Life expectancy in two Caucasian countries.

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How much due to overestimated population? [(Note 1)]

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Abstract

This study is a first attempt to produce reliable estimates of mortality in Georgia and Armenia in the 1990s. Official statistics registered a decrease in mortality over the 1990s in spite of local wars, mass flows of refugees, and severe economic hardships faced by populations. According to official statistics, in 1999-2000 population size was about 5.4 millions in Georgia and about 3.8 millions in Armenia. Non-official estimates based on migration surveys are much lower: 4.0-4.1 millions and 3.0 millions, respectively. This huge difference is mostly due to unregistered out-migration.

In addition to corrections in population, corrections are made for under-registration of deaths. Hospital statistics is used for infant deaths and the Coale-Demeny model life tables are used for ages above 70.

In Georgia, the introduction of payment for the declaration of vital events resulted in a greater under-registration of deaths than in Armenia. Modified populations, mortality and life expectancy values are produced for the 1990s. In 1999 life expectancy was 68.6 and 75.6 for males and females in Georgia and 68.7 and 75.4 for males and females in Armenia. These figures are lower than the official estimates by 5.2 and 5.6 years for males and females in Georgia and by 3.8 and 1.7 years for males and females in

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Armenia. After corrections Caucasian male life expectancy is higher than in other post-Soviet countries.

1. Introduction

During the last years much of the demographic and epidemiological research was focused on changing patterns of health and mortality in the former Soviet Union. This increasing volume of research, however, was almost exclusively focused on Russia and Baltic countries. Much less attention have been paid to other former Soviet republics.

Before the collapse of the Soviet Union mortality patterns in Armenia and Georgia were quite different from those in Russia and Baltic countries. The former had substantially higher level of male life expectancy than the latter (about 68-69 years *vs.* 62-64 years in 1990). This difference was induced by male mortality rates at working ages, which were much higher in Russia or in Baltic countries than in Armenia or Georgia. There is a belief that this gap is attributable to special socio-cultural patterns typical for Caucasus and many other countries of Southern Europe.

Since the end of the 1980s the populations of the northern part of the former Soviet Union has experienced dramatic fluctuations in mortality. Surprisingly, official statistics of Caucasian countries registered a decrease in mortality over the 1990s in spite of local wars, mass flows of refugees, and severe economic hardships faced by Armenian and Georgian populations.

In 1989-90 male life expectancy at birth was 68.6 and 68.2 for Armenia and Georgia, respectively. Female life expectancy was 75.4 and 75.8, respectively. By the year 1998-99 these figures have increased significantly to 72.5 and 73.8 years for males and to 77.3 and 81.2 for females in Armenia and Georgia (Note 2, Note 3), respectively. There are, however, serious reasons to suspect these data (Badurashvili *et al.*, submitted; Kingkade, 2000). Most importantly, in both countries a sharp increase in out-migration occurred in the 1990s. First, many Russians returned to Russia in the first years of independence. The migration out-flow has become even greater after 1991 due to socio-economic crisis and dramatic worsening of life conditions, which have become substantially worse than those in Russia. But the registration systems both in Georgia and Armenia failed to capture the scale of these flows. Consequently, official population numbers are over estimated while age structure less and less conforms to reality.

Furthermore, the 90's also brought some perturbations in the civil registration system and yearly numbers of deaths can be suspected to be underestimated. We shall try here to overpass these two problems to obtain new estimates of recent mortality change and to compare them to those of other countries of the ex-USSR.

2. Re-estimating populations

Both Armenia and Georgia faced during the 90's very important migration flows but in different ways linked to local situation and history. Let us look at them successively.

2.1 Georgia

At the end of the Soviet era the total population size of Georgia was 5.5 million. According to official sources the net out-migration from this country in the decade 1990-99 constituted about 220 thousand people. In reality, estimates of the number of people, who have left Georgia is very much undercounted. In addition to the dramatic changes which followed Independence, Georgia had to face two ethnic disputes: the claim for independence of South Ossetia (or Tskhinvali) and the Abkhazian war. The migration flows increased suddenly, not only because of the departure of Russians but also as direct or indirect consequences of these specific conflicts. Also, the territory actually controlled by Georgian government and the population covered by demographic statistics changed with the de facto separation of Abkhazia and part of Ossetia. Meanwhile, since 1989 the registration of migrations deeply deteriorated, and official statistics so largely underestimate real numbers that the total departures from Georgia are quite less than total immigrants from the country numbered in only Russia, which is far to be the only host country for Georgian migrants. According to Toma Gougoushvili, from 1990 until 1996, among 5.5 millions of inhabitants, Georgia would have lost 800,000 because of net emigration (Tsuladze and Badurashvili, 1999), and according to Giorgi Tsuladze, from 1990 till 1999, the losses would have reached 1.2 million (Tsuladze and Maglaperidze, 2000). Consequently, GCPR's estimate for total Georgian population at January 1st 1999 (Note 4) is 4.11 millions instead of 5.40 millions officially stated by SDSG, and CSS' estimate for January 1st 2000 is 4.07 instead of 5.10 (without Abkhasia and Tskhinvali) according to official data (Note 5). These estimations are roughly corroborated by an national extrapolation of the results of the longitudinal household survey undertaken since 1996 by the SDSG in collaboration with the World Bank which gives 4.00 million population for mid-1999.

Taking in account the changes in the age structure of the population showed by this household survey, CSS produced new estimations of populations by five-year age groups for each year from 1990 to 2000 (Table 1).

Figure 1 shows the estimated annual change in Georgian population since 1989 to 2000, with a comparison with official estimations. At the beginning, we assume that the results of 1989 census are correct. Then, there is a progressive effect of the net out migrations combined with the loss of control on Abkhasia and Tskhinvali. In 1999

official data give the numbers with and without these lost territories and in 2000 they give only the population without them. We can see that, in 1999, the difference of 1.3 million between official and estimated population is due to the underestimation of out migration by about 1 million and by near 0.3 million to the loss of Abkhazia and Tskhinvali territories.

Figure 1:   *Estimated trends in Georgian population as compared with official data, 1989-2000 (in millions)*

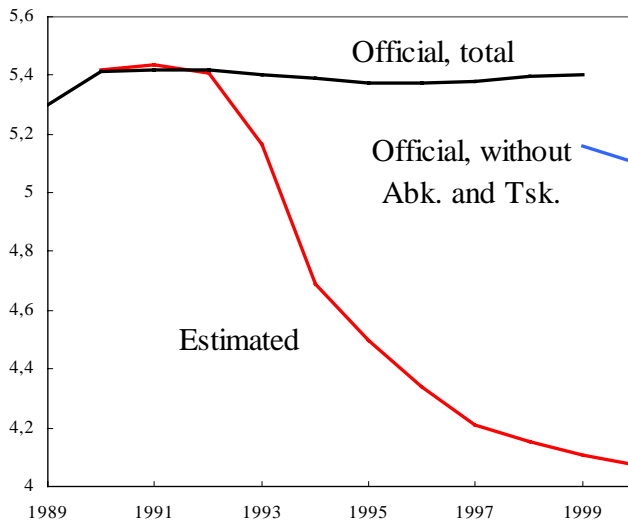Figure 2 compares the estimated age structure of 2000 Georgian population with the official data (without Abkhazia and Tskhinvali). As expected, the biggest differences appears at the ages between 5 and 40, since migration flows are much more important at these ages. There are still some differences at ages 40 to 65 but almost none after 65 and nothing at all below age 5. These differences are rather less for females.

Figure 2: *Estimated age structure of Georgian population in January 1ˢᵗ 2000, as compared with official data (in thousands)*
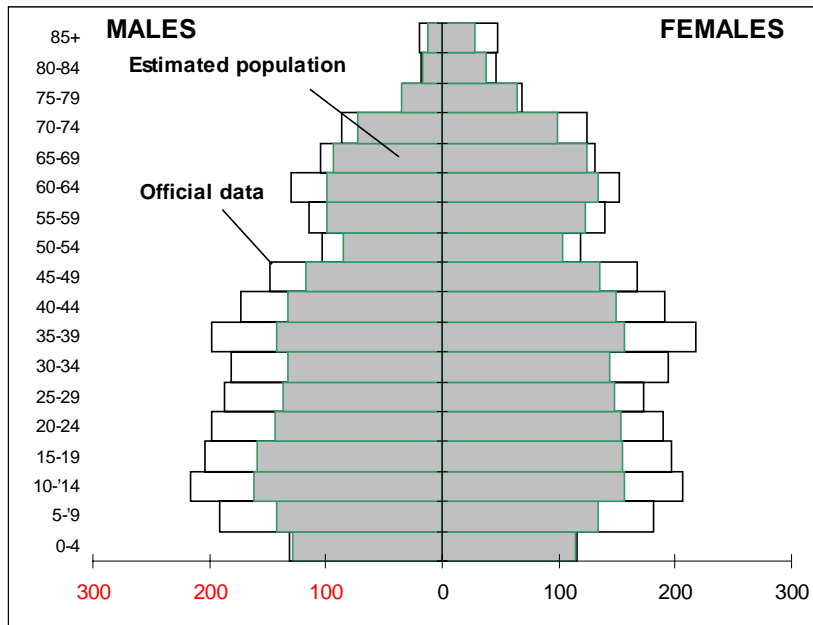
Of course this estimation will need to be confirmed by the next census which might be performed next year, but it allows us to try to produce right now better estimation of mortality rates.

In particular, it is striking to see at Figure 2 that the number of under-five-year boys is unexpectedly much higher than that of girls and we shall see that it will be the same for Armenia (Figure 4, below). At this age population numbers are very few dependant on migration (and migrations very few dependant on sex). The differences are only due to sex ratio at birth and mortality. In fact, in this case it seems to be due to an unusually high proportion of boys among births (see Annex 2). Reasons for such a phenomenon are not clear at all. This special topic should be treated elsewhere; however, it is not likely to bias too much our present estimations of mortality rates.

2.2 Armenia

According to the 1989 census, Armenian population would have been 3.10 million inhabitants. However, to follow the same calendar as for the other Republics, this census was demanded by the USSR Goskomstat in spite of the objections of Armenian Government, while the country was shocked by the tragic earthquake which occurred in Spitak and its region in December 1988, and this result largely underestimated the real population. Indeed, the previous estimation founded on the 1979 census and vital and migration statistics gave 3.31 millions for 1988, 3.31 for 1989, and 3.35 for 1990. Taking in account these previous estimations and the results of the 1989 census for the regions where it was good, the Armenian Central Bureau of Statistics starts its new series of population numbers with a total population of 3.51 millions in 1990. In the absence of enough information on materials and methods used, we cannot evaluate the reliability of this estimation and we shall take it at this stage as the starting point of our reestimates for the 90's.

From this point, as Georgia, Armenia faced a very difficult period. Not only the social and economical consequences of Independence and the transition to market economy were severe but the country was also involved in a war with Azerbaijan, about the status of Nagorny Karabach. A major consequence of these events was both a large out-migration flow, mainly of Russian population going back to Russia, and an also important in-migration of Armenian refugees escaping from Bakou or other places were they lived in Azerbaijan. Balancing these two contradictory flows, official statistics estimate the total net out-migration for the decade 1990-1999 to only 22.6 thousand people. In reality, estimates of the number of people, who have left Armenia is very much undercounted because a lot of them did not register their moves to outside.

Thus, according to data of the Aviation Department of the Government of Armenia in 1990-99 the total number of passengers leaving the country was higher than the number of arriving passengers by 630 thousand people. It is true that during the blockade years 1992-95 air transportation was almost the only connection between Armenia and outside world but before 1992 and since 1995 there were other means to leave Armenia and this figure is obviously understating of the real net out-migration. Another fact, indirectly confirming the absence of a substantial part of population is that by the end of the privatization of state property (in 1995) 650 thousand residents of Armenia had not taken their vouchers.

In order to make a better estimation of the size and structures of population losses due to out-migration in the 1990s one can use the results of two population surveys of 1995 (by UNDP, see Karapetyan, 1996) and of 1999 (by the Ministry of Statistics, see Yeganyan and Shakhnazaryan, 1999). These surveys were based on interviewing of

 people from a representative samples of the total (official) population of Armenia. The 1995 survey, concerning a sample of 3100 households, focused on 1991-95 out-migration and in-migration flows, and the 1999 survey (3600 households) on the same flows for the entire period 1991-98. In both cases, two questionnaires were used: a very brief questionnaire devoted to families, all members of which left Armenia was applied to the neighbors (number of family members, their sex and age), and a more detailed one for families in which at least one family member was still living in Armenia.

According to the results of these surveys, the cumulative net out-migration from Armenia in the 1990s was about 800 thousand people. Most of them left for Russia (about 60%-70% of the overall out-flow). Part of migrants went to other post-Soviet countries and to some western countries (USA). Based on the information collected on the age of the migrants and their year of leave, it has been possible to re-estimate year by year the total of the population by sex and, at the end of the period (1st January 2000), the specific numbers by sex and age (Yeganyan and Davtyan, 2000; Yeganyan, 2000).

According to the estimates, the size of the Armenian population at the beginning of the year 2000 was 3.0 millions while the official figure by the Armenian Bureau of Statistics is 3.8 millions. To evaluate the reliability of this re-estimation of the total of out-migration, we can use vital statistics collected in Russia on Armenians living in Russia. It is especially useful to compare the change in the number of Armenian deaths registered in Russia with the estimated flows of out-migrants from Armenia (Figure 3).

Figure 3 shows four curves of yearly changes since 1990 (in indexed values):

- number of deaths of Armenians registered in Russia,

- number of deaths of Russians registered in Russia,

- estimated population of Armenians in Russia taking in account all out-migrants from Armenia,

- estimated population of Armenians in Russia taking in account 60 % of out-migrants from Armenia.

The trends in deaths are very different for Armenians and Russians. In general, the numbers are growing much faster for the former than for the latter, and, in particular, when this number is decreasing among Russians (1995-1998) it is stabilising among Armenians. That is due to the important flows of Armenians towards Russia.

Figure 3:   *Proportional changes since 1988 in the number of deaths of Armenians and Russians in Russia and in the size of Armenian population in Russia*
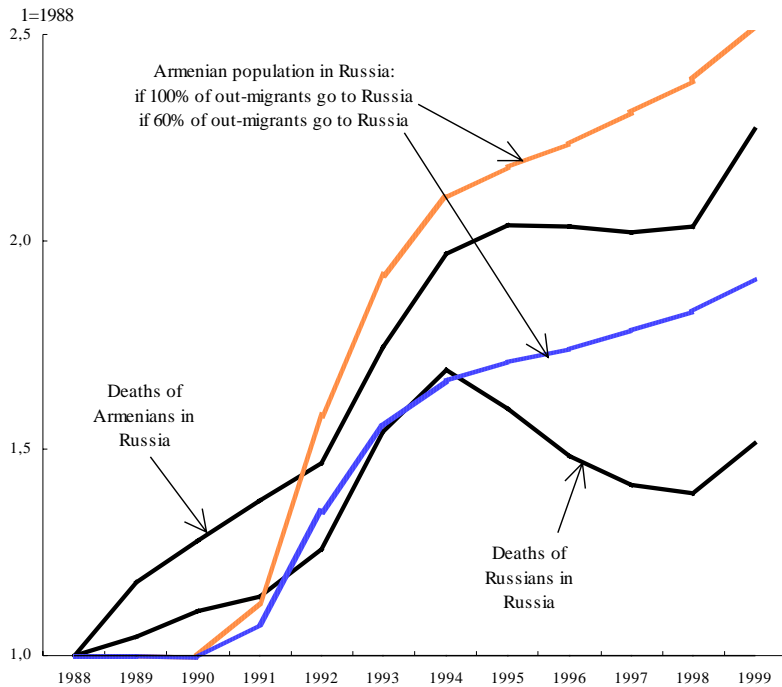
Comparing the dynamics of the Armenian deaths in Russia to the estimates of Armenian population in Russia, we can clearly see that at the beginning of the period (1988-1991), deaths growth is more than that of Armenian population. This is due to the importance of the in-flow of Armenian refugees from Azerbaijan just before the Nagorny Kharabach war. On the contrary, since 1991, trends in Armenian deaths and population are rather similar. In fact there is a visible divergence during the years 1995-98, but the reason for the stabilisation in the number of deaths in spite of continuing out-migration from Armenia is due to the well known decrease in mortality in Russia during this period (Meslé *et al.* 2000). This comparison makes very plausible our estimates of Armenian out-migrations, and then, the new estimate of Armenian population trends.

To produce annual population by age founded on these estimates and on the final age-structure already calculated above for the last year (2000), we first calculated the ratios of 2000 estimated population by age group to official numbers. Then, admitting a linear change in these ratios, from 1 in 1992 to their 2000 level, we apply interpolated ratios to the official annual numbers and then reduce or increase the results to reach the total population previously estimated.

Results are given in table-annex 2 below.

Figure 4 shows the 2000 estimated Armenian age pyramid as compared to the official figures.

As for Georgia, the differences between estimated and official figures are mainly concentrated on active age groups and more important for males than for females. Again, we can also see here the strikingly higher number of under-five-year boys as compared to girls (see Annex 2).

Figure 4: *Estimated age structure of Armenian population in January 1ˢᵗ 2000, as compared with official data (in thousands)*
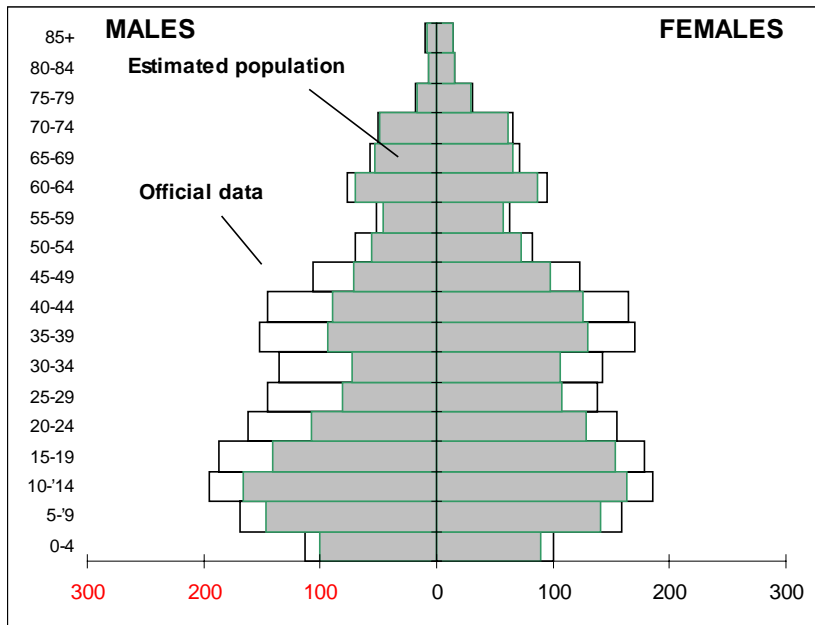
3. Taking in account under-registration of deaths

Apart from the problem of denominator, we cannot exclude the possible effect of under-registration of deaths. Indeed, it seems that specific difficulties were recently encountered in this field, especially in Georgia. After comparison between different sources and between observed specific death rates by age group to model life tables, we finally had to make some correction for infant mortality and, at a lesser extent, for mortality at the oldest ages.

3.1 Problems in registration system

As far as registration problems are concerned, the situation is rather different in the two countries.

In Georgia, it appears rather clearly that a significant part of the total deaths fails to be registered and the problem seems to have got worse since the Independence. The Soviet system put constraints which were favourable to the completeness of the reporting but also gave people some advantages. The vanishing of these two factors and the introduction of a new rule requesting a payment for the declaration (the amount of the fee for the registration of a death is as high as that of a month of retirement pension !) seem to have worsened the under-reporting of deaths. As burials, especially in rural areas, can take place without a certificate, it seemed to us that this change could have produced an important reduction in the registration of death, at specific ages, especially among babies or, on the contrary, among elderly. On another hand, independently from the ZAGS (Note 6) records, thanks to information received from hospitals and other health centres by the Ministry of Health, it is clear that the registration of deaths below one year of age is not complete. Thus, in 1998, while the State Department of Statistics officially registered 710 deaths under age 1, the Ministry of Health numbered 1054 of them. Such an under-registration was already prevailing in the 80s. However, according to series from the Ministry of Health it has deteriorated since Independence.

Another difficulty of the Georgian situation is that, due to the Abkhasian war, vital statistics collection encountered some particular difficulties in 1993 and we do not know at what extent death registration coverage was affected this year.

In Armenia, the registration system is more similar to that which was in rule during the Soviet time. No fee is required to register an event. And, in the case of the death of retired person, families even receive the all pension for the rest of the year, which gives some motivation to make registration, unless it could be better not to declare and let the pension go on. Nevertheless, it is thought by specialists that a certain

under-registration prevails among rural population and the question must be examined for this country too.

3.2 Infant mortality

An evidence of the under-registration of infant deaths is given for both Georgia and Armenia, by simply comparing official statistics and special health data produced by Ministries of Health (Table 1). As expected, the problem is obviously more important in Georgia than in Armenia. Of course we have no proof that health data from the Ministries of Health are perfect (we may suspect some omissions) but it seems to us that it probably is much closer to the reality than official statistics. We decided to correct infant mortality rates by coefficients deduced from this comparison (Table 1 and Figure 5).

Table 1: *Infant mortality rates according to official statistics and Ministry of Health's data, in Armenia and Georgia*

Indicators	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Armenia										
Infant mortality rate (official statistics)	18.3	18.0	18.9	17.8	15.1	14.2	15.5	15.4	14.7	15.7
Infant mortality rate (data of Ministry of Health)	20.0	20.8	23.2	22.1	19.0	17.8	18.8	20.1	19.3	18.1
Coefficient of correction	1.09	1.15	1.23	1.25	1.26	1.25	1.21	1.30	1.31	1.16
Georgia										
Infant mortality rate (official statistics)	15.8	13.8	12.6	16.9	16.7	13.1	17.4	16.3	15.2	17.5
Infant mortality rate (data of Ministry of Health)	19.8	21.1	20.0	24.9	25.0	23.5	27.4	23.5	21.0	23.4
Coefficient of correction	1.25	1.53	1.58	1.47	1.50	1.80	1.57	1.44	1.39	1.33

Figure 5: *Infant mortality rates according to official statistics and corrected on the basis of Ministries of Health data*

Mortality rate (per 1000)
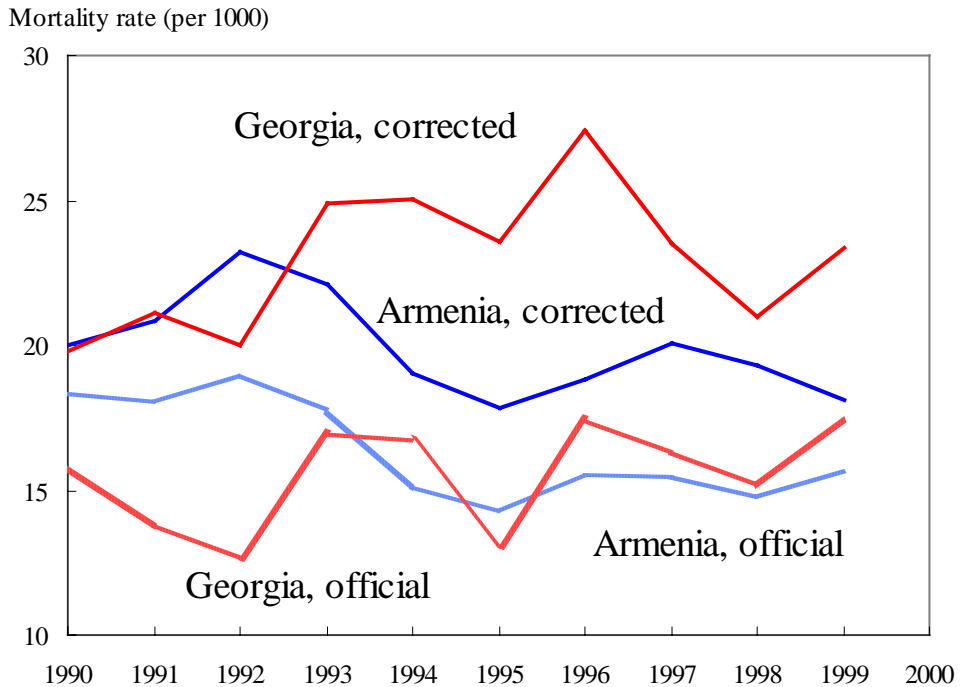
According to these corrections, infant mortality rates were about the same in Armenia and Georgia at the beginning of the 90's, whereas the official data showed a better situation in Georgia than in Armenia. In the same way, after 1992, it seems rather clear that infant mortality increased in Georgia while it was decreasing in Armenia. In the most recent years, however, the gap between the two countries narrowed again.

3.3 Old age mortality

For both Georgia and Armenia, we compared mortality rates by age obtained on the basis of registered deaths and our population estimates to those of different model life tables. For these two countries, like in Russia and other countries of the ex-USSR, age structure of mortality is very atypical, demonstrating an exceptionally high mortality at working ages (even if this phenomenon is less prominent than in Russia itself). However, at the young ages (except infant mortality) and among the oldest, mortality might fit to the models if death registration was complete.

Due to very different relative levels of mortality at young, middle and old ages, there is no model mortality schedule which would enable us to fit the observed mortality rates for the whole range of ages. Therefore, we decided to apply a very approximate approach by comparing Georgian and Armenian mortality patterns with several model life tables of the Coale and Demeny sets (1982) at similar levels of overall life expectancy. Our corrections of mortality at old ages, based on comparisons with model life tables, can not be considered exact. This is only one reasonable version of such correction.

We found that, for the year 1989, both Armenian and Georgian mortality at ages 70+ fit rather well with the model life table corresponding to the actual level of infant and child mortality (as corrected here above). The best fit was with model West level 23 which we finally took in reference for adjusting mortality at old ages. Indeed, for the successive years in the 90's, at the older ages, mortality rates are less than expected from the model. This is specially true for males in Georgia (Figure 6).

In this case of Georgian men, the deterioration was growing till 1993 about. So, we adopted correction coefficients for the years 1993-1999, adjusted from mean ratios observed for the period: 1.2 for age 70-74, 1.35 for age 75-79, 1.45 for age 80-84 and 1.5 for age 85 and over. For the years 1991 to 1992, we then interpolated correction coefficients for the same age groups assuming that no correction was needed for 1989 and 1990.

For Georgian women, on one hand, observed ratios were not enough clear to decide on proper correction coefficients. On the other hand, there is no reason for a better quality of death registration and we could even suspect a worse situation. So we decided to keep the same coefficients.

Figure 6: *Relative difference between observed male age-specific mortality rates of each year (1990 to 1999) and those of Coale and Demeny life table, model West, level 23, in Georgia and Armenia*
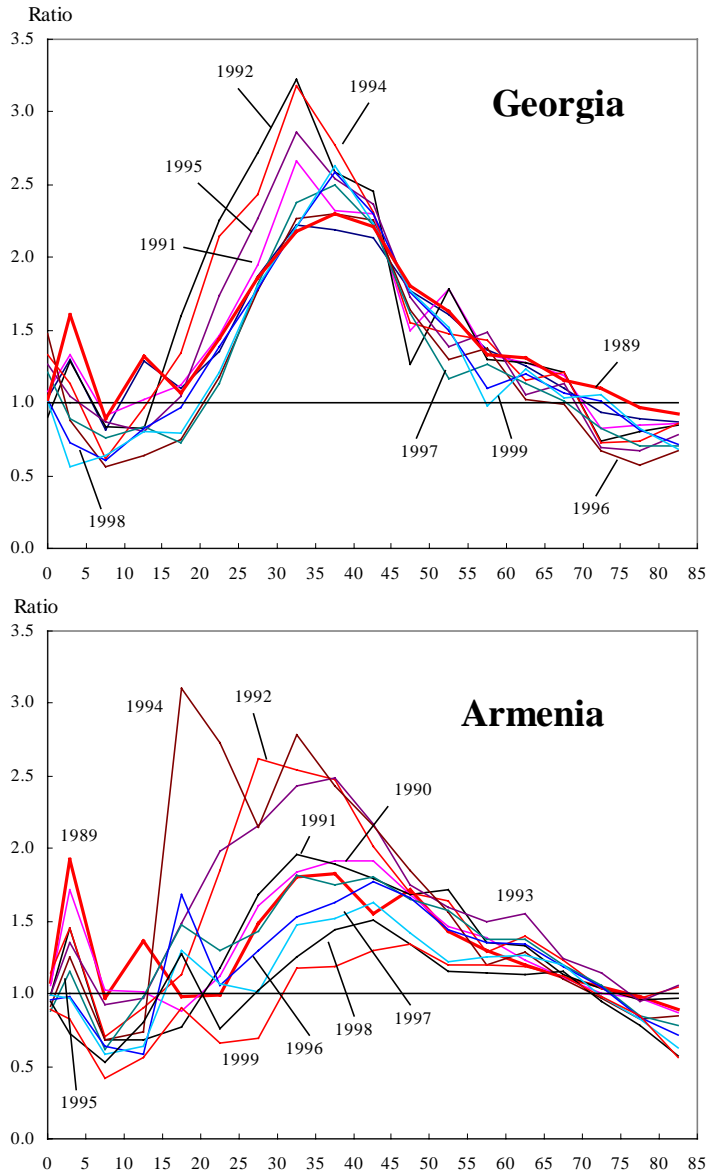
For Armenia, the deviation from the model life table at the older ages is less pronounced (Figure 6). At age 70-74, it is almost negligible except for the year 1993, where observed mortality is higher than in the model, which is not unrealistic in the context of the war. However at the upper ages, the deviation from the model is growing with age, which probably indicates an under-registration of deaths at the oldest ages. For these reasons, we decided to keep constant, for each year, the relative difference with the model after the age 70-74, at its level at this age.

4. New estimates of mortality changes

After all these corrections mortality rates were used to produce life tables for each year from 1990 to 1999, for each sex and both countries. The results are significantly different from the official data. They also change substantially the comparison that one can do with other countries of the former Soviet Union.

4.1 The effect of population overestimation and death under-registration

Final correction of the population at risk and numbers of deaths results in decrease of life expectancy at birth in 1999 by 3.8 years for males and 1.7 year for females in Armenia and by 5.2 and 5.6 years in Georgia, correspondingly. Revised values of life expectancy at birth are: 68.7 years and 75.4 years for males and females in Armenia, respectively, and 68.6 and 75.6 in Georgia, respectively (Table 2).

The greatest part of the correction is due to the re-estimation of populations, but correction of deaths also produces considerable modifications. In Georgia, for example with new estimates of population, in 1999, male life expectancy is 3.6 years less than with official data while the correction of deaths decreases life expectancy by an additional 1.7 years. Figure 7 displays the divergence with time between official data and successive corrections.

The total correction is much larger for Georgia than for Armenia and, in Armenia it is more important for males than for females. Another difference between the two countries is that the reduction of life expectancy due to the correction of the numbers of deaths is more important in Georgia than in Armenia.

Table 2: *Change in life expectancy at birth in the 90's according to official data, re-estimated populations and after correction of numbers of deaths*

Year	Males			Females		
	I	II	III	I	II	III
Armenia						
1989	69.11	69.11	68.70	74.99	74.99	74.82
1990	69.18	69.18	68.64	76.07	76.07	75.73
1991	69.03	68.87	68.37	75.73	75.68	75.16
1992	67.92	66.93	66.44	75.00	74.63	73.94
1993	67.61	65.60	65.00	74.66	73.86	73.46
1994	68.56	65.76	65.09	76.41	75.40	74.91
1995	69.61	66.93	66.02	76.12	75.06	74.50
1996	70.02	67.41	66.42	76.14	75.15	74.55
1997	71.25	68.74	67.35	76.74	75.80	74.74
1998	72.46	70.06	68.31	77.28	76.38	75.29
1999	72.50	70.30	68.69	77.10	76.21	75.36
Georgia						
1989	68.13	68.13	68.13	75.98	75.98	75.98
1990	68.90	69.04	68.73	76.44	76.50	76.23
1991	68.92	69.22	68.23	76.68	76.87	75.72
1992	69.00	69.04	67.76	76.84	76.89	75.25
1993	68.23	67.44	65.84	76.23	75.59	73.58
1994	70.76	69.11	67.28	78.52	76.98	74.79
1995	72.64	70.29	68.11	80.60	78.32	75.77
1996	74.84	71.67	69.29	82.44	79.27	76.55
1997	74.67	71.02	69.02	81.32	77.87	75.55
1998	74.19	70.16	68.34	82.00	77.98	75.76
1999	73.81	70.22	68.59	81.16	77.63	75.57

I : Population: Official. Number of death: Official
II : Population: With correction. Number of death: Official
III : Population: With correction. Number of death: Adjusted

Figure 7: *Trends in life expectancy at birth since 1989 according to official data and successive corrections for population and deaths*
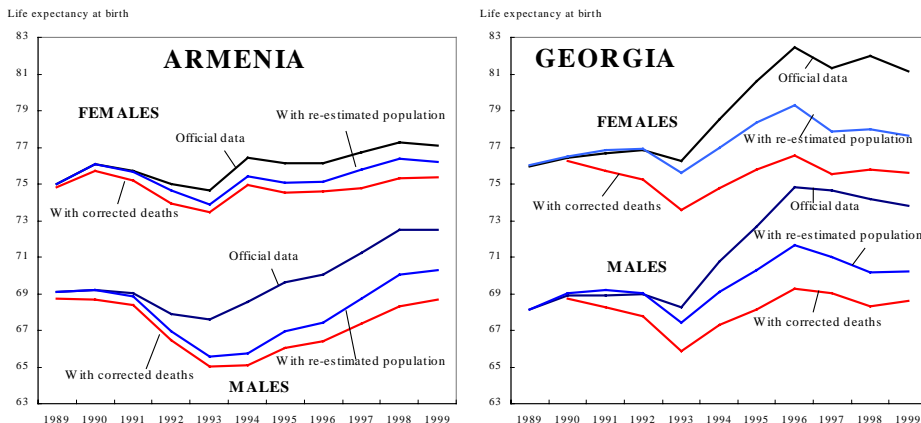
The remarkable difference in the importance of the correction between sexes in Armenia reflects the fact that net out-migration from this country involved much more men than women, whereas it seems that in Georgia this flow was more balanced.

Figure 8 compares males age specific mortality rates before and after correction and the impact of these corrections on the estimation of life expectancy at birth, for the year 1999. Corrected mortality curve is significantly different from the non corrected one at the older ages in both countries and we can clearly see here to what extent the corrected values are more reliable than the uncorrected ones, since they fit much better with the expected increase of mortality with age. This difference is obviously due to the corrections in death numbers. The impact of population re-estimation is more concentrated on adult ages, especially in Armenia. In Georgia, however, the correction of population numbers shows certain anomalies, since the corrected mortality curve is more fluctuating between ages 50 and 70 than the initial one.

Figure 8: *Age specific mortality rates before and after correction, and impact of the corrections on life expectancy at birth, for the year 1999*
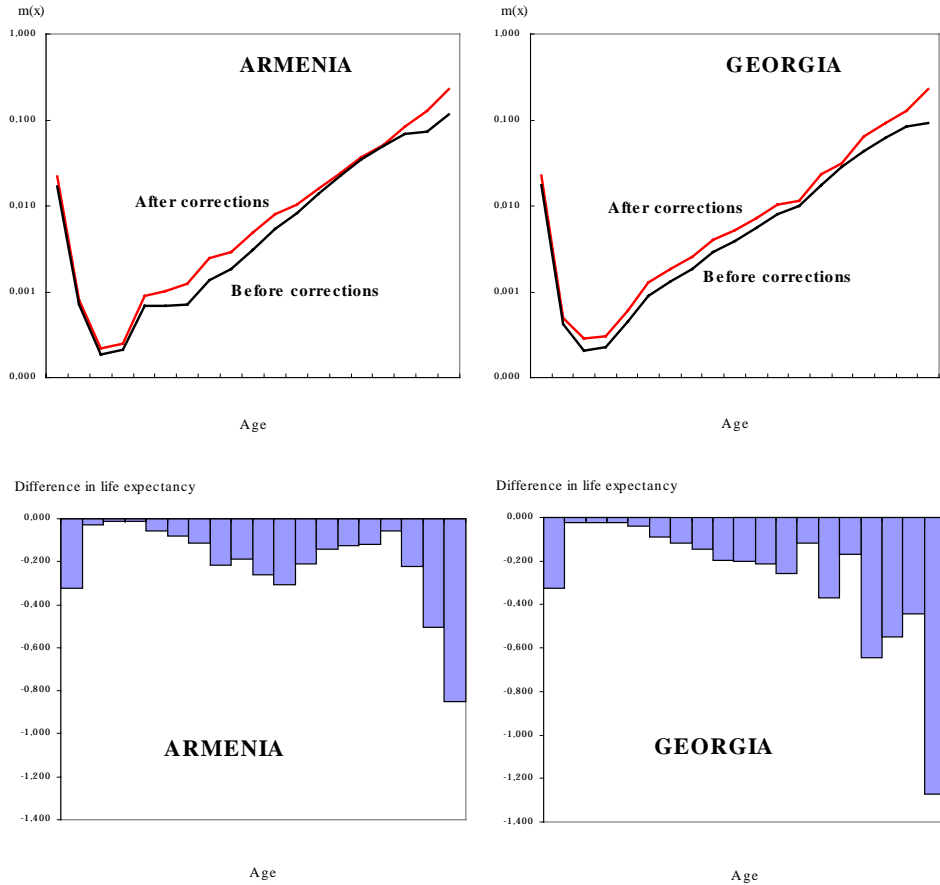
The lower panel of Figure 8 displays the specific amount of reduction in life expectancy at birth corresponding to these changes in age-specific mortality rates. In both countries, the re-estimation of infant mortality plays a certain role, since it decreases life expectancy at birth by more than 0.3 year but the main effect is provided by the correction of mortality rates at the older ages, especially in Georgia, where the only correction of the rate at the age 85+ reduces life expectancy by 1.3 year. However, in the total, correction made at the active ages is the most important: the correction of the mortality rates between the ages 15 and 75 reduces life expectancy at birth by 1.9 year in Armenia and 2.6 in Georgia, while the correction at the upper ages reduces it by 1.6 and 2.3 respectively.

4.2 Comparison with other countries of the ex-USSR

Figure 9 compares the corrected trends in life expectancy of Armenia and Georgia with some other countries of the former Soviet Union: Russia, Ukraine, Lithuania and Latvia.

Figure 9: *Corrected trends in life expectancy at birth in Armenia and Georgia compared with some other countries of the ex-USSR*
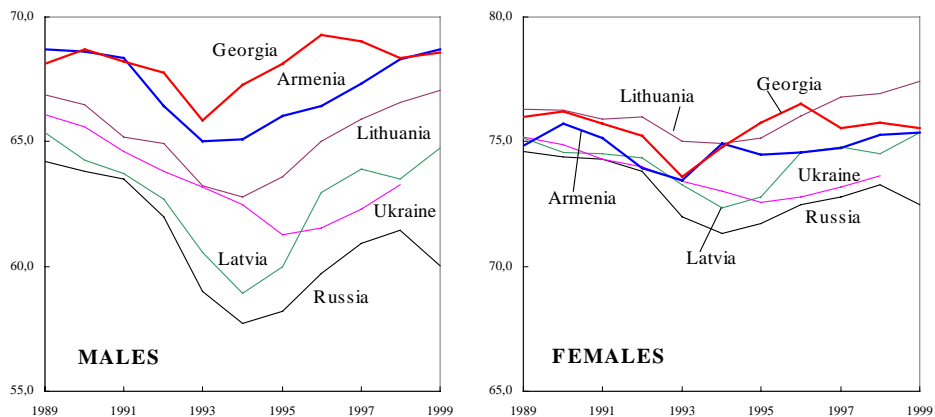
Even after correction, the levels of Caucasian male life expectancy remains substantially higher than those of the other ex-Soviet countries. However, they follow better the shape of the general trends, with a decrease in the early 90's followed by an improvement after 1994, especially in Armenia. In the case or Armenia, it seems that the dramatic events including the consequences of the Spitak earthquake and Nagorny Kharabach war had not more influence on mortality trends than the common history of the whole ex-USSR. The case of Georgia is less similar to the rest of ex-USSR, since the only marked deterioration occurred in 1993, and could be explained by the Abkhazian war. Nevertheless, all these countries, including the two Caucasian ones, are in 1999 back to their levels of 1989.

The situation of Caucasian countries is rather different for women than for men. Contrary to the latter, the former are not in a better position than the rest of ex-USSR countries. But also they seem much less affected by the big fluctuation which characterises Russia and other northern republics.

5. Conclusion

This work is only a first attempt to produce more reliable estimations of Caucasian mortality. The results could be improved later, especially when the results of new censuses will be available to re-estimate populations. But it will probably remain necessary for a longer time to use estimations of under-registration of deaths. Even if it can be improved later, it seems to us that this first attempt already allows to get more precise idea on the recent trends and especially to know how these countries have passed through the consequences of Independence, transition to a market economy, and more specific local events like Armenian earthquake and Caucasian wars. It is at least easier to compare their situation to those of other countries of the ex-USSR.

Notes

1. Paper presented at the Helsinki, June 7-9 European Population Conference-2001 Theme C: Health, morbidity and mortality.

2. These values are computed from official populations and deaths (Tsuladze and Maglaperidze, 2000).

3. Since 1993 indicators for Georgia do not cover the territory of Abkhazia and part of South Ossetia. These regions are de facto not under the Georgian authority since the early 1990s.

4. Excluding Abkhazia and Tskhinvali region (South-Ossetia).

5. GCPR is the Georgian Centre for Population Research, SDSG is the State Department of Statistics of Georgia, and CSS is the Centre for Social Studies.

6. Russian head-letters for the local authorities recording vital events.

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Annex I. Tables

Table Annex 1: *Estimation of Georgian population by age groups from January 1st 1990 to January 1st 2000 (in thousands)*

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Males											
-1	46.1	46.6	44.6	36.3	31.2	29.3	28.8	27.6	27.5	26.0	25.4
1-4	188.8	182.7	175.5	161.8	141.6	130.5	120.9	112.2	105.7	104.5	103.4
5-9	228.3	224.1	218.5	204.7	182.1	170.8	161.3	152.7	146.9	145.3	141.7
10-14	219.0	219.7	218.9	209.6	190.6	183.0	177.0	171.7	169.3	167.4	162.1
15-19	214.2	214.1	212.6	202.8	183.9	175.9	169.3	163.7	160.8	159.0	159.4
20-24	202.2	201.1	198.7	188.6	170.1	161.9	155.1	149.2	145.7	144.1	143.7
25-29	225.4	220.4	214.2	199.7	177.0	165.3	155.2	146.4	140.2	138.6	136.6
30-34	204.1	201.2	197.0	185.3	165.6	156.1	148.1	140.9	136.3	134.8	132.4
35-39	178.8	181.5	183.0	177.3	163.2	158.5	154.9	151.8	151.3	149.6	142.1
40-44	139.0	143.7	147.6	145.3	136.0	134.2	133.1	132.3	133.7	132.2	133.0
45-49	120.7	125.2	129.0	127.4	119.5	118.1	117.5	117.2	118.6	117.3	117.8
50-54	170.7	162.5	153.4	138.6	118.7	106.8	96.4	87.0	79.3	78.4	84.8
55-59	136.3	137.2	137.2	131.9	120.5	116.1	112.6	109.6	108.5	107.3	99.3
60-64	136.2	136.0	135.0	128.8	116.7	111.6	107.5	103.8	102.0	100.9	99.7
65-69	65.8	73.6	81.0	84.8	83.7	86.7	89.8	92.9	97.3	96.3	93.9
70-74	36.8	44.0	51.0	55.5	56.7	60.2	63.9	67.3	71.7	71.0	72.4
75-79	33.7	34.2	34.6	33.6	31.0	30.2	29.5	29.0	29.0	28.7	34.7
80-84	18.4	18.9	19.3	19.0	17.7	17.4	17.2	17.0	17.1	17.0	17.0
85+	10.4	11.0	11.6	11.6	11.1	11.2	11.3	11.4	11.7	11.6	12.2
Total	2574.9	2577.7	2562.7	2442.6	2216.9	2123.8	2049.4	1983.7	1952.6	1930.0	1911.6
Females											
-1	43.4	44.3	42.5	34.5	28.5	26.3	25.9	24.6	23.2	22.6	21.5
1-4	180.0	173.6	165.6	152.1	132.0	121.1	111.2	102.5	95.7	95.0	93.2
5-9	220.2	216.1	210.0	196.6	174.3	163.6	153.8	145.6	139.8	138.8	134.2
10-14	211.0	211.7	210.3	201.5	182.9	175.7	169.4	164.5	162.1	160.9	155.7
15-19	200.0	200.9	199.8	191.7	174.2	167.6	161.7	157.2	155.1	154.0	154.2
20-24	201.7	202.8	202.0	194.0	176.5	170.1	164.3	159.9	158.0	156.8	153.8
25-29	241.2	235.9	228.6	213.0	188.2	175.8	164.6	155.1	148.2	147.1	147.4
30-34	219.6	216.6	211.7	199.2	177.6	167.6	158.6	151.1	146.1	145.0	143.3
35-39	192.4	195.8	197.4	191.8	176.5	172.0	168.0	165.3	165.1	163.9	156.9
40-44	151.5	157.3	161.7	160.0	149.9	148.5	147.4	147.3	149.4	148.2	149.3
45-49	139.8	145.0	148.7	147.0	137.5	136.0	134.8	134.5	136.3	135.2	136.0
50-54	188.7	181.7	172.8	158.2	136.9	125.2	114.4	105.1	97.6	96.8	103.5
55-59	158.3	160.8	161.6	156.6	143.8	139.8	136.2	133.8	133.3	132.2	123.4
60-64	168.6	170.4	170.5	164.5	150.3	145.5	141.1	138.0	136.9	135.8	133.3
65-69	112.4	119.3	124.9	125.8	119.7	120.4	121.2	122.7	125.9	124.9	124.6
70-74	79.7	86.0	91.4	93.3	89.9	91.4	92.9	94.9	98.1	97.3	99.5
75-79	71.2	72.6	73.2	71.1	65.5	63.8	62.4	61.4	61.3	60.8	64.8
80-84	40.4	41.6	42.3	41.5	38.5	37.9	37.3	37.0	37.2	36.9	37.4
85+	26.7	28.1	29.1	29.0	27.4	27.4	27.4	27.5	28.1	27.8	27.7
Total	2846.8	2860.5	2844.1	2721.4	2470.1	2375.7	2292.6	2228.0	2197.4	2180.0	2159.7
Gr.Total	5421.7	5438.2	5406.8	5164.0	4687.0	4499.5	4342.0	4211.7	4150.0	4110.0	4071.3

Table Annex 2: *Estimation of Armenian population by age groups from January 1ˢ 1989 to January 1ˢᵗ 2000 (in thousands)*

Age	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Males
0	37.5	38.3	40.4	38.7	32.4	26.2	22.7	21.9	22.0	20.5	18.8	17.7
1-4	144.7	160.1	156.6	153.5	141.1	131.8	122.4	111.5	100.6	92.4	87.3	82.8
5-9	160.8	187.8	193.2	193.1	180.9	172.0	165.9	165.7	165.3	162.2	156.4	146.5
10-14	136.8	164.6	168.7	169.3	159.9	155.9	157.0	161.4	165.1	167.9	168.7	165.9
15-19	132.2	149.4	152.0	149.0	138.0	131.8	130.4	132.3	135.0	136.7	139.0	140.9
20-24	131.8	141.0	141.0	137.2	124.6	115.9	111.0	109.8	109.2	108.8	108.6	107.7
25-29	159.8	159.2	152.3	141.5	121.5	107.2	99.1	95.1	92.0	88.9	85.6	81.3
30-34	137.9	152.1	160.7	155.4	136.9	121.0	109.6	99.3	92.4	84.8	78.1	72.0
35-39	103.7	111.9	117.9	119.5	113.1	111.1	109.9	112.1	109.8	105.6	99.8	93.0
40-44	59.0	75.8	85.5	87.7	83.8	80.7	81.1	82.4	84.1	86.0	89.3	89.6
45-49	64.4	56.8	49.8	48.6	49.0	52.2	56.1	61.5	64.6	67.3	69.3	71.6
50-54	83.3	89.9	89.4	83.1	67.7	54.9	44.7	38.8	39.1	43.1	49.4	55.4
55-59	74.4	71.8	71.3	73.1	69.8	69.7	72.4	72.3	69.3	62.3	54.2	45.9
60-64	56.0	72.2	76.2	73.8	67.1	61.4	57.0	57.1	59.8	62.0	65.8	70.5
65-69	19.6	30.0	35.4	43.5	48.1	52.7	54.7	58.2	57.4	56.9	55.2	52.6
70-74	12.3	14.3	14.4	15.1	16.0	17.4	21.6	25.6	32.1	38.9	45.8	48.6
75-79	12.8	15.0	14.3	13.3	11.5	11.0	9.9	10.0	10.8	12.0	13.2	17.2
80-84	7.1	9.1	9.1	9.0	8.8	8.6	9.3	9.4	8.9	8.2	8.4	7.6
85 +	4.3	5.5	5.8	5.8	5.8	5.7	5.5	5.8	6.2	7.1	7.7	9.0
Total	1538.4	1704.8	1734.0	1710.0	1576.2	1487.4	1440.4	1430.2	1423.7	1411.6	1400.7	1375.8
Females
0	36.7	35.7	38.2	37.2	32.0	25.8	21.8	21.0	20.6	18.7	16.6	15.2
1-4	136.9	151.9	148.0	145.6	139.2	132.5	123.6	110.7	98.0	87.9	80.9	74.7
5-9	152.2	178.4	184.3	186.3	180.4	173.8	168.3	166.7	164.9	160.8	153.0	140.6
10-14	129.8	157.2	160.7	163.4	160.1	158.9	161.2	165.7	168.7	170.1	168.6	163.3
15-19	117.1	140.9	145.3	147.1	142.5	139.5	139.9	141.8	145.8	148.1	151.1	152.9
20-24	131.7	145.1	139.7	135.9	129.7	125.1	123.7	125.7	127.6	127.9	128.3	128.1
25-29	159.9	173.5	166.2	157.5	144.9	133.9	124.3	117.2	113.3	111.3	109.7	107.5
30-34	135.6	167.4	175.8	175.8	165.4	155.0	146.0	136.8	129.1	122.5	115.6	106.5
35-39	103.3	126.7	134.1	139.5	138.7	139.0	142.0	145.6	145.9	142.6	137.2	129.2
40-44	60.2	84.8	95.6	100.3	102.5	103.0	106.5	110.9	115.8	119.4	123.0	125.2
45-49	66.5	65.1	57.8	58.0	60.6	66.2	73.1	80.8	85.1	90.5	94.3	98.0
50-54	84.3	101.3	101.8	96.3	83.1	68.7	58.2	51.1	51.9	56.2	64.5	72.0
55-59	76.8	79.8	79.6	85.0	84.6	86.2	90.6	91.1	87.0	78.2	67.3	57.6
60-64	69.9	80.5	84.9	83.6	81.1	75.9	70.6	70.3	75.3	77.8	82.0	86.7
65-69	32.1	43.7	48.9	57.6	62.8	66.9	68.9	72.9	71.7	72.3	70.2	65.2
70-74	23.8	25.8	26.9	27.0	28.8	29.2	35.5	39.4	46.9	53.1	59.5	61.3
75-79	22.2	26.2	25.3	24.7	22.6	21.9	19.7	20.8	20.4	22.2	23.3	29.1
80-84	13.0	16.2	16.5	16.6	17.9	16.2	17.3	17.0	16.7	15.5	16.8	14.7
85 +	7.7	9.9	10.9	11.4	11.3	10.8	10.8	10.9	11.4	12.7	12.6	14.1
Total	1559.7	1810.1	1840.5	1848.9	1788.3	1728.6	1702.0	1696.3	1696.0	1688.0	1674.6	1641.9

Annex II. Questions about sex ratio at birth

As it appears at the figure-annex below, according to the WHO Mortality Database, registered sex ratio at birth has suddenly risen since the mid 90's in the three Caucasian countries, while no changes are observed in the other countries of the former USSR. Especially we do not see any change in Central Asian countries like Uzbekistan, Tadjikistan, etc. To explain this change, it is necessary either to think of a real change or to refer to a worsening in the quality of registration. As far as the quality of registration is concerned, it would be necessary to assume that there is an advantage for a better registration for boys than for girls. It could be the case if families demonstrate a male preference. This assumption is however rather weak since it could better apply to countries like Tadjikistan, Kyrgyzstan or Uzbekistan, or even Azerbaijan than to Armenia or Georgia. It clearly appears here as a Caucasian phenomenon than a question of Muslim culture.

As far as the change in sex ratio at birth could be an actual fact, it is even more difficult to explain. Indeed it is theoretically possible to think of selective abortion in favour of males like it can be observed in some regions of India or China (Miller, 1996). However, it would be necessary to assume the emergence or re-emergence of a very strong male preference.

It seems to us that it is impossible to propose any hypothesis before doing more precise investigation, which is not allowed to us in the frame of this only paper.

Figure Annex: *Trends in sex ratio at birth in the three Caucasian countries as compared with some other countries of the former Soviet Union (source: WHO mortality data base)*