ISCED education level																
Tertiary									1				1			
Secondary					*(unadjusted)*				1.71	0.10	**	*1.53 - 1.91*	1.79	0.12	**	*1.57 - 2.04*
Primary									2.41	0.15	**	*2.14 - 2.71*	2.62	0.19	**	*2.28 - 3.02*
Missing									2.46	0.26	**	*2.00 - 3.01*	2.31	0.29	**	*1.81 - 2.96*

Notes: (1) ‘reference’ refers to individuals born in metropolitan France to two parents born in metropolitan France; (2) significance levels at ** p < 0.01, * p < 0.05, and † p< 0.10.

Table A-2: Mortality hazard ratios (ages 18–64) for first- and second-generation immigrant subgroups by region of origin, France, females, 1999–2010; unweighted vs. weighted sample

Females	Model 1 *(baseline)*								Model 2 *(+ education level)*							
	Unweighted				Weighted				Unweighted				Weighted			
	Haz. ratio	SE	Sig	95% CIs	Haz. ratio	SE	Sig	95% CIs	Haz. ratio	SE	Sig	95% CIs	Haz. ratio	SE	Sig	95% CIs
Generation by region																
Reference	1				1				1				1			
G1																
North Africa	1.23	0.23		*0.85 - 1.76*	1.29	0.27		*0.85 - 1.95*	1.08	0.20		*0.75 - 1.56*	1.15	0.25		*0.75 - 1.75*
Southern Europe	0.56	0.11	**	*0.37 - 0.84*	0.52	0.13	**	*0.33 - 0.84*	0.49	0.10	**	*0.33 - 0.73*	0.46	0.11	**	*0.29 - 0.74*
Other regions	1.05	0.14		*0.81 - 1.36*	1.00	0.15		*0.74 - 1.35*	1.09	0.15		*0.84 - 1.41*	1.02	0.16		*0.75 - 1.39*
G2																
North Africa	0.99	0.38		*0.47 - 2.09*	0.93	0.40		*0.40 - 2.16*	0.93	0.35		*0.44 - 1.95*	0.87	0.37		*0.37 - 2.02*
Southern Europe	0.70	0.15	†	*0.46 - 1.06*	0.67	0.16		*0.42 - 1.08*	0.67	0.15	†	*0.44 - 1.02*	0.65	0.15	†	*0.41 - 1.05*
Other regions	0.86	0.19		*0.56 - 1.33*	1.04	0.26		*0.64 - 1.70*	0.85	0.19		*0.55 - 1.31*	1.03	0.25		*0.63 - 1.67*
G2 mixed																
North Africa	1.11	0.22		*0.76 - 1.63*	0.89	0.19		*0.58 - 1.37*	1.14	0.22		*0.78 - 1.67*	0.92	0.20		*0.60 - 1.40*
Southern Europe	0.92	0.14		*0.69 - 1.24*	1.07	0.19		*0.76 - 1.51*	0.91	0.14		*0.68 - 1.23*	1.06	0.18		*0.76 - 1.49*
Other regions	1.33	0.15	*	*1.06 - 1.67*	1.53	0.21	**	*1.18 - 1.99*	1.34	0.15	**	*1.07 - 1.68*	1.55	0.21	**	*1.19 - 2.02*
ISCED education level																
Tertiary									1				1			
Secondary					*(unadjusted)*				1.71	0.10	**	*1.53 - 1.91*	1.79	0.12	**	*1.57 - 2.04*
Primary									2.41	0.15	**	*2.14 - 2.71*	2.62	0.19	**	*2.28 - 3.02*
Missing									2.46	0.26	**	*2.00 - 3.01*	2.31	0.29	**	*1.81 - 2.96*

Note: (1) 'reference' refers to individuals born in metropolitan France to two parents born in metropolitan France; (2) significance levels at ** p < 0.01, * p < 0.05, and † p< 0.10.

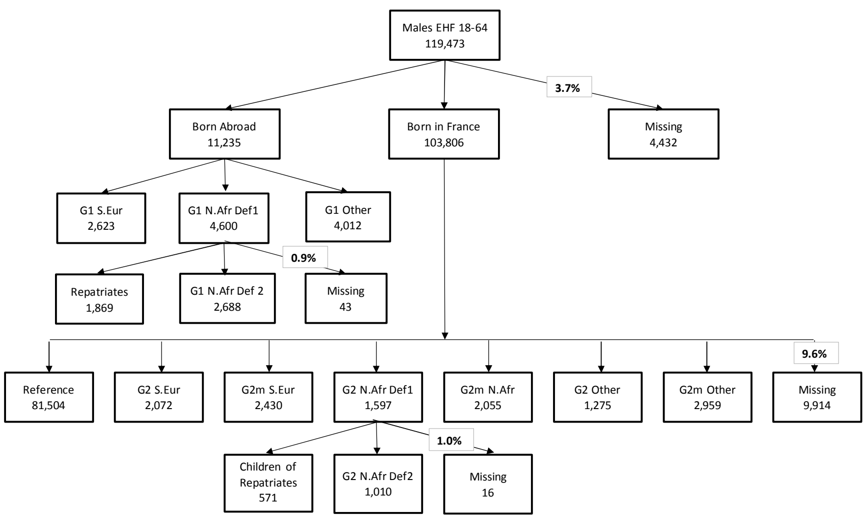
2. Missing data in the EHF sample

Our results exclude EHF individuals who could not be allocated to a specific population group due to missing values on the relevant variables (place of birth, parental place of birth, languages, and nationality at birth). Figures A-1 and A-2 show the process of subgroup attribution and the extent of missing data at each step. In these figures, the missing cases in a given box correspond to individuals who had missing values on variables needed for the attribution of categories at the same level.

Among males, a total of 14,405 individuals, or 12.1% of the total EHF sample of 119,473 individuals, had missing information on variables necessary for subgroup attribution. In terms of proportion missing among non-missing individuals in the previous level, the largest percentage is for individuals born in France who didn't report the necessary information for allocation in a specific reference or G2 category (9.6%).

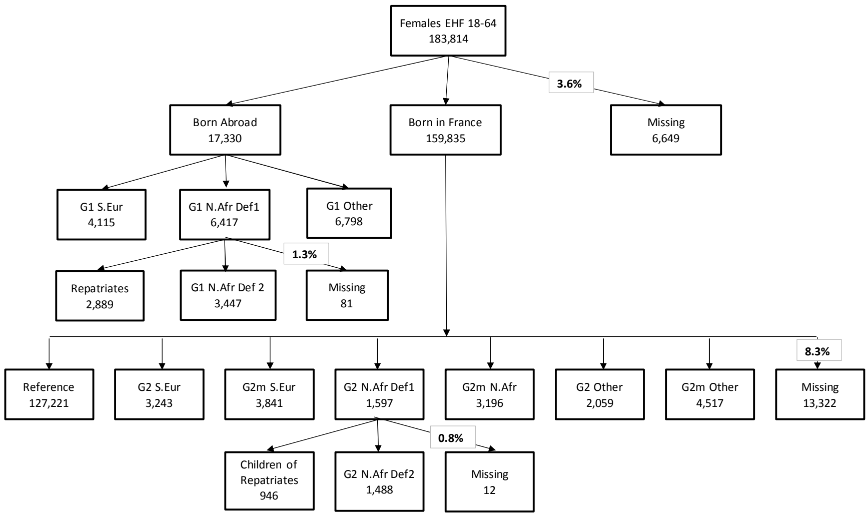
The amount of missing data was slightly lower for females. Out of a total of 183,814 females in the EHF, 20,064 (10.9%) had missing information for subgroup attribution. Among females born in France, 8.3% could not be attributed to a specific reference or G2 category.

Figure A-1: Flow chart representing how individuals in the EHF are attributed to different population subgroups, males



Note: G1 = first generation; G2 = second generation; G2m = mixed second generation. N.Afr = North African origin: S.Eur = southern European origin. G1/G2 N.Afr Def 1: first- or second-generation immigrants of North African origin, based on country of birth information only. G1/G2 N.Afr Def 2: first- or second-generation immigrants of North African origin, based on country of birth, language, and nationality information (see text for details).

Figure A-2: Flow chart representing how individuals in the EHF are attributed to different population subgroups, females



Note: See Figure A-1.

Table A-3 shows how these native-born individuals with missing information for G2 vs. reference subgroup attribution were distributed according to the type of missing information (paternal and/or maternal place of birth).

Table A-3: Distribution of native-born individuals in the EHF with missing paternal and/or maternal country of birth

Type of missing parental place of birth	Males	Females
Both parents missing	5,951	7,302
One parent France, other parent missing	3,663	5,516
One parent southern Europe, other parent missing	98	165
One parent North Africa, other parent missing	92	136
One parent other countries, other parent missing	110	203
Total	9,914	13,322

While the majority of these missing cases had missing place of birth for both parents, a large proportion of these missing cases declared one parent born in France (36.9% for males and 41.4% for females). While we cannot attribute these individuals to a specific subgroup category, we do know that they do not belong to the two main G2 categories of interest in the paper (G2 southern Europe and G2 North Africa).

However, they may or may not belong to the reference category (born in France to two parents born in France).

In order to examine the robustness of our results to this specific type of missing information (one parent France, other parent missing), we estimated our main model using two extreme scenarios: (1) a scenario in which none of these individuals belong to the reference category; (2) a scenario in which all of these individuals belong the reference category.

The first scenario is examined in a model treating native-born individuals with one parent born in France and the other parent with missing country of birth (one parent France, one unknown) as a separate category. Results from this model are shown in Table A-4. The second scenario is examined in a version of the model that includes all these individuals in the reference category. Results are shown in Table A-5.

Results show that while these G2 missing cases have higher mortality than the reference category (Table A-4), the hazard ratios for G2 subgroups of interest are robust to these different model specifications (Tables A-4 and A-5). In particular, the excess mortality among G2 North African males and the mortality advantage among G2 southern European males discussed in the paper are not affected by the choice of scenario for handling these G2 missing cases. While this robustness test does not address all the G2 missing cases, it addresses a substantial portion of them. The remaining cases with missing parental place of birth not addressed by this robustness test are 6,251 for males (6.0% of all native-born males) and 7,806 for females (4.9% of all native-born females).

Table A-4: Mortality hazard ratios (ages 18–64) for first- and second-generation immigrant subgroups by region of origin, France, 1999–2010; native-born individuals with ‘one parent France, one unknown’ (G2 missing) treated as separate category

	Model 1 *(baseline)*						**Model 2** *(+ education level)*					
	Haz. ratio	**SE**	**Sig**	**95% CIs**			**Haz. ratio**	**SE**	**Sig**	**95% CIs**		
Males												
Generation by region												
Reference	1						1					
G1												
North Africa	0.79	0.11	†	*0.60*	–	*1.03*	0.69	0.09	**	*0.53*	–	*0.90*
Southern Europe	0.73	0.10	*	*0.57*	–	*0.93*	0.61	0.08	**	*0.48*	–	*0.78*
Other regions	0.80	0.10	†	*0.64*	–	*1.00*	0.84	0.10		*0.67*	–	*1.06*
G2												
North Africa	1.82	0.39	**	*1.19*	–	*2.77*	1.67	0.36	**	*1.09*	–	*2.55*
Southern Europe	0.64	0.11	**	*0.46*	–	*0.88*	0.61	0.10	**	*0.44*	–	*0.85*
Other regions	1.05	0.16		*0.78*	–	*1.42*	1.04	0.16		*0.77*	–	*1.41*

Table A-4: (Continued)

	Model 1 *(baseline)*						**Model 2** *(+ education level)*					
	Haz. ratio	**SE**	**Sig**	**95% CIs**			**Haz. ratio**	**SE**	**Sig**	**95% CIs**		
Males												
G2 mixed												
North Africa	0.94	0.15		*0.69*	–	*1.30*	0.98	0.16		*0.71*	–	*1.35*
Southern Europe	0.81	0.10	†	*0.64*	–	*1.02*	0.78	0.09	*	*0.61*	–	*0.99*
Other regions	1.01	0.10		*0.83*	–	*1.22*	1.05	0.10		*0.87*	–	*1.26*
G2 missing												
One parent France, one unknown	1.24	0.11	**	*1.05*	–	*1.46*	1.15	0.10	†	*0.98*	–	*1.37*
ISCED education level												
Tertiary							1					
Secondary			*(unadjusted)*				1.74	0.10	**	*1.56*	–	*1.93*
Primary							2.47	0.15	**	*2.20*	–	*2.77*
Missing							2.44	0.25	**	*2.00*	–	*2.97*
Females												
Generation by region												
Reference	1						1					
G1												
North Africa	1.23	0.23		*0.85*	–	*1.76*	1.09	0.20		*0.76*	–	*1.56*
Southern Europe	0.56	0.12	**	*0.37*	–	*0.84*	0.49	0.10	**	*0.33*	–	*0.74*
Other regions	1.05	0.14		*0.81*	–	*1.36*	1.09	0.14		*0.84*	–	*1.41*
G2												
North Africa	0.99	0.38		*0.47*	–	*2.08*	0.93	0.35		*0.44*	–	*1.95*
Southern Europe	0.70	0.15	†	*0.46*	–	*1.06*	0.67	0.14	†	*0.44*	–	*1.03*
Other regions	0.86	0.19		*0.56*	–	*1.33*	0.85	0.19		*0.55*	–	*1.31*
G2 mixed												
North Africa	1.11	0.22		*0.76*	–	*1.62*	1.14	0.22		*0.78*	–	*1.67*
Southern Europe	0.91	0.14		*0.69*	–	*1.24*	0.92	0.14		*0.68*	–	*1.23*
Other regions	1.33	0.15	**	*1.06*	–	*1.67*	1.34	0.15	**	*1.07*	–	*1.68*
G2 missing												
One parent France, one unknown	1.45	0.16	**	*1.17*	–	*1.79*	1.37	0.15	**	*1.11*	–	*1.70*
ISCED education level												
Tertiary							1					
Secondary			*(unadjusted)*				1.44	0.10	**	*1.26*	–	*1.65*
Primary							1.82	0.13	**	*1.57*	–	*2.10*
Missing							2.08	0.26	**	*1.63*	–	*2.65*

Note: (1) 'reference' refers to individuals born in metropolitan France to two parents born in metropolitan France; (2) significance levels at ** p < 0.01, * p < 0.05, and † p< 0.10.

Table A-5: Mortality hazard ratios (ages 18–64) for first- and second-generation immigrant subgroups by region of origin, France, 1999–2010; native-born individuals with 'one parent France, one unknown' included in the reference category

	Model 1 *(baseline)*						**Model 2** *(+ education level)*					
Males	**Haz. ratio**	**SE**	**Sig**	**95% CIs**			**Haz. ratio**	**SE**	**Sig**	**95% CIs**		
Generation by region												
Reference	1						1					
G1												
North Africa	0.78	0.11	†	0.60	–	1.02	0.68	0.09	**	0.52	–	0.89
Southern Europe	0.72	0.10	*	0.56	–	0.93	0.60	0.08	**	0.47	–	0.77
Other regions	0.79	0.10	*	0.63	–	0.99	0.84	0.10		0.67	–	1.05
G2												
North Africa	1.80	0.39	**	1.18	–	2.74	1.66	0.36	**	1.09	–	2.53
Southern Europe	0.63	0.11	**	0.45	–	0.87	0.61	0.10	**	0.44	–	0.85
Other regions	1.04	0.16		0.77	–	1.41	1.03	0.16		0.77	–	1.40
G2 mixed												
North Africa	0.94	0.15		0.68	–	1.29	0.97	0.16		0.70	–	1.34
Southern Europe	0.80	0.10	†	0.63	–	1.01	0.77	0.09	*	0.61	–	0.98
Other regions	1.00	0.10		0.83	–	1.21	1.04	0.10		0.86	–	1.25
ISCED education level												
Tertiary							1					
Secondary			(unadjusted)				1.74	0.10	**	1.56	–	1.94
Primary							2.48	0.15	**	2.21	–	2.78
Missing							2.45	0.25	**	2.01	–	2.99
Females												
Generation by region												
Reference	1						1					
G1												
North Africa	1.21	0.22		*0.84*	–	*1.73*	1.07	0.20		*0.74*	–	*1.54*
Southern Europe	0.55	0.11	**	*0.37*	–	*0.82*	0.48	0.10	**	*0.32*	–	*0.73*
Other regions	1.03	0.14		*0.80*	–	*1.34*	1.07	0.14		*0.83*	–	*1.39*
G2												
North Africa	0.97	0.37		*0.46*	–	*2.05*	0.91	0.35		*0.43*	–	*1.92*
Southern Europe	0.69	0.15	†	*0.45*	–	*1.04*	0.66	0.14	†	*0.44*	–	*1.01*
Other regions	0.85	0.19		*0.55*	–	*1.31*	0.84	0.18		*0.55*	–	*1.29*
G2 mixed												
North Africa	1.09	0.21		*0.74*	–	*1.60*	1.12	0.22		*0.77*	–	*1.64*
Southern Europe	0.91	0.14		*0.68*	–	*1.22*	0.91	0.14		*0.67*	–	*1.21*
Other regions	1.31	0.15	**	*1.05*	–	*1.64*	1.32	0.15	**	*1.06*	–	*1.66*
ISCED education level												
Tertiary							1					
Secondary			*(unadjusted)*				1.45	0.10	**	*1.27*	–	*1.65*
Primary							1.83	0.13	**	*1.59*	–	*2.11*
Missing							2.11	0.26	**	*1.65*	–	*2.69*

Note: (1) 'reference' refers to individuals born in metropolitan France to two parents born in metropolitan France; (2) significance levels at ** p < 0.01, * p < 0.05, and † p< 0.10.

3. Missing survival status among EHF individuals

The results presented in the paper are based on the ELM data set, which includes only those EHF individuals who could be matched with the RNIPP (National Directory for the Identification of Natural Persons), as explained in the paper. Individuals who could not be matched with the RNIPP had an unknown survival status and were thus excluded from the final sample. As explained in the paper, the matching procedure was based on information on first and last names as well as date of birth.

The overall proportion of the EHF individuals who could be matched with the RNIPP is 87.3% for males and 76.3% for females. Tables A-6 and A-7 show proportions matched for each of the subgroups identified in the above flowcharts. Results for males show that the proportions matched were highest for the reference population (90.9%) and lowest for the foreign-born groups (68.2% for G1 southern Europe and 61.0% for G1 North Africa). Second-generation immigrant groups were somewhere in between, with 82.8% matched for G2 southern Europe and 75.5% for G2 North Africa. Repatriates, whether G1 or G2, had proportions matched that were close to the reference population, which is consistent with the expectation that a large majority of repatriates had French last names (vs. Arabic last names for the North African immigrants) that were likely more easily matched with the RNIPP.

Proportions matched among females were generally lower than for males, presumably because of changes in last names after marriage, making it more difficult to match female respondents with the RNIPP.

Table A-6: Counts and proportions of EHF individuals matched with the RNIPP, by population subgroup; males

Males, EHF, 18–65					
Generation by region of origin			**Total**	**Matched**	
				n	**%**
Foreign-born	G1 southern Europe		2,623	1,788	68.2
	G1 North Africa (Definition 1)	Definition 2	2,688	1,640	61.0
		Repatriates	1,869	1,637	87.6
		Missing	43	36	83.7
	G1 other		4,012	2,419	60.3
Native-born	Reference population		81,504	74,096	90.9
	G2 southern Europe		2,072	1,715	82.8
	G2 mixed southern Europe		2,430	2,144	88.2
	G2 North Africa (Definition 1)	Definition 2	1,010	763	75.5
		Repatriates	571	485	84.9
		Missing	16	12	75.0
	G2 mixed North Africa		2,055	1,810	88.1
	G2 other		1,275	1,017	79.8
	G2 mixed other		2,959	2,619	88.5
	One parent born in France, other parent missing		3,641	3,194	87.7
	Missing		6,273	5,210	83.1
Missing			4,432	3,722	84.0
Total			119,473	104,307	87.3

Note: G1 = first generation; G2 = second generation; G2 mixed = mixed second generation. G1/G2 North Africa Definition 1: first- or second-generation immigrants of North African origin, based on country of birth information only. G1/G2 North Africa Definition 2: first- or second-generation immigrants of North African origin, based on country of birth, language, and nationality information (see text for details).

Table A-7: Counts and proportions of EHF individuals matched with the RNIPP, by population subgroup; females

Females, EHF, 18–65					
Generation by region of origin			**Total**	**Matched**	
				n	**%**
Foreign-born	G1 southern Europe		4,115	2,094	50.9
	G1 North Africa (Definition 1)	Definition 2	3,447	1,594	46.2
		Repatriates	2,889	2,110	73.0
		Missing	81	47	58.0
	G1 other		6,798	3,566	52.5
Native-born	Reference population		127,211	101,620	79.9
	G2 southern Europe		3,243	2,408	74.3
	G2 mixed southern Europe		3,841	3,057	79.6
	G2 North Africa (Definition 1)	Definition 2	1,488	1,045	70.2
		Repatriates	946	730	77.2
		Missing	12	10	83.3
	G2 mixed North Africa		3,196	2,635	82.4
	G2 other		2,059	1,487	72.2
	G2 mixed other		4,517	3,547	78.5
	One parent born in France, other parent missing		5,478	4,149	75.7
	Missing		7,844	5,320	67.8
Missing			6,649	4,921	74.0
Total			183,814	140,340	76.3

Note: See Table A-6.

In our analysis, all the individuals who were unmatched with the RNIPP were removed from the analysis as their survival status could not be ascertained. In order to assess the impact of these matching failures on our mortality estimates, we examined which background variables were associated with the probability of being unmatched using multivariate logistic regression. Results (Table A-8) confirm the matching patterns by population subgroup observed in Tables A-6 and A-7. Additionally, they show that individuals with lower education or who were unemployed were more likely to be unmatched. Being married was associated with a higher likelihood of being unmatched for females but not for males, which is consistent with the expectation that changes in last name make matching more problematic. Overall, Table A-8 suggests an overall downward bias in mortality estimates in the ELM due to selective exclusion of individuals from lower SES categories. Given the lower proportions matched among G2 North Africa by comparison with the reference category, the downward bias is likely to be larger for this group, suggesting that the excess mortality we find among G2 North African–origin males underestimates the true amount of excess mortality for this group.

Table A-8: Logistic regression for the probability of being unmatched with the RNIPP, EHF 1999

	Males						Females					
	HR	S.E.	Sig	95% CIs			HR	S.E.	Sig	95% CIs		
Generation by region of origin												
Ref	**1**						**1**					
G2												
North Africa	2.97	0.23	**	2.56	–	3.46	2.62	0.16	**	2.34	–	2.96
Southern Europe	1.82	0.12	**	1.61	–	2.06	1.46	0.06	**	1.34	–	1.59
Other	2.03	0.16	**	1.74	–	2.36	1.48	0.08	**	1.33	–	1.64
G2 mixed												
North Africa	1.27	0.09	**	1.10	–	1.46	1.19	0.06	**	1.08	–	1.32
Southern Europe	1.18	0.08	**	1.04	–	1.35	1.05	0.04		0.97	–	1.14
Other	1.17	0.07	**	1.04	–	1.32	1.08	0.04	*	1.00	–	1.16
G1												
North Africa	5.55	0.24	**	5.10	–	6.04	4.01	0.15	**	3.73	–	4.31
Southern Europe	4.10	0.18	**	3.76	–	4.48	3.07	0.10	**	2.88	–	3.28
Other	6.17	0.22	**	5.76	–	6.62	3.56	0.09	**	3.38	–	3.75
Age												
18–24	**1**						**1**					
25–29	1.14	0.05	**	1.04	–	1.25	1.17	0.04	**	1.09	–	1.26
30–34	1.18	0.06	**	1.07	–	1.29	1.18	0.04	**	1.10	–	1.26
35–39	1.16	0.06	**	1.06	–	1.28	1.29	0.05	**	1.20	–	1.39
40–44	1.21	0.06	**	1.10	–	1.34	1.47	0.05	**	1.37	–	1.58
45–49	1.29	0.06	**	1.17	–	1.43	1.62	0.06	**	1.52	–	1.75
50–54	1.30	0.07	**	1.18	–	1.44	1.66	0.06	**	1.54	–	1.78
55–59	1.28	0.07	**	1.15	–	1.44	1.57	0.06	**	1.45	–	1.70
60–64	1.22	0.09	**	1.05	–	1.41	1.46	0.06	**	1.34	–	1.59
ISCED education level												
Tertiary	**1**						**1**					
Secondary	1.12	0.03	**	1.06	–	1.18	1.09	0.02	**	1.05	–	1.12
Primary	1.40	0.05	**	1.31	–	1.49	1.35	0.03	**	1.30	–	1.41
Missing	2.22	0.11	**	2.01	–	2.45	2.45	0.08	**	2.30	–	2.62
Marital status												
Single	**1**						**1**					
Married	0.86	0.05	**	1.31	–	0.90	2.14	0.04	**	2.06	–	2.23
Widowed	1.00	0.03		1.06	–	1.26	2.96	0.11	**	2.75	–	3.18
Divorced	0.95	0.11		2.01	–	1.05	2.14	0.06	**	2.03	–	2.27
Economic activity												
Employed	**1**						**1**					
Studying	0.95	0.05		0.86	–	1.06	1.08	0.05	†	1.00	–	1.17
Unemployed	1.06	0.04		0.99	–	1.13	1.07	0.02	**	1.03	–	1.13
Retired	0.89	0.05	*	0.80	–	1.00	1.09	0.03	**	1.03	–	1.16
At home, long-term sick	1.15	0.07	*	1.02	–	1.29	1.06	0.02	**	1.03	–	1.10
Missing	1.64	0.08	**	1.49	–	1.80	1.73	0.05	**	1.63	–	1.83

The conclusion that the ELM produces conservative estimates of the true amount of excess mortality for G2 North African–origin males is further supported by a comparison of education distributions for all individuals (whether matched or unmatched in the RNIPP) vs. the education distributions for matched individuals only (i.e., those on the basis of whom mortality hazard ratios are estimated). Results (Table A-9) show that for the reference population and G2 southern Europe, there is little distortion in educational distribution for the matched sample vs. the entire EHF sample. For the G2 North Africa group, however, the matched sample is substantially distorted toward higher education categories. The proportions with primary education for this group are indeed systematically lower in the matched sample than in the entire EHF sample. This further suggests that the excess mortality we find for second-generation North African–origin males underestimates the true amount of excess mortality for this group.

Table A-9: Distribution (%) of reference and second-generation immigrant subgroups by educational attainment, all EHF individuals vs. EHF individuals matched with the RNIPP

ISCED education level	Reference		G2 southern Europe		G2 North Africa	
	All	Matched	All	Matched	All	Matched
Males						
18–34						
Primary	11.0	10.7	16.2	14.8	23.6	19.1
Secondary	63.7	63.8	66.5	67.6	64.3	63.2
Tertiary	25.3	25.6	17.3	17.6	12.1	17.7
Total	100.0	100.0	100.0	100.0	100.0	100.0
35–44						
Primary	16.5	16.3	21.4	20.6	26.7	18.9
Secondary	63.8	63.9	65.0	63.5	52.0	56.8
Tertiary	19.7	19.9	13.7	15.9	21.3	24.3
Total	100.0	100.0	100.0	100.0	100.0	100.0
45–64						
Primary	30.1	29.6	33.8	33.1	52.4	35.7
Secondary	53.2	53.3	53.2	54.1	38.1	50.0
Tertiary	16.8	17.1	13.0	12.9	9.5	14.3
Total	100.0	100.0	100.0	100.0	100.0	100.0
Females						
18–34						
Primary	10.0	9.4	13.7	12.2	18.6	14.8
Secondary	58.1	58.2	63.7	63.3	64.6	62.3
Tertiary	31.9	32.4	22.7	24.5	16.9	22.9
Total	100.0	100.0	100.0	100.0	100.0	100.0

Table A-9: (Continued)

ISCED education level	Reference		G2 southern Europe		G2 North Africa	
	All	Matched	All	Matched	All	Matched
Females						
35–44						
Primary	18.8	17.7	19.5	18.8	24.1	17.8
Secondary	58.3	58.6	64.2	65.1	61.6	60.1
Tertiary	23.0	23.7	16.3	16.1	14.3	22.1
Total	100.0	100.0	100.0	100.0	100.0	100.0
45–64						
Primary	40.7	40.0	47.0	47.3	63.9	44.4
Secondary	45.5	46.2	45.9	46.3	25.0	42.6
Tertiary	13.8	13.9	7.1	6.5	11.1	13.0
Total	100.0	100.0	100.0	100.0	100.0	100.0

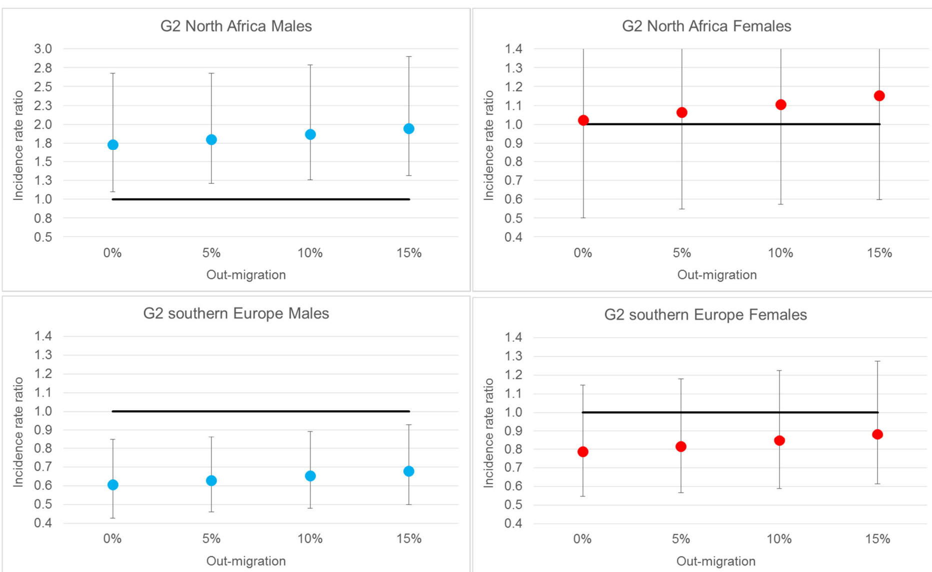
4. Impact of out-migration on mortality estimates

As explained in the text, the ELM does not contain information on international out-migrations. As a result, individuals who leave France during the follow-up period (1999–2010) erroneously remain in the risk pool, producing a downward bias in mortality rates. This is a classic bias inherent to many studies in this literature (Palloni and Arias 2004). In the paper, we explain that G2 individuals are more likely to out-migrate than individuals with no immigration background, implying that the downward bias in mortality rates will be larger for G2 individuals than for the reference population. We conclude that the excess mortality we find among G2 North African males cannot be explained by a lack of information on international out-migrations.

Here we illustrate this conclusion with simulations. These simulations were carried out using a Poisson regression framework with death and exposure terms broken down into two periods (1999–2004 and 2005–2010). We applied various rates of out-migration to our two main G2 groups (North Africa and southern Europe) and examined the impact of these out-migration scenarios on incidence rate ratios. Out-migrations were uniformly distributed during the follow-up period. For example, the scenario with a 10% out-migration rate assumes that by the end of the follow-up period, 10% of the baseline G2 population left France, generating a 2.5% decrease in exposure for the period 1999–2004 and a 7.5% decrease in exposure for the period 2005–2010. The Poisson model is then estimated with dummy variables for population subgroup, age, and time period as explanatory variables. Out-migration rates in these simulations correspond to the amount of additional out-migration that these G2 groups experience relative to the reference population. (If all groups experienced the same rates of out-migration, hazard ratios would remain unbiased.)

Results are shown in Figure A-3. In this figure, the baseline scenario with an out-migration rate of 0% produces results that correspond to those presented in the paper, which is expected given that the paper does not adjust for out-migration. (The use of a Poisson framework here produces almost identical results as the Gompertz framework used in the paper.) When out-migration is introduced, the incidence ratios systematically increase, illustrating the point made in the paper that our hazard ratios underestimate true hazard ratios whenever G2 groups experience more out-migration than the reference population. Results for G2 North African males confirm the paper's conclusion that our lack of information on out-migrations produces conservative estimates of the true hazard ratios for this population. Interestingly, our simulations also show that the mortality advantage we find among G2 southern European males is also unlikely to be explained by out-migration. Even in a scenario in which 15% of individuals at baseline leave by the end of the observation period, incidence rate ratios for this group would still remain below 1 and statistically significant. Results for females show that incidence rate ratios remain insignificant whatever the amount of assumed out-migration.

Figure A-3: Mortality incidence rate ratios (ages 18–64) for second-generation immigrant subgroups estimates using different out-migration scenarios, France, 1999–2010



A different type of mechanism that could potentially affect our mortality estimates involves selective out-migration of healthier G2 individuals prior to the baseline year of 1999. Indeed, if such selective out-migration was taking place before 1999, this would make the baseline sample in 1999 less healthy than in the absence of out-migration, potentially generating an upward bias in mortality estimates. The importance of this mechanism is difficult to assess in the absence of longitudinal follow-up since birth. However, it is unlikely that the excess mortality we observe during the follow-up period among G2 North African–origin males would be explained by this mechanism, because out-migration among this population, while higher than for the reference population, is estimated to be rather small (Richard 2004). Also, a recent study has shown that the mortality disadvantage among second-generation North African individuals is already observed at infant ages, a result that cannot be explained by left-truncation bias (Wallace, Guillot, and Khlat 2019).

5. Overall quality of the ELM for mortality estimation purposes

The previous sections examine the robustness of our mortality estimates to various sources of errors in the ELM. In this section, we examine the overall quality of the ELM data for mortality estimation purposes by comparing ELM-based adult mortality estimates with mortality estimates based on official exhaustive census and vital registration (VR) data. This unlinked data forms the basis for the calculation of official life tables in France and thus constitutes a useful comparison point for evaluating the ELM-based mortality data.

This comparison is possible for only the native-born and the foreign-born, since G2 status cannot be derived from the information available on death certificates. We were able to access VR death data by nativity for 2005–2009, a period that is not exactly the same but overlaps with the time frame of the ELM (1999–2010). Exposure terms by sex and nativity for the period 2005–2009 were derived from census information. Deaths and exposure terms were then combined to calculate age-specific mortality rates, which were then converted into probabilities of dying between age 18 and 65 using standard life table methodologies. (For more information about these sources, see Guillot et al. 2018.)

Table A-10 compares these probabilities of dying calculated on the basis of these two different data sources. Results show that despite its limitations, the ELM produces mortality estimates that are reassuringly close to those based on exhaustive official VR data. The ELM has a tendency to underestimate mortality, which is expected given the discussion of biases in the preceding sections. Nonetheless, the difference is never more than 9%. The difference is even smaller for the foreign-born population, despite the specific data limitations inherent in this population. Overall, this comparison suggests that despite its limitations, the ELM appears as a reliable source of mortality information for these population subgroups in France.

Table A-10: Comparison of ELM- vs. vital registration–based estimates of the probability of dying between age 18 and 65 ($q_{18–65}$), by sex and nativity

		1999-2010 ELM	2005-2009 VR	Difference
Males	Native-born	0.16067	0.17353	–7.4%
	Foreign-born	0.12738	0.13135	–3.0%
Females	Native-born	0.07137	0.07845	–9.0%
	Foreign-born	0.06516	0.06630	–1.7%

6. Defining the G1 and G2 North African–origin group

According to the French national statistical office, an immigrant is a person residing in France who was born abroad and had a foreign nationality at birth. Building on that definition, a second-generation immigrant is a person residing in France who was born in France and had at least one immigrant parent.

As explained in the text, we generally relied only on country of birth information for determining first- and second-generation immigrant status. The reason is that although we have information on the respondent's country of birth, nationality at birth, and parental country of birth in our data, we do not have information on parental nationality at birth, which would be necessary for determining second-generation immigrant status as officially defined. Using country of birth as the sole piece of information for identifying immigrants is an acceptable approximation for most countries of birth because the proportion of foreign-born individuals who have a French nationality at birth is negligible in most cases. In the case of North African countries, however, this approximation is problematic. Indeed a substantial share of France's North Africa–born population includes 'repatriates,' a group of individuals who were born in Algeria during the colonial period and relocated to France following Algeria's independence in 1962. Repatriates include three main categories: (1) individuals of European descent; (2) North African Jews; (3) some North African Muslims, including soldiers who fought with the French army against independence (also called 'harkis') and officials of the former colonial administration who feared for their security in post-independence Algeria. Typically these 'repatriates' are not considered immigrants in the French context because not only were they French by birth but they did not lose their French nationality after Algeria's independence (Beauchemin, Hamel, and Simon

2016). Available estimates show that among repatriates, individuals of European descent constituted by far the largest category (about 80%) (Moumen 2010).

In response to the specificity of North African countries, and in the absence of information on parental nationality at birth, we used additional variables to identify immigrants (vs. repatriates) from North Africa and their native-born children. As explained in the text, our approach uses language and nationality information for this distinction.

This approach is not perfect. In particular, it tends to classify repatriates of the third category (North African Muslims) as immigrants rather than repatriates. We believe this is not problematic for our paper because (1) North African Muslims represent a small percentage of the 'repatriates' category (about 9%); and (2) although they are not considered 'immigrants' per se due to their nationality status, they share the same ethnic background with their immigrant counterparts and are thus likely to face similar barriers to education and employment in France. Our approach also classifies second-generation immigrants from North Africa who report that their parents spoke to them only in French and who had a French nationality at birth as children of repatriates. We also believe that this will have a small impact on estimates because studies have shown that while proficiency of Arabic or Berber at adult ages among G2 North African–origin individuals is somewhat variable, exposure to these languages as children in households with two immigrant parents is very high. In the TeO survey, 86% of G2 individuals with two North African immigrant parents reported some exposure to Arabic or Berber when they were children (Condon and Régnard 2016, Annex 5). Moreover, our use of a second variable – nationality at birth – for those reporting that their parents spoke to them only in French at age 5 further alleviates concerns that some second-generation immigrants may be misclassified in our study as children of repatriates.

Figures A-1 and A-2 show that the distinction between immigrants and repatriates is not trivial demographically. Among males, 41% of respondents born in North Africa are identified in the EHF as repatriates and 36% of respondents born in France to two parents born in North Africa are identified as native-born children of repatriates. For females, the proportions are 45% and 39%, respectively.

In this section we examine the impact of making this distinction between immigrants and repatriates from North Africa on our results. First, instead of excluding repatriates from the analysis, as we do in the paper, we treated them as separate G1 and G2 categories, allowing us to examine whether repatriates and their native-born children have a distinct mortality pattern (Table A-11). Second, we estimated our model without making the distinction between immigrants and repatriates from North Africa; that is, we treated all individuals born in North Africa as first-generation immigrants from North Africa and all individuals born in France to two parents born in North Africa as second-generation immigrants from North Africa (Table A-12).

Results including repatriates as separate G1 and G2 categories (Table A-11) show that for the G2 male subgroups, there is a clear distinction between the children of immigrants per se (G2 North Africa), who as we know exhibit excess mortality, and the children of repatriates (G2 repatriates), who have mortality levels that are not statistically different from the reference population. This is expected given that for the most part children of repatriates from North Africa do not face the same barriers to education and employment as children of immigrants from North Africa per se (Beauchemin, Hamel, and Simon 2016).

Models using country of birth information only for the identification of immigrant subgroups (i.e., without making the distinction between immigrants and repatriates from North Africa) are presented in Table A-12. Results show that when repatriates and immigrants from North Africa are merged, the hazard ratio for G2 North African males decreases from 1.82 to 1.32 and loses significance. This is also expected given the more favorable mortality patterns of G2 repatriates. It illustrates the importance of going beyond parental country of birth information when examining second-generation immigrants from North Africa in the French context.

Table A-11: Mortality hazard ratios (ages 18–64) for first- and second-generation immigrant subgroups by region of origin, France, 1999–2010; G1 and G2 repatriates included as separate subgroup categories

	Model 1 *(baseline)*						**Model 2** *(+ education level)*					
	HR	**SE**	**Sig**	**95% CIs**			**HR**	**SE**	**Sig**	**95% CIs**		
Males												
Generation by region												
Reference	1						1					
G1												
North Africa	0.79	0.11	†	0.60	–	1.03	0.69	0.09	**	0.53	–	0.90
Repatriates	0.73	0.09	**	0.60	–	0.92	0.79	0.09	*	0.62	–	1.00
G2												
North Africa	1.82	0.39	**	1.20	–	2.78	1.67	0.36	**	1.10	–	2.55
Repatriates	0.75	0.27		0.38	–	1.50	0.76	0.27		0.37	–	1.51
ISCED education level												
Tertiary							1					
Secondary			(unadjusted)				1.71	0.10	**	1.53	–	1.91
Primary							2.44	0.15	**	2.17	–	2.74
Missing							2.47	0.25	**	2.02	–	3.02

Table A-11: (Continued)

	Model 1 (baseline)						Model 2 (+ education level)					
	HR	SE	Sig	95% CIs			HR	SE	Sig	95% CIs		
Females												
Generation by region												
Reference	1						1					
G1												
North Africa	1.23	0.23		0.85	–	1.76	1.09	0.20		0.76	–	1.56
Repatriates	1.00	0.15		0.75	–	1.33	1.06	0.15		0.80	–	1.41
G2												
North Africa	0.99	0.38		0.47	–	2.09	0.93	0.35		0.44	–	1.96
Repatriates	1.22	0.43		0.61	–	2.45	1.23	0.44		0.61	–	2.46
ISCED education level												
Tertiary							1					
Secondary			(unadjusted)				1.45	0.10	**	1.27	–	1.67
Primary							1.84	0.14	**	1.59	–	2.13
Missing							2.09	0.27	**	1.63	–	2.69

Note: (1) 'reference' refers to individuals born in metropolitan France to two parents born in metropolitan France; (2) significance levels at ** p < 0.01, * p < 0.05, and † p< 0.10.

Table A-12: Mortality hazard ratios (ages 18–64) for first- and second-generation immigrant subgroups by region of origin, France, 1999–2010; North Africa–origin G1 and G2 defined using country of birth information only

	Model 1 (baseline)						Model 2 (+ education level)					
	HR	SE	Sig	95% CIs			HR	SE	Sig	95% CIs		
Males												
Generation by region												
Reference	1						1					
G1												
North Africa	0.75	0.07	**	0.63	–	0.90	0.74	0.07	**	0.62	–	0.89
Southern Europe	0.73	0.09	*	0.57	–	0.94	0.61	0.08	**	0.47	–	0.78
Other regions	0.80	0.09	†	0.64	–	1.00	0.84	0.10		0.67	–	1.06
G2												
North Africa	1.32	0.24		0.92	–	1.89	1.27	0.23		0.88	–	1.81
Southern Europe	0.64	0.11	**	0.46	–	0.88	0.62	0.10	**	0.44	–	0.86
Other regions	1.05	0.16		0.78	–	1.42	1.04	0.16		0.77	–	1.40
G2 mixed												
North Africa	0.95	0.16		0.69	–	1.30	0.98	0.16		0.71	–	1.35
Southern Europe	0.81	0.10	†	0.64	–	1.02	0.78	0.09	*	0.61	–	0.99
Other regions	1.01	0.10		0.83	–	1.22	1.04	0.10		0.87	–	1.26
ISCED education level												
Tertiary							1					
Secondary			(unadjusted)				1.71	0.10	**	1.53	–	1.91
Primary							2.44	0.15	**	2.17	–	2.74
Missing							2.46	0.25	**	2.01	–	3.00

Table A-12: (Continued)

	Model 1 (baseline)						Model 2 (+ education level)					
	HR	SE	Sig	95% CIs			HR	SE	Sig	95% CIs		
Females												
Generation by region												
Reference	1						1					
G1												
North Africa	1.08	0.12		0.86	–	1.35	1.06	0.12		0.85	–	1.34
Southern Europe	0.56	0.12	**	0.37	–	0.84	0.49	0.10	**	0.32	–	0.74
Other regions	1.05	0.14		0.81	–	1.36	1.08	0.14		0.84	–	1.41
G2												
North Africa	1.10	0.29		0.66	–	1.83	1.07	0.28		0.64	–	1.78
Southern Europe	0.70	0.15	†	0.46	–	1.06	0.67	0.15	†	0.44	–	1.03
Other regions	0.86	0.19		0.56	–	1.33	0.85	0.19		0.55	–	1.31
G2 mixed												
North Africa	1.11	0.22		0.76	–	1.63	1.14	0.22		0.78	–	1.67
Southern Europe	0.92	0.14		0.69	–	1.24	0.92	0.14		0.68	–	1.23
Other regions	1.33	0.15	**	1.06	–	1.68	1.34	0.15	**	1.07	–	1.68
ISCED education level												
Tertiary							1					
Secondary			(unadjusted)				1.45	0.10	**	1.27	–	1.67
Primary							1.87	0.14	**	1.59	–	2.13
Missing							2.09	0.27	**	1.63	–	2.69

Note: (1) 'reference' refers to individuals born in metropolitan France to two parents born in metropolitan France; (2) significance levels at ** p < 0.01, * p < 0.05, and † p< 0.10.

7. Using alternative age breakdowns

The hazard ratios presented in the paper are based on mortality risks for the age range 18 to 64, summarizing mortality at working ages. In this section, we examine whether the hazard ratios for population subgroups vary depending on different age specifications in order to better target ages within the adult age range where subgroups may be particularly vulnerable or advantaged. We focus on the following age groups: 18 to 44 and 45 to 64. These two age groups are distinct epidemiologically, with a larger share of external causes in the age range 18 to 44 and a larger share of noncommunicable diseases in the age range 45 to 64. Results are presented in Table A-13 for mortality at ages 18 to 44 and in Table A-14 for mortality at ages 45 to 64.

The main lesson of this exercise is that excess mortality among second-generation North African–origin males is particularly salient in the age range 18 to 44, with a hazard ratio of 2.02, higher than when considering the entire 18 to 64 age range. No statistically significant excess mortality is detected for this population subgroup at ages 45 to 64. The reverse is true for second-generation southern European–origin males: Their advantage is salient in the age range 45 to 64 but not in the age range 18 to 44.

Results for G2 females, which were not significant in the age range 18 to 64, remain insignificant in these models with alternative age breakdowns.

Table A-13: Mortality hazard ratios (ages 18–44) for first- and second-generation immigrant subgroups by region of origin, France, 1999–2010

	Model 1 (baseline)						Model 2 (+ education level)					
	HR	SE	Sig	95% CIs			HR	SE	Sig	95% CIs		
Males												
Generation by region												
Reference	1						1					
G1												
North Africa	0.75	0.27		0.37	–	1.50	0.68	0.24		0.34	–	1.36
Southern Europe	1.02	0.34		0.53	–	1.97	0.80	0.27		0.51	–	1.54
Other regions	0.87	0.23		0.52	–	1.44	0.87	0.23		0.52	–	1.45
G2												
North Africa	2.02	0.52	**	1.23	–	3.33	1.74	0.44	*	1.06	–	2.87
Southern Europe	0.78	0.24		0.43	–	1.42	0.73	0.22		0.40	–	1.32
Other regions	0.93	0.42		0.39	–	2.25	0.90	0.40		0.37	–	2.17
G2 mixed												
North Africa	0.77	0.21		0.45	–	1.30	0.79	0.21		0.46	–	1.34
Southern Europe	0.77	0.23		0.42	–	1.39	0.73	0.22		0.40	–	1.32
Other regions	0.71	0.22		0.39	–	1.29	0.73	0.22		0.40	–	1.33
ISCED education level												
Tertiary							1					
Secondary							2.16	0.28	**	1.67	–	2.80
Primary			(unadjusted)				3.62	0.54	**	2.70	–	4.84
Missing							4.30	1.01	**	2.72	–	6.81
Females												
Generation by region												
Reference	1						1					
G1												
North Africa	1.88	0.60	†	1.00	–	3.53	1.52	0.49		0.81	–	2.88
Southern Europe	0.77	0.39		0.29	–	2.08	0.63	0.32		0.24	–	1.70
Other regions	1.47	0.36		0.91	–	2.36	1.42	0.35		0.88	–	2.29
G2												
North Africa	1.31	0.54		0.59	–	2.95	1.18	0.49		0.52	–	2.64
Southern Europe	0.87	0.31		0.43	–	1.75	0.81	0.29		0.40	–	1.64
Other regions	0.81	0.47		0.26	–	2.54	0.77	0.44		0.25	–	2.39
G2 mixed												
North Africa	1.14	0.32		0.65	–	1.98	1.18	0.34		0.68	–	2.06
Southern Europe	0.83	0.29		0.41	–	1.67	0.81	0.29		0.40	–	1.63
Other regions	1.59	0.41	†	0.96	–	2.62	1.62	0.42	†	0.99	–	2.69
ISCED education level												
Tertiary							1					
Secondary							2.18	0.31	**	1.64	–	2.89
Primary			(unadjusted)				3.35	0.57	**	2.41	–	4.67
Missing							3.72	1.08	**	2.10	–	6.58

Note: (1) 'reference' refers to individuals born in metropolitan France to two parents born in metropolitan France; (2) significance levels at ** p < 0.01, * p < 0.05, and † p< 0.10.

Table A-14: Mortality hazard ratios (ages 45–64) for first- and second-generation immigrant subgroups by region of origin, France, 1999–2010

	Model 1 (baseline)				Model 2 (+ education level)			
	HR	SE	Sig	95% CIs	HR	SE	Sig	95% CIs
Males								
Generation by region								
Reference	1				1			
G1								
North Africa	0.83	0.13		0.61 – 1.13	0.71	0.11	*	0.52 - 0.97
Southern Europe	0.69	0.10	*	0.52 – 0.93	0.58	0.09	**	0.44 - 0.78
Other regions	0.80	0.12		0.60 – 1.06	0.84	0.12		0.63 - 1.11
G2								
North Africa	1.02	0.72		0.25 – 4.06	0.97	0.69		0.25 - 3.87
Southern Europe	0.64	0.14	*	0.42 – 0.97	0.63	0.13	*	0.41 - 0.95
Other regions	1.17	0.19		0.85 – 1.62	1.17	0.19		0.84 - 1.62
G2 mixed								
North Africa	1.14	0.27		0.72 – 1.81	1.18	0.28		0.75 - 1.89
Southern Europe	0.85	0.12		0.64 – 1.12	0.82	0.12		0.62 - 1.09
Other regions	0.99	0.11		0.79 – 1.23	1.02	0.12		0.82 - 1.28
ISCED education level								
Tertiary					1			
Secondary	(unadjusted)				1.55	0.11	**	1.35 – 1.77
Primary					2.10	0.15	**	1.83 – 2.42
Missing					2.17	0.27	**	1.69 – 2.78
Females								
Generation by region								
Reference	1				1			
G1								
North Africa	1.10	0.28		0.66 – 1.84	0.97	0.25		0.58 - 1.62
Southern Europe	0.63	0.15	*	0.40 – 0.99	0.55	0.13	*	0.35 - 0.87
Other regions	0.83	0.16		0.57 – 1.22	0.85	0.17		0.58 - 1.25
G2								
North Africa								
Southern Europe	0.81	0.23		0.47 – 1.40	0.79	0.22		0.46 - 1.36
Other regions	1.00	0.24		0.62 – 1.62	0.99	0.24		0.61 - 1.60
G2 mixed								
North Africa	1.05	0.37		0.52 – 2.10	1.07	0.38		0.53 - 2.14
Southern Europe	1.01	0.19		0.70 – 1.45	1.01	0.19		0.70 - 1.45
Other regions	1.42	0.19	**	1.08 – 1.85	1.42	0.20	**	1.08 - 1.86
ISCED education level								
Tertiary					1			
Secondary	(unadjusted)				1.19	0.12	†	0.98 – 1.44
Primary					1.47	0.14	**	1.22 – 1.78
Missing					2.01	0.32	**	1.48 – 2.74

Note: (1) ‘reference’ refers to individuals born in metropolitan France to two parents born in metropolitan France; (2) significance levels at ** p < 0.01, * p < 0.05, and † p< 0.10.