Sex differences in life expectancy at birth in two Caucasus countries and impact of the alcohol-related mortality

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Short abstract

In the framework of the unfavourable mortality trends observed in the former Soviet republics, Caucasian countries experience specific evolution. In this region, civil registration of vital events remains not complete. We re-estimated mortality levels and trends in Armenia and Georgia since the early 1980s, confirming specific mortality patterns, but similar in both countries. However, gender differences are greater in Georgia than in Armenia. The aim of this paper is to explore the reasons for these differences: looking at all ages, but more specifically at adult mortality for which data are more reliable and where we suspect a major role of alcohol-related mortality that is higher in Georgia than in Armenia.

Working paper

1. Introduction

In the framework of the unfavourable mortality trends observed in the region of the former Soviet Union since the 1960s, it is of particular interest to look at the specific evolution of Caucasian countries. In order to discuss mortality patterns in the Caucasus, a preliminary stage was to make better estimates of mortality levels and trends. In this region, data quality has always been at issue, but since the collapse of the Soviet Union in 1991 the question has become even more acute. Not only did the region experience a failure in the follow-up of dramatic international migration flows, along with a series of political conflicts in the Caucasian countries that disrupted many statistical series, but the current data collection systems for births and deaths have been deteriorating (Badurashvili and Kapanadze 2003; Meslé *et al*. 2006). However, both countries carried out censuses at the beginning of the 2000s. These population counts have provided a much more reliable basis for re-estimating recent mortality trends in these two Caucasian countries. New estimates of mortality trends during the last two decades have been proposed, correcting infant mortality rates and life expectancy at age 60 (Duthé *et al*., 2010a). The second step of this work was to provide continuous series of deaths by cause dealing with changes in the classification of causes of death during the soviet period and even later (Duthé *et al*., 2010b). Mortality levels and trends in Armenia and Georgia since the early 1980s confirm specific mortality patterns, but similar in both countries. However, gender differences are greater in Georgia than in Armenia. The aim of this paper is to explore the reasons for these differences exploring cause-specific mortality: we will first look at cause-specific mortality at all ages in a first part and look in a second part at adult mortality for which data are more reliable. We suspect a major role of the alcohol-related mortality higher in Georgia than in Armenia.

2. Studying mortality in the Caucasus countries: corrections and reconstructions of series

2.1. Data sources

Our analyses, using deaths counts and population estimates are almost based on official statistics. A slight correction has been done for population estimates since 2005 in Georgia due to a suspicious jump of in-migration flows which would lead to an unrealistic population increase (Duthé et al. 2010a) and preliminary results from the census conducted end of 2011 were used for correcting population estimates in Armenia between the last two censuses[1]. For Armenia, deaths counts are from civil registration for the entire period. In Georgia, deaths statistics were based on civil registration until 1988. For the period 1989-2002, the Department for statistics published deaths estimates; for the period 2003-2009[2], deaths counts were deducted from a dual system of data collection comparing two sources: civil registration on one side and medical facilities services on the other side.

2.2. Re-estimating life expectancy

2.2.1. Infant mortality

In order to measure the under-registration of infant mortality rates, official statistics can be compared to results from retrospective surveys, representative at national level. In Armenia,

[1] The previous one was conducted in 2001.

[2] Since 2010, deaths counts are again based on civil registration only.

two Demographic and Health Surveys (DHS) were carried out in 2000 and 2005, while Georgia also produced results from two Reproductive and Health Surveys (RHS), very similar to DHS, conducted in 1999 and 2005. We assume that the survey results give a better view of the general levels and trends than current vital statistics but also that current statistics capture the actual short term changes in infant mortality, and we estimated annual coverage infant mortality rates to correct infant mortality since the early 1980s (Duthé *et al*. 2010a). An update has been done in order to take into account of the levels provided by the last surveys conducted in 2010 in both countries (a DHS in Armenia and a RHS in Georgia).

2.2.2. Mortality at old ages

The correction of infant mortality gives a solid basis for re-estimating life expectancy. If infant deaths are clearly under-registered, registration of deaths at old ages also are. Model life tables can be used as a reference to assess a possible underestimation of mortality at old ages. We examined the relationship between corrected infant mortality and life expectancy at age 60 from official statistics. The comparison with levels given by Coale and Demeny regional life tables reveals an overestimation of life expectancy at age 60 in both countries until the early 1990s and we corrected life expectancy at age 60 until 1991 in Armenia and in Georgia according to the West regional model for males and the North model for females. In Georgia, from 2005 to 2008, old mortality levels are also suspiciously low for females and were corrected in the same way (Duthé *et al*., 2010a).

2.2.3. Life expectancy at birth estimations

For both countries, age-specific mortality rates from age 1 to 60 were computed from official data. Life tables were then built on the basis of these age-specific rates plus our estimates of IMR and of life expectancy at age 60.

2.3. Providing continuous series of deaths by cause

The second methodological issue of this work consisted in providing continuous series of deaths by cause. To do so, we computed the so-called "hidden causes" and treated the changes in causes of death classification which lead to statistical discontinuities in absence of any double counts. We used a method developed for the French data (Vallin and Meslé, 1988) which has also been used in many countries such as Russia or Ukraine (Meslé et al., 1996, Meslé and Vallin, 2012).

2.3.1. Causes of death classifications

Since early 1980s, different classifications of causes have been used, but during the soviet period, the statistics were similar in both countries. Causes of death were classified in the same way since 1981 according to 185 items. After the independence, Georgia continued to use this classification until 1997. Since 1998, causes of deaths are classified according to the 10th revision of the International Classification of diseases (ICD-10) which led to major changes compared to the previous way of classifying. We constituted an abridged ICD-10[3] which counts 197 items. In Armenia, the classification has changed in 2004 with the adoption of ICD-10 but the statistical office publish data in an abridged ICD-10 considering 229 items which is used here to reconstruct continuous series.

[3] on the basis of the work which has been done for Baltic countries (reference.)

2.3.2. The method of reconstruction

Thus, for each country and for the studied period, we treated two transitions. The first one is relatively simple and common to both countries, whereas the second one is more complex and different in each country. The method is described elsewhere (Duthé et al., 2010b).

2.3.3. From deaths by cause to cause-specific mortality

Providing cause-specific mortality rates supposes to combine corrections done on the mortality levels with the series of deaths by cause: the estimated missing death for different age groups (mostly before age 1 and after age 60) are considered as deaths from unknown cause. These deaths are redistributed proportionally into the specified groups of causes, as well as the other ill-defined deaths (those which were registered and classified as ill-defined).

3. Results

3.1. Gender differences in life expectancy

Table 1 presents life expectancy figures in Armenia and Georgia for both sexes according to author's estimates. The dramatic impact of the 1988 earthquake in Armenia is quite visible with life expectancy falling below 60 years for both sexes. For the rest, in both countries, female life expectancy increased slowly over the period, except for some short interruptions just after Independence. For males, the downtrends were much sharper in Georgia and the up trends have levelled off since the end of the 1990s.

Figure 1 presents trends in the gap between male and female life expectancies at birth in both countries. During the period, the sex difference is systematically higher in Georgia than in Armenia, except for a few years: in 1994 the year of the Armenian-Azerbaijanese war and in 2005-2006[4]. The gap was around two years more in Georgia in the 1980s, it is more fluctuated in the 2000s but in 2009 there are still 2 years of difference.

[4] Which are among the years for which we corrected Georgian female old mortality (these two specific years, official IMR was very similar for males and females).

Table 1. Life expectancy at birth since the early 1980s for males and females, and sex differences

	Armenia			Georgia			Diff.
Year	Male	Female	Sex gap	Male	Female	Sex gap	
	(1)	(2)	(3)	(4)	(5)	(6)	(6)-(3)
1980	65.1	70.2	5.1	64.4	71.2	6.8	1.6
1981	65.8	71.0	5.2	63.7	70.5	6.8	1.6
1982	65.8	70.8	5.0	64.8	71.7	6.9	1.9
1983	65.5	70.4	4.9	65.3	72.2	6.9	2.0
1984	65.7	70.9	5.2	65.0	72.0	7.0	1.8
1985	66.1	70.4	4.3	65.4	71.9	6.6	2.3
1986	66.9	71.3	4.4	65.3	71.9	6.6	2.2
1987	67.2	71.5	4.3	65.6	72.0	6.4	2.2
1988	58.1	58.3	0.2	65.5	72.4	6.9	6.7
1989	66.4	72.4	6.0	65.2	72.3	7.1	1.1
1990	66.5	73.0	6.4	65.8	73.0	7.2	0.8
1991	66.6	72.8	6.1	65.8	73.4	7.6	1.4
1992	65.6	73.0	7.4	65.2	73.6	8.4	1.0
1993	64.6	72.2	7.6	62.9	72.0	9.1	1.5
1994	64.9	74.0	9.1	65.0	73.6	8.6	-0.5
1995	66.0	73.6	7.6	66.3	74.3	8.0	0.4
1996	66.3	73.4	7.1	66.0	73.9	7.8	0.8
1997	67.5	73.9	6.4	66.5	73.9	7.4	1.0
1998	68.8	74.6	5.8	66.8	74.4	7.6	1.8
1999	68.9	74.5	5.5	66.6	74.2	7.6	2.1
2000	69.1	75.1	6.0	66.9	74.5	7.6	1.6
2001	68.7	75.1	6.4	67.8	74.8	7.0	0.6
2002	68.8	74.7	5.9	67.9	74.9	6.9	1.0
2003	68.9	74.9	6.1	68.6	75.3	6.7	0.6
2004	68.9	75.3	6.4	67.8	75.2	7.4	1.0
2005	68.6	75.0	6.4	69.2	75.5	6.3	-0.2
2006	68.2	74.7	6.5	68.5	75.0	6.5	0.0
2007	69.0	75.6	6.6	69.8	77.5	7.7	1.1
2008	69.1	75.7	6.6	68.8	76.2	7.4	0.8
2009	68.7	75.2	6.6	68.5	77.2	8.7	2.1

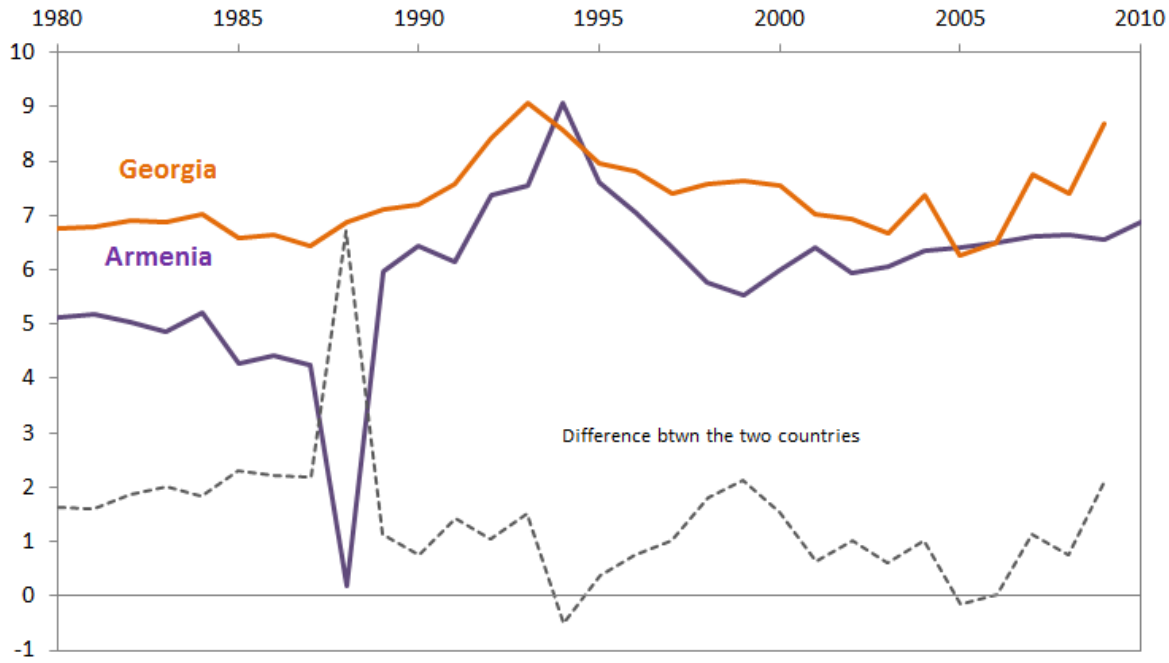


Figure 1. Trends in male-female life expectancy gap in Armenian and Georgian since the early 1980s according to authors' estimates, for males and females

3.2. Which age groups and cause of death are involved in the e_0 sex difference in each country?

Figures 2 to 5 present the decompositions of the difference in the life expectancy at birth between males and females by age group and large group of cause for both countries in early 1980s and late 2000s. In 1983, in Georgia the sex difference is larger than in Armenia for respiratory diseases at infant ages, injuries and poisoning for young adults, and cardiovascular for adults (figures 2 & 3). In 2007, differences don't have exactly the same component with a larger contribution of neoplasms in Armenia which is largely offset by cardiovascular diseases much more frequent among males than females in Georgia (figures 4 & 5).
However, there are still some problems to be corrected in the data, as clearly show the unrealistic large difference between males and females in Georgia at ages 65-69.

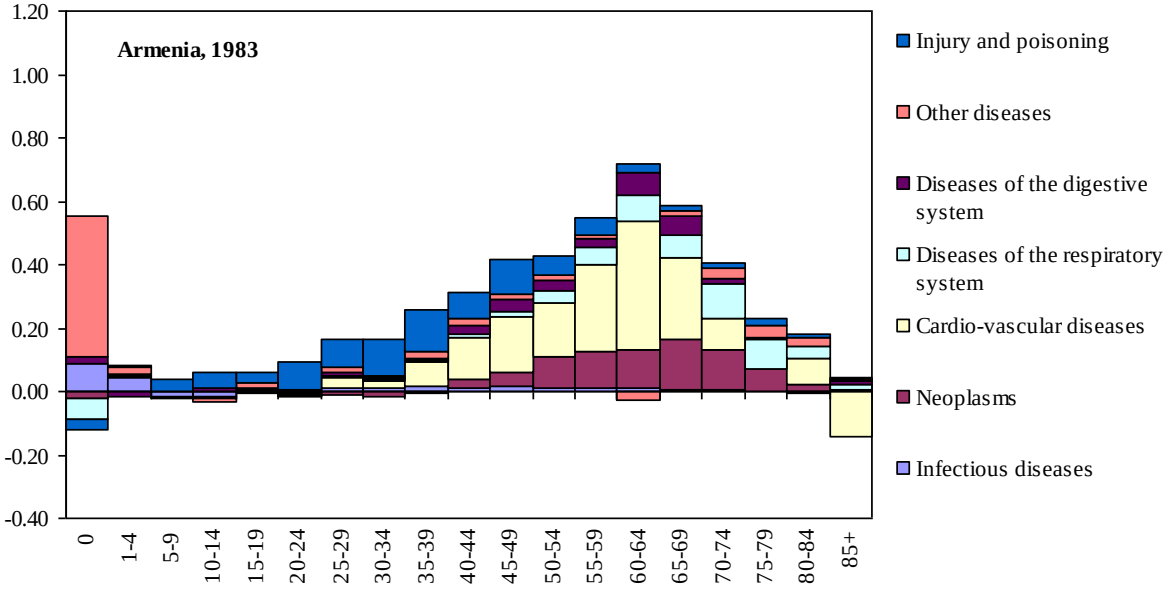


Figure 2. Decomposition of the e_0 gap between males and females by age group and large groups of causes in Armenia in 1983

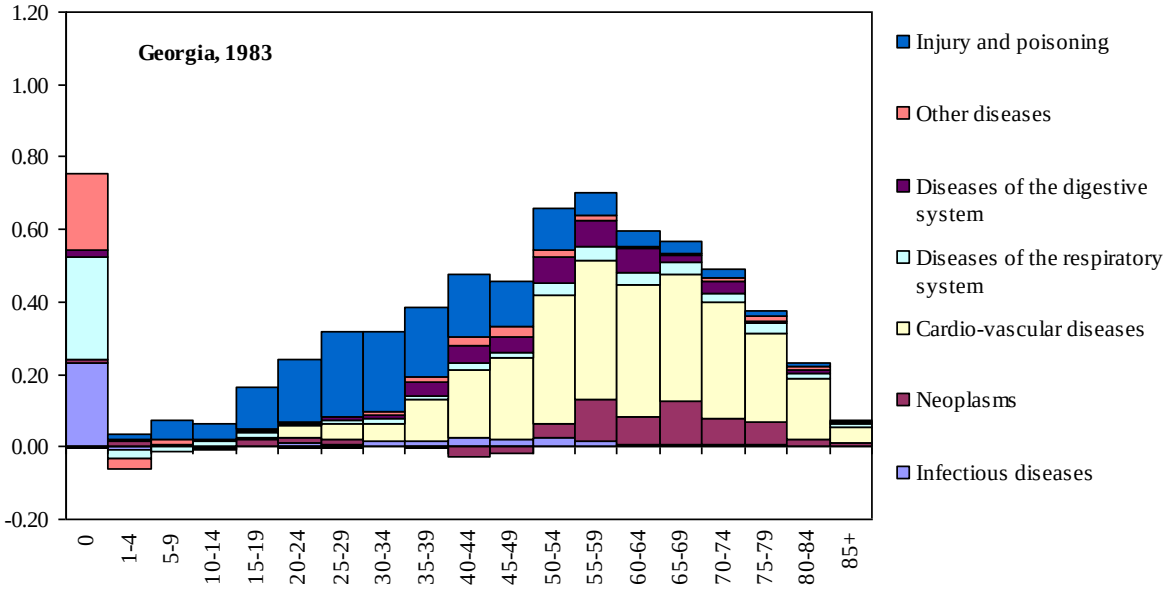


Figure 3. Decomposition of the e_0 gap between males and females by age group and large groups of causes in Georgia in 1983

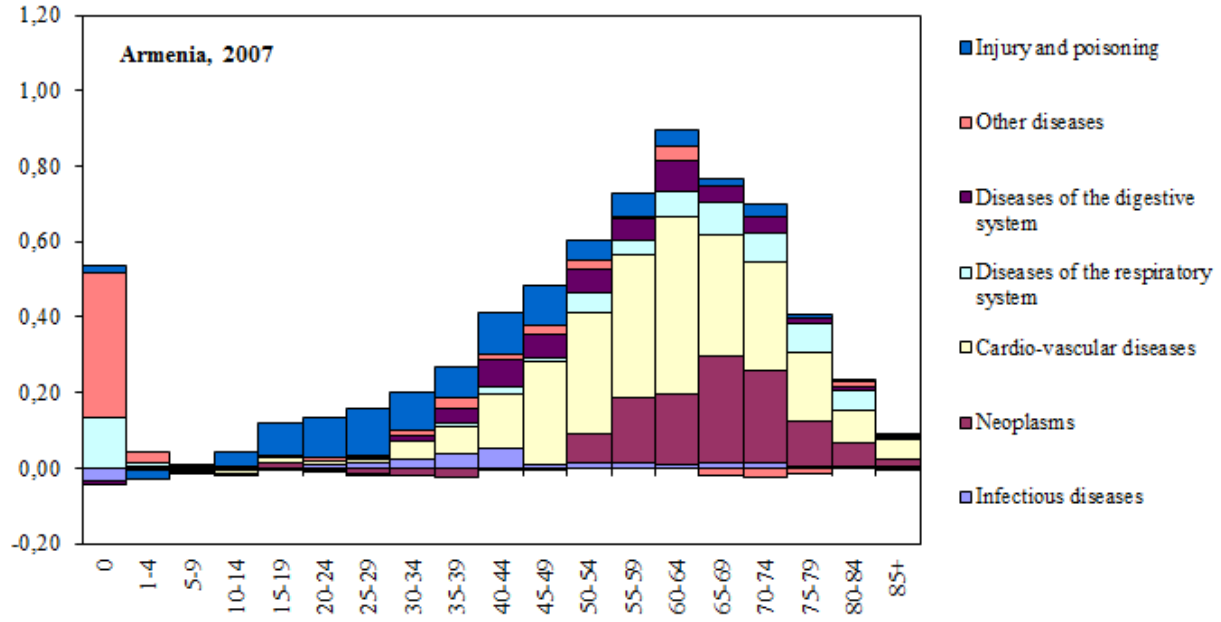


Figure 4. Decomposition of the e_0 gap between males and females by age group and large groups of causes in Armenia in 2007

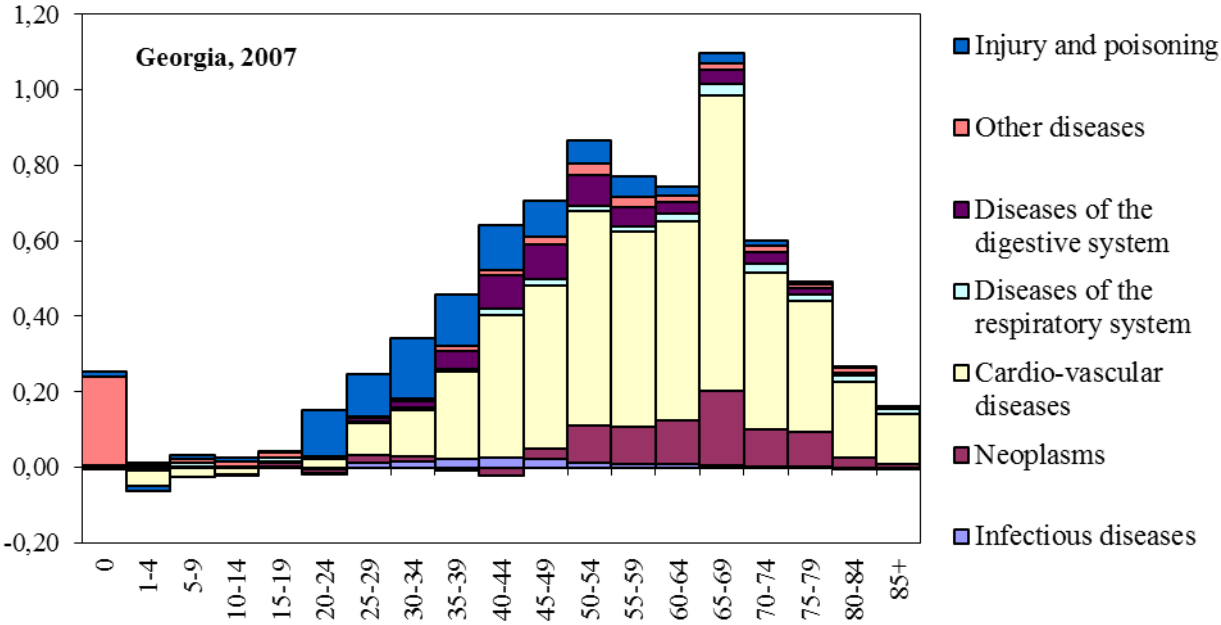


Figure 5. Decomposition of the e_0 gap between males and females by age group and large groups of causes in Georgia in 2007

3.3. Which age groups and causes of death are involved in the larger gap in Georgia compared to Armenia?

Tables 2 and 3 present the decomposition of the difference for the sex gap in e_0 between Armenia and Georgia in 1983 and 2007 by large age group and group of causes respectively. The largest part of the higher level of sex gap in Georgia compared to Armenia involves the adult ages, from 20 to 60 with 1.2 years for the year 1983 when the total difference is 1.9 and it's almost all the difference in 2007. It is also interesting to note that the difference between

Georgia and Armenia at adult ages is the same for these two years (1.2 years) (Table 2). Regarding causes of death, cardiovascular diseases is the main age group responsible for the larger difference in Georgia between male and female mortality, with 1.3 years in 1983 and 2.0 in 2007. In 1983, deaths from injury and poisoning were also involved which is not the case in 2007.

Table 2. Decomposition of the difference for the sex gap in e_0 by large age group between Armenia and Georgia in 1983 and 2007, by large age group

	Age group	Armenia e_0 sex gap	Georgia e_0 sex gap	Difference
1983	0	0.4	0.7	0.3
	1-19	0.2	0.3	0.1
	20-59	2.3	3.5	1.2
	60+	2.0	2.3	0.3
	Total	4.9	6.8	1.9
2007	0	0.5	0.3	-0.2
	1-19	0.1	0.0	-0.1
	20-59	2.9	4.1	1.2
	60+	3.0	3.4	0.4
	Total	6.6	7.7	1.1

Table 3. Decomposition of the difference for the sex gap in e_0 by large age group between Armenia and Georgia in 1983 and 2007, by large group of causes

	Group of causes	Armenia e_0 sex gap	Georgia e_0 sex gap	Difference
1983	Infectious diseases	0.2	0.4	0.2
	Neoplasms	0.7	0.5	-0.2
	Cardiovascular diseases	1.6	2.9	1.3
	Diseases of the respiratory system	0.5	0.6	0.1
	Diseases of the digestive system	0.3	0.5	0.2
	Other diseases	0.7	0.4	-0.3
	Injury and poisoning	0.9	1.6	0.7
	Total	4.9	6.8	1.9
2007	Infectious diseases	0.2	0.1	-0.1
	Neoplasms	1.1	0.8	-0.2
	Cardiovascular diseases	2.7	4.7	2.0
	Diseases of the respiratory system	0.6	0.2	-0.4
	Diseases of the digestive system	0.5	0.5	0.0
	Other diseases	0.5	0.5	0.0
	Injury and poisoning	1.0	1.0	0.0
	Total	6.6	7.7	1.1

In Russia (the largest and the most studied former Soviet republic), unfavourable mortality trends have been observed for several decades, mainly due to a large increase in cardiovascular diseases and external causes of death (Meslé 2004). These trends have been attributed to a large extent to high consumption of strong alcoholic beverages among adults, especially males (Leon et al. 2007; Zaridze et al. 2009a). Comparing Georgian and Armenian sex gap in e_0 led us to highlight the role of adult mortality and cardiovascular diseases, this is

thus reasonable to think that alcohol-related mortality can be largely involved in the difference between the two countries.

3.4. Impact of alcohol-related mortality on the sex difference between Armenia and Georgia

To confirm that assumption, we calculated annual standardized mortality rates between ages 20 and 60 years old as follow for different group of causes:

$$_{40}M_{20}^{S} = (_5M_{20} + _5M_{25} + \ldots + _5M_{55}) / 8$$

We grouped causes of death according to their possible link with alcohol consumption. We used alcohol-related (AR) causes of death which have been identified in a specific survey in Russia (Zaridze et al. 2009a, 2009b): alcoholic and other cirrhosis, chronic alcoholism and alcohol poisoning, all the other external causes except for the Armenian earthquake in 1988[5], heart diseases (but myocardial infarction), upper aero-digestive tract cancer, liver cancer, tuberculosis, pneumonia, liver and pancreatic diseases. We nevertheless made an exception by not including ill-defined causes. In Georgia, deaths from ill-defined cause reflect more a problem in the registration system (Duthé et al. 2010b) independent to the cause, than suspicious unreported alcohol-related deaths as it is the case in Russia. Ill-defined deaths were thus proportionally redistributed in the other known causes as it was done for the large group of causes in the previous part.

As expected, AR mortality is much higher among males than females in both countries. However in Armenia, the sex gap is almost the same between AR mortality and not AR mortality. In Georgia, it is greater for AR mortality (Annex 1). Figure 6 presents the difference in the sex gap in adult mortality ($_{40}M_{20}$) between Georgia and Armenia. Except for 1988, the year of the earthquake, the sex gap in adult mortality is almost the same in Armenia and in Georgia (i.e. equal or close to 0) whereas the AR mortality rate is systematically higher in Georgia than in Armenia and this difference has remained relatively stable over time.

[5] Considering all injuries and poisoning as AR mortality is indeed not relevant for 1988 in Armenia with the impact of the earthquake.

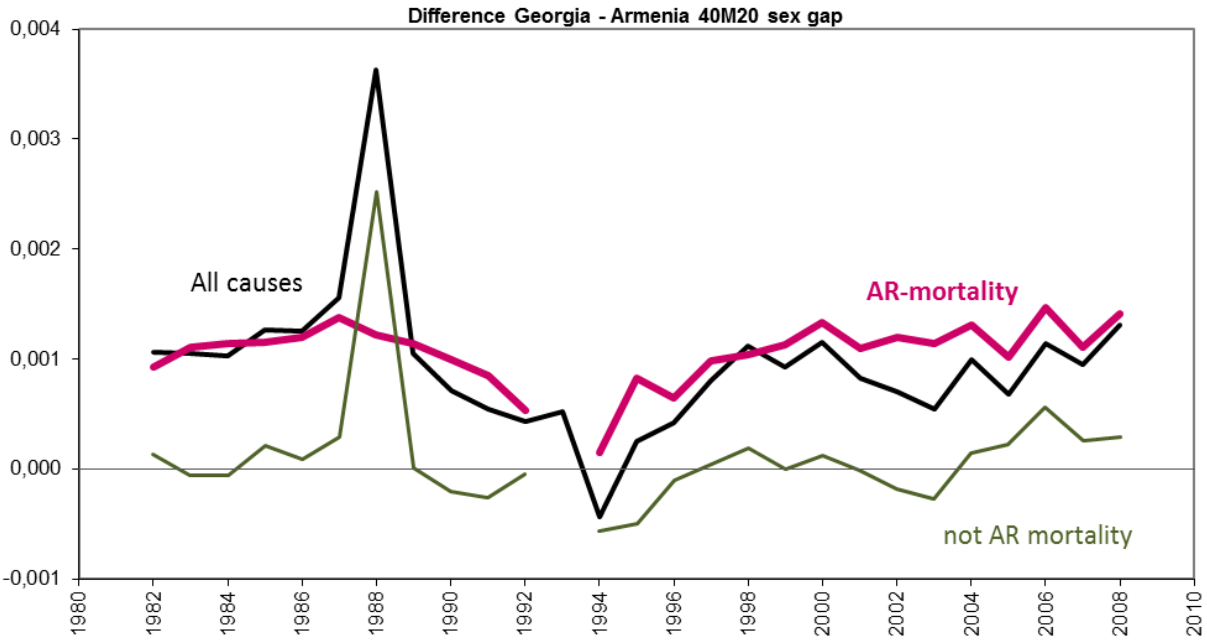


Figure 6. Yearly difference of the sex gap in ${}_{40}M_{20}$ between Armenia and Georgia, by large group of causes (alcohol related mortality or not).

4. Discussion

Alcohol consumption seems to play an important role in the reason why sex differential in mortality is higher in Georgia than in Armenia. According to a survey conducted in 2001 in the former republics, it seems that Armenians drink more strong spirits than Georgians who drink a lot of wine but the prevalence of heavy drinkers is almost twice higher in Georgia than in Armenia among males (28% versus 16%). For females, it is also higher but at a much lower level (2% in Georgia) (Pomerleau et al. 2008, table 4).

Table 4. Prevalence of episodic heavy drinking among males and females, 2001

	Armenia		Georgia	
	Males	Females	Males	Females
Beer or wine or spirits (≥80 g of alcohol from beer or ≥90 g of alcohol from wine or ≥86 g of alcohol from strong spirits)	16%	<1%	28%	2%

Source: Pomerleau et al. 2008.

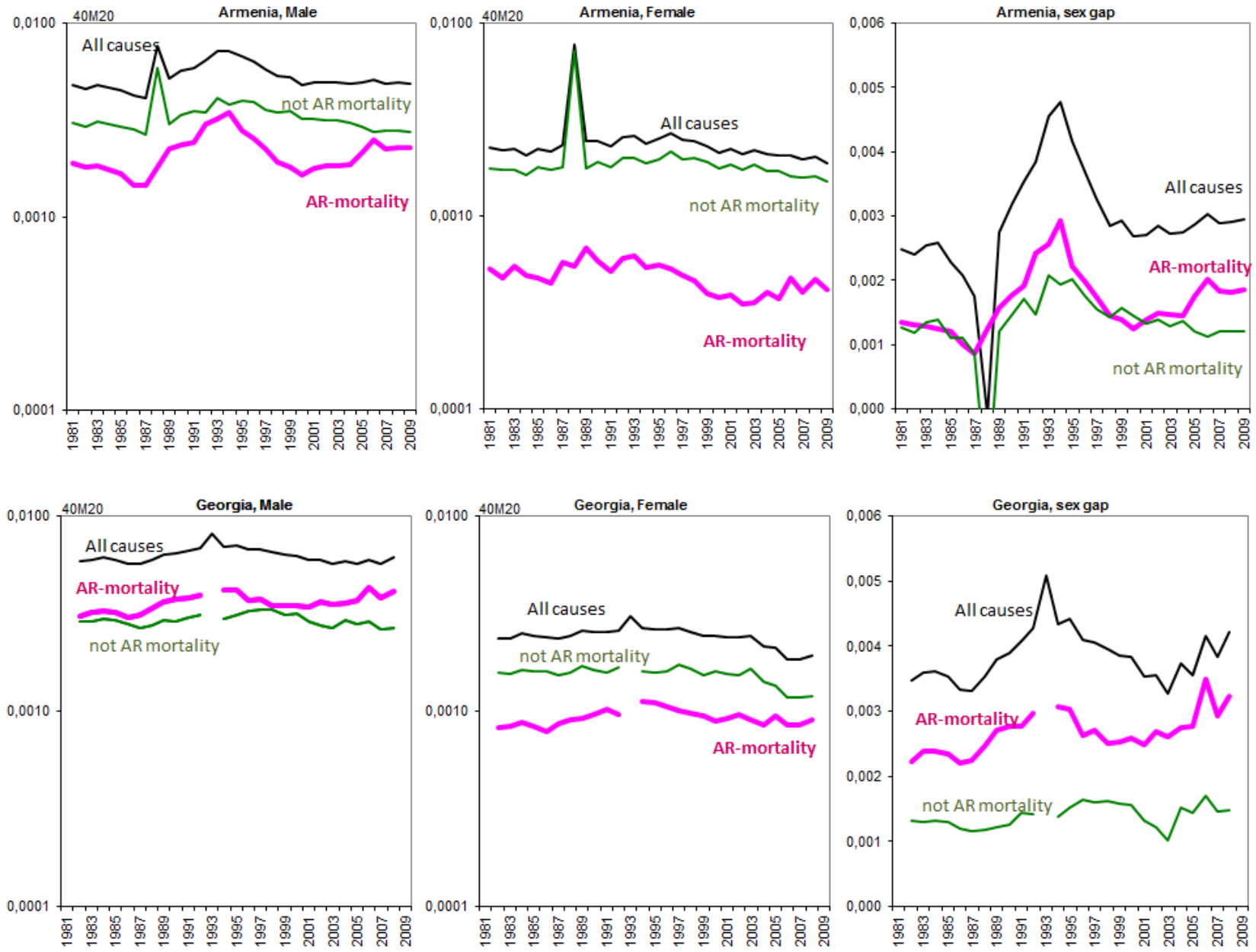
Our study has however some limitations.

First, we calculated mortality levels on the basis of population and death counts provided by the official statistical services. Official population estimates were an issue in the early 1990s due to the massive out-migration and geopolitical conflicts. In Armenia, the earthquake occurred in December 1988, just before the last Soviet census has also led to uncertain population estimates. With the 2000s censuses, estimates are much better though annual out-migration occurred in early 1990s may have not been well measured. In Armenia, data from the last census (2011) are not yet available. In Georgia, a suspicious jump in annual in-migration and population estimates for the last years are subject to caution and have been corrected (Duthé et al. 2010a). Future updated population counts will give a better view of the

current situation. Regarding death counts, despite the restriction to adult ages, civil registration coverage is not totally complete even if we can assume that error is negligible. In Georgia, statisticians proposed to correct deaths counts even at adult ages and we took their estimates into account, it's difficult to estimate biases induced by these limitations but we assume the difference between countries would remain the same as it has always been during the period. However, our correction of infant and old mortality may have led to a different picture in sex differential for these age groups.

Second, analysing causes of death implies limitations due to the classification process which changes over time and countries: the statistical ruptures over time have been treated for Armenia and Georgia for which we propose continuous series of death by cause according to an abridged ICD-10 (Duthé et al. 2010b). A few codes from ICD-10 mentioning alcohol are not included in the AR mortality group because they were not used, but they are very negligible (almost no deaths). But even for a similar year or period, international comparisons remain challenging as, beyond the classification used, habits in coding causes of death may strongly differ (reference). As a consequence, the Zaridze classification of the AR-deaths has been assessed in one specific area in Russia and may be less relevant for other countries. Some countries have specific events and external causes are not necessarily strongly related to alcohol consumption: it is the case for the 1988 earthquake which killed at least 10,000 people we didn't consider as AR mortality but political conflicts occurred in Armenia and Georgia implied deaths which were considered here as AR mortality. In parallel, the ill-defined causes which are considered as AR-mortality in the Zaridze classification are in the Caucasus countries largely related to data reliability. For this reason, we adopted a neutral treatment of ill-defined causes for the three countries, redistributing them proportionally among the other causes. Another limitation related to the use of the Zaridze classification for other contexts is that alcohol consumption probably show diverse patterns regarding to the type of alcohol, the amounts and the frequency and this may lead to a different pattern of AR deaths.

Annex 1. Adult mortality trends in Armenia and Georgia according to alcohol-related mortality, by sex and sex gap



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