



# The 2011 Italian census cohort for the study of socioeconomic inequality in mortality

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## Abbreviations

ICD-10 International Classification of Diseases, 10th Revision  
ISTAT National Institute of Statistics  
NCoDR National Cause of Death Register

## Objectives

Socioeconomic inequality in health is a long-standing and challenging public health problem (Gray 1982; Sim and Mackie 2006; Mackenbach et al. 2008).

In Europe, socioeconomic inequality in mortality has decreased due to a general overall reduction in mortality. However, there is growing evidence that relative inequality has widened due to a steeper decline among the higher social classes (Mackenbach et al. 2016). This clearly indicates that countries' response has been inadequate, and much is still to be done to ensure that the whole population adopt healthy behaviors and receive early diagnosis and effective treatment.

In Italy, clear evidence of inequality in mortality emerged from the follow-up of subjects enrolled in the Health Interview Survey, and from a series of metropolitan population cohort studies, set up in cities located in the north and in the centre of the country (Caranci et al. 2018; Sebastiani et al. 2019). However, these studies are not representative of the whole country and the limited number of events did not allow to precisely quantify inequality in

cause-specific mortality and in subgroups of the population.

Accurate quantification of the differences in health outcomes among strata of the population is definitely the first step in identifying the most vulnerable individuals that could benefit from public interventions.

Against this backdrop, in 2016, at the National Institute of Statistics (ISTAT) we conceived a cohort of all Italian residents registered in the 2011 Population and Housing Census who have been followed-up for mortality over the subsequent years.

## Subjects

The cohort consists of 59,227,313 residents registered in the 2011 Population and Housing Census and who were alive on 1 January 2012 and did not emigrate over the period elapsed between the census reference date (9 October 2011) and 1 January 2012.

In Italy, until 2011 census took place every 10 years and participation was mandatory. Questionnaires were mailed out to all the households included in municipal registers and respondents had the option of returning back them online, by mail or by delivery to municipal collection offices. The coverage of the census was high with an under coverage rate of 1.07% estimated by the Post Enumeration Survey (National Institute of Statistics 2019a).

Table 1 reports the main sociodemographic characteristics of the cohort.

The cohort was conceived within the project “IF IST-2646, Analisi delle differenze socioeconomiche nella mortalità” that was included in the National Statistical Program and approved by the Italian Data Protection Authority.

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**Table 1** Baseline sociodemographic characteristics of the cohort

Characteristics	No. (%)
Gender	
Males	28,642,791 (48.4)
Females	30,584,522 (51.6)
Citizenship	
Italian	55,221,311 (93.2)
Foreign	4,006,002 (6.8)
Age (years)	
< 1	402,710 (0.7)
1–14	7,788,575 (13.2)
15–24	5,902,701 (10)
25–44	16,300,875 (27.5)
45–64	16,403,405 (27.7)
65–84	10,723,831 (18.1)
≥ 85	1,705,216 (2.9)
Marital status	
Single	24,438,910 (41.3)
Married	27,042,852 (45.7)
Divorced/separated	3,171,045 (5.4)
Widowed	4,574,506 (7.7)
Educational attainment <sup>a</sup>	
Primary school or none	11,647,157 (25.9)
Middle school	13,151,600 (29.2)
High school	14,195,244 (31.5)
University	6,003,517 (13.3)
Employment status <sup>b</sup>	
Employed	22,978,383 (45.1)
Looking for the first employment	1,021,163 (2.0)
Unemployed	1,940,822 (3.8)
Pensioners or capital income recipients	12,565,838 (24.7)
Students	3,732,078 (7.3)
Housekeepers	5,807,085 (11.4)
Other conditions	2,865,219 (5.6)

Italy, 1 January 2012

<sup>a</sup>Data on educational attainment are shown only for individuals aged 25 years or over at census

<sup>b</sup>Data on employment status are shown only for individuals aged 15 or over at census

## Collected variables

Table 2 reports an overview of the information collected by the census.

Causes of death were obtained from the National Cause of Death Register (NCoDR) (National Institute of Statistics 2019b) that contains the information on both underlying and contributing causes of death for all the deaths occurred in Italy. The classification of causes of death and the selection of the underlying cause is performed according to

the rules and provisions included in the International Classification of Diseases, 10th Revision (ICD-10) (World Health Organization 1992).

## Follow-up

Follow-up data include migration, vital status and causes of death. The NCoDR and population register have been linked annually with the core database for each calendar year in order to track vital status and migration of all individuals of the cohort, whereas the baseline characteristics of the cohort have not been updated over the follow-up. The fiscal code, a composite alphanumeric code made up of 16 digits, was used as linkage key. It is derived from the first name, surname, sex, date and place of birth.

To minimize false-positive matching, the fiscal code reported in the NCoDR was checked for consistency with personal details before matching and, in case of inconsistency, a new fiscal code was recalculated and used for the matching.

The start of the follow-up was postponed from the reference date of the census to 1 January 2012 as in a preliminary analysis we noticed that the probability of being linked to a corresponding record of the census archive was low for the individuals who died shortly after the census date.

Figure 1 shows an overview of the cohort from baseline to the last available calendar year of follow-up.

## Strengths and weaknesses

The 2011 Italian census cohort is the largest cohort to date available to study socioeconomic inequality in mortality and this is certainly its main strength.

It also has high quality follow-up data with more than 97% of the deaths occurred in 2012–2014 linked to a corresponding record of the census (Frova et al. 2019).

The 2011 census collected a comprehensive set of variables that will enable to have a complete picture of socioeconomic inequality in mortality in our country and will provide important data for international comparisons.

In addition, we collected all contributing causes reported in the death certificate, beyond the underlying cause of death (WHO Statistical Information System 2014). This gives additional value to the cohort when studying comorbidities or when the outcome of interest is a cause of death with low probability of being selected as the underlying cause.

Finally, the detailed socioeconomic information available will certainly be useful in addressing some open research topics in epidemiology, social medicine and

**Table 2** List of variables collected and corresponding availability

Key variables	Data availability	
	All individuals	Sample of the census population <sup>a</sup>
Demographic information		
Sex	X	
Date of birth	X	
Place of birth	X	
Place of residence	X	
Citizenship	X	
Marital status	X	
Household characteristics		
Household type	X	
Number of members in the households	X	
Type of family nucleus	X	
Housing characteristics		
Type of housing unit	X	
Type of ownership	X	
Number of rooms		X
Number of occupants	X	
Surface area	X	
Type of kitchen		X
Heating system		X
Water supply system		X
Bathing facilities		X
Toilet facilities		X
Socioeconomic characteristic		
Educational attainment	X	
Employment status	X	
Occupation		X
Branch of economic activity		X
Type of contract (fixed-term/permanent)		X
Type of occupation (full time/part-time)		X
Hours worked		X
Mode of transport to work		X
Time taken to travel to work		X
Follow-up variables		
Date of death	X	
Underlying cause of death	X	
Contributing cause of death	X	
Date of migration	X	

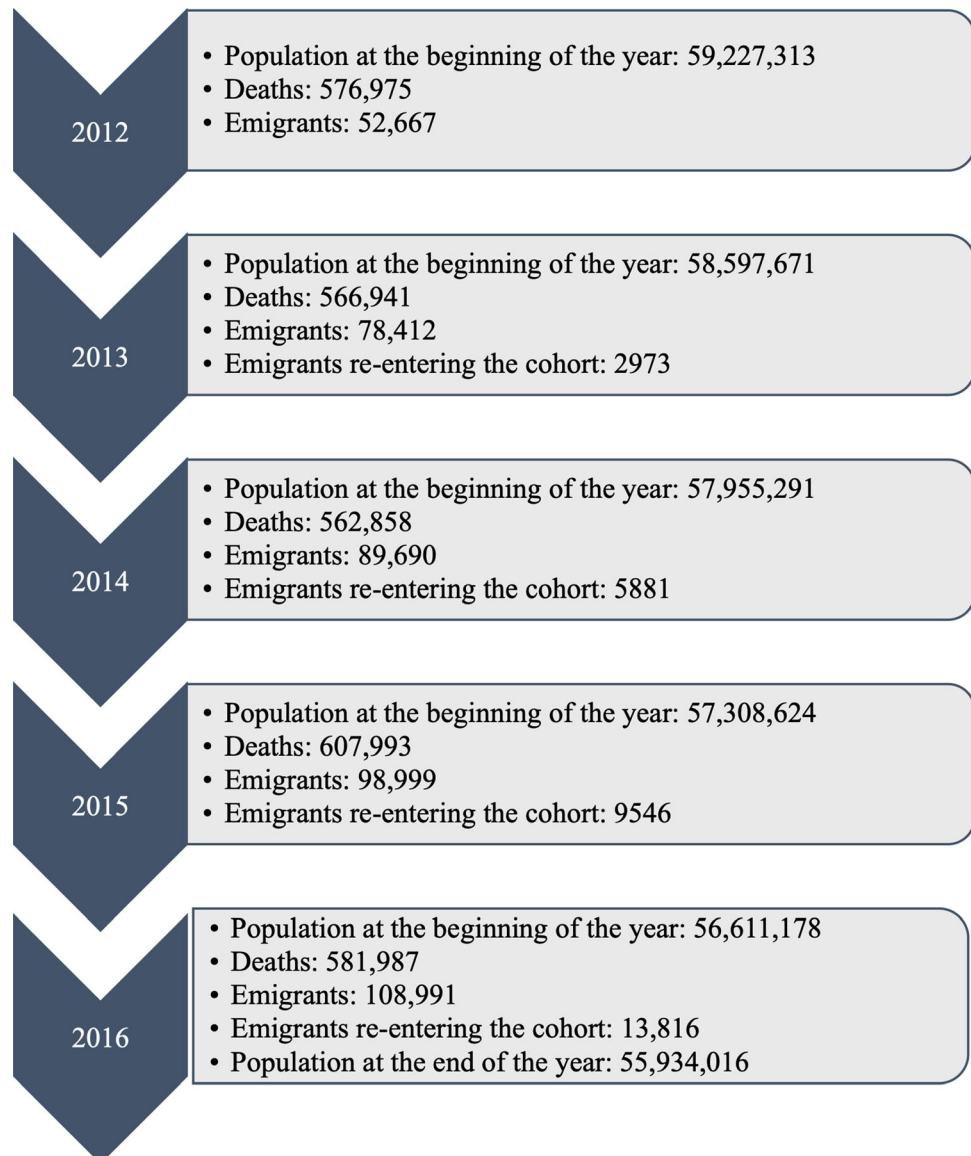
Italy, baseline variables collected on the census reference date (9 October 2011), follow-up variables collected over the period 2012–2016

<sup>a</sup>In the 2011 census, two different forms of the questionnaire were used. A long form, including a wide set of questions on socioeconomic aspects, was sent to all the households in the municipalities with less than 20,000 residents and to a sample (one-third) of the households in all municipalities with 20,000 residents or more. A short form, including a limited number of questions necessary for compliance with the EU regulations, was sent to the remaining households

public health, such as early exposure to socioeconomic disadvantage and mortality in children and adolescents, relationship between family structure and mortality in the

young, quantification of mortality attributable to occupational risks in the era of improved occupational hygiene

**Fig. 1** Overview of the 2011 Italian census cohort



and surveillance, and mortality of migrants living in our country.

The main limitations rely on the retrospective design of the original project generating the cohort that does not permit updating baseline information over the follow-up as well as the analysis of other potential exposures and confounders not collected in the census. This is an important limitation when studying the relationship between employment status, occupation and mortality (Cambois 2004).

Moreover, older individuals or more vulnerable subjects, may have had less confidence in completing the questionnaires, however, all respondents were provided with free assistance by dedicated collection centres, located in each municipality.

## Data sharing

The ISTAT which holds the database containing data on this cohort is open to collaborations with national and international research institutions. Open access to data is not possible and access to data is limited to the authorized personnel of the ISTAT since the Italian independent authority of data privacy does not allow providing micro-data of the project. Nevertheless, collaborations in specific projects with other research groups or institutes are possible upon collaboration agreement approval from the Presidential Committee of the ISTAT. Further request of information on the cohort and on collaborations can be addressed to the principal investigator (Luisa Frova, ISTAT, frova@istat.it, +39 0646737382).

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## Compliance with ethical standards

**Conflict of interest** The authors declare that they have no conflict of interest.

## References

- Cambois E (2004) Careers and mortality in France: evidence on how far occupational mobility predicts differentiated risks. *Soc Sci Med* 58:2545–2558. <https://doi.org/10.1016/j.socscimed.2003.09.028>
- Caranci N, Di Girolamo C, Giorgi Rossi P et al (2018) Cohort profile: The Italian Network of Longitudinal Metropolitan Studies (IN-LiMeS), a multicentre cohort for socioeconomic inequalities in health monitoring. *BMJ Open* 8:e020572. <https://doi.org/10.1136/bmjopen-2017-020572>
- Frova L, Alicandro G, Demuru E, Sebastiani G (2019) Integrazione di archivi nazionali per lo studio delle disuguaglianze socioeconomiche nella mortalità in Italia. <https://www.istat.it/it/files/2019/08/IWP-2-2019.pdf>
- Gray AM (1982) Inequalities in health. The black report: a summary and comment. *Int J Heal Serv* 12:349–380. <https://doi.org/10.2190/xxmm-jmqu-2a7y-hx1e>
- Mackenbach JP, Stirbu I, Roskam AJ et al (2008) Socioeconomic inequalities in health in 22 European countries. *N Engl J Med* 358:2468–2481
- Mackenbach JP, Kulhánová I, Artnik B et al (2016) Changes in mortality inequalities over two decades: register based study of European countries. *BMJ* 353(353):i1732. <https://doi.org/10.1136/bmj.i1732>
- National Institute of Statistics. Information system on quality of statistical production processes. <https://www.istat.it/en/methods-and-tools/tools-for-data-quality/siqual>. Accessed 15 Oct 2019b
- National Institute of Statistics. Post Enumeration Survey (PES) of the 15th Italian population census. <https://www.istat.it/en/archivio/145236>. Accessed 15 Oct 2019a
- Sebastiani G, Di Filippo P, Demaria M et al (2019) Lo studio longitudinale italiano: integrazione delle indagini sulla salute con dati di mortalità e ospedalizzazione. Metodologia e potenzialità di utilizzo. [https://www.istat.it/it/files/2019/11/IWP\\_14-2019.pdf](https://www.istat.it/it/files/2019/11/IWP_14-2019.pdf)
- Sim F, Mackie P (2006) Health inequalities: The Black Report after 25 years. *Public Health* 120:185–186
- WHO Statistical Information System WHO mortality database. Geneva: World Health Organization, 2014. [http://www.who.int/healthinfo/statistics/mortality\\_rawdata/en/index.html](http://www.who.int/healthinfo/statistics/mortality_rawdata/en/index.html). Accessed 11 Apr 2018
- World Health Organization (1992) International Statistical Classification of Disease and related Health Problems: 10th revision. World Health Organization, Geneva

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