Annals of Global Health
VOL. 82, NO. 5, 2016

ISSN 2214-9996/$36.00
http://dx.doi.org/10.1016/j.aogh.2016.10.005

ORIGINAL RESEARCH

Mortality Trends in Young People Aged 1-24 Years: Argentina, 1947-2012

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Abstract

BACKGROUND Global mortality trends highlight changing patterns in young people, especially young men, yet little evidence of long-term trends is available in Argentina.

OBJECTIVE Given the lack of published evidenced within the country, this work seeks to construct long-term mortality trends for young people in Argentina.

METHODS A descriptive mortality time series was developed for ages 1-24 years by sex and cause of death in Argentina during 1947-2012. Diverse international and domestic public data sources were used to calculate the specific mortality rates. Causes of death were classified into the 3 Global Burden of Disease groups to ensure comparability.

FINDINGS The greatest decline in mortality was found in the 1-4 year age group. Women and girls of all ages had large decreases in mortality. Mortality in boys and men aged 15-24 years declined, but much less than in all other groups; mortality in this group was twice that of women and girls by 2012. Mortality as a result of communicable, nutritional, and maternal causes declined in all groups, but in young men injury mortality increased. In all groups, reductions were greater during the first half of the period.

CONCLUSIONS Long-term trends offer a broader view of health phenomena—like injury mortality, disproportionately affecting young men—so as to better inform actions and policy that could change ways of living and dying in Argentina.

KEY WORDS child, adolescent, young adult, mortality, time series studies, Argentina

INTRODUCTION

In Argentina, daily life has changed dramatically over the last 65 years. Political, economic, and technological changes mark ways of living and of dying, generating new health and disease patterns. Viner et al[1] carried out a study on mortality in people aged 1-24 years in 50 countries over 50 years (1955-2004), although Argentina was not included because of lack of data in the World Health Organization (WHO) Mortality Database. The authors found, for the first time at a global level, that the mortality rate in children 1-4 years is less than that of men and boys 15-19 and 20-24 years and women 20-24 years. These findings invite us to rethink the emphasis placed on under-5 mortality, given that the 1-4 age group is no longer one of the most vulnerable in terms of human health.

Studies have been done in Argentina regarding infant mortality and mortality in adolescents, especially regarding injuries as a cause of death at the national or regional level.[2-15] Although numerous

None of the authors have sources of funding or conflict of interests to declare.
All authors had access to the data and took part in writing the manuscript.
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studies exist regarding mortality in Argentina, studies with time series longer than 3 decades or that focus on the ages of 1-24 years were not found. A longer tendency and the inclusion of other ages help shed light on the particular development of mortality in young people in the Argentine context, which is needed for a more thorough comprehension of the changes that have been produced.

METHODS

A descriptive study of mortality trends in people of 1-24 years (by age group) was carried out for the period 1947-2012 in Argentina. All-cause mortality by age and sex was analyzed starting in 1947 and by age, sex, and cause group starting in 1960, because no prior information on causes could be located. Numerous secondary sources, including historic official publications, were used to construct the time series.[16-37] Many of these sources were historical publications of vital statistics or population estimates, spanning different national government agencies under the Health Ministry, the Finance Ministry, and National Institute of Statistics and Censuses as political changes occurred. Because the majority of the sources for the earliest years of the series were not in electronic format, save some years that formed part of the WHO Mortality Database, they are not easily located outside of specific libraries within the country. Most included data already grouped by sex, age group, and, when relevant, cause, although in the later years of the series the official mortality data were provided at the individual level. In many cases it was necessary to use more than 1 source to recover information for all age groups and both sexes, and it was not possible to recover mortality information for some years of the series, particularly in the years of institutional crisis preceding the last military dictatorship. When more than 1 source of information was available, that which was identified as the original source (or an electronic version with the same data) was used; when that could not be determined, the data that best corresponded with the other data sets in the series were chosen. For more information regarding sources used, please see the online supplement.

Different sources were used for all-cause mortality and mortality by cause given the scarcity of information regarding causes. Because secondary sources were used, no ethics committee approval was needed.

Mortality Trends by Age and Sex. Specific rates were calculated according to sex and 5-year age group, using only records with sex and age information, and a descriptive analysis was performed. Because the focus of the study was on the mortality trends in each age group, and it was not of interest to generate a general or summary trend for the age range of 1-24 years as a whole, age-adjusted mortality rates were not used. Constructing specific rates by age group and sex assumes a certain internal homogeneity in each group—that is, that the experience of mortality is similar in each of the ages contained within the 5-year group.

Percent variation each year with respect to 1960 (the first year with information on all age groups and causes) and male-to-female rate ratios were also calculated.

Morality Trends by Age, Sex, and Cause. Information on underlying cause of death was organized into 3 large groups, using the WHO Global Burden of Disease Classifications[38]: group I, communicable, maternal, and nutritional conditions; group II, noncommunicable diseases; and group III, injuries. "Garbage" or unspecific codes—in our study, these were primarily ill-defined causes—were distributed in a prorated fashion between groups I and II.[38]

Given the number of years and sources included in the study, a number of revisions and lists of the International Classification of Disease (ICD) were used. To overcome difficulties posed by years in which the causes were not disaggregated in the manner described by the WHO (1960-1966, 1979, 1982-1989), percentage equivalents were established using years with same revisions (seventh and ninth) but with greater cause disaggregation.

Once causes of death were properly classified, mortality rates by sex and cause groups were calculated by 10-year age groups, in accordance with Viner et al.[1] As with the prior analysis, it was not necessary to adjust the rates for age because the rates calculated were specific to each age group. Percent variation for each year with respect to 1960 was calculated by sex and age, as well as proportional mortality owing to each cause group. Finally, male-to-female rate ratios were calculated according to age and cause group.

RESULTS

Mortality Trends by Sex and Age. In Figure 1 the mortality trends for males and females aged 1-24 years in the period 1947-2012 can be seen. No information was available for the 20-24 age group in the years 1947-1953 and 1971-1976.

Mortality rates are similar in males and females at the start of the series. In both sexes, at the start

Annals of Global Health, VOL. 82, NO. 5, 2016
September–October 2016: 738–748

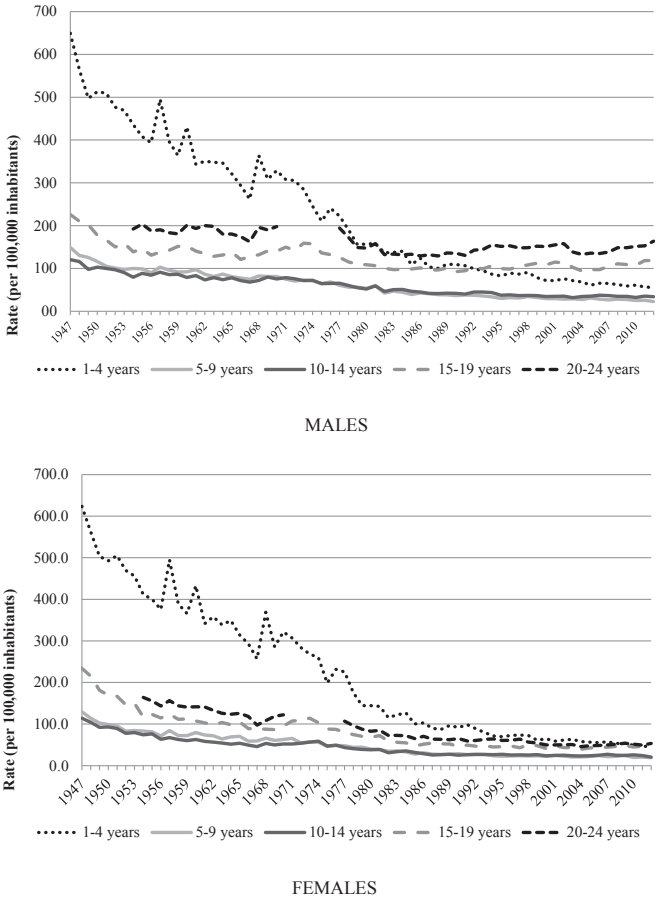

Figure 1. All-cause mortality trends by sex and age group in people aged 1-24 years. Argentina, 1947-2012. (Source: Authors' elaboration using data from official publications[16-18,20-35] and the mortality and live birth databases of the Office of Statistics and Health information of the Argentine Ministry of Health. *Note*: No information could be obtained for the 20-24 year age group for the years 1947-1953 and 1971-1976.)

of the period, the highest rate is found in children 1-4 years, followed by the groups of 20-24 years (which begins later in the series because of lack of information), 15-19 years, and 5-9 years, with the lowest rates in young people 10-14 years. Mortality in children 1-4 years is almost triple the mortality in people aged 15-19 years at the start of the period and almost double those aged 20-24 years in the first year with that information, 1954. A reduction in mortality in all ages and both sexes can be identified; nevertheless, the strongest reduction in mortality can be found in children in the 1-4 year age group. Mortality is lower in young people aged 5-14 years throughout the series; although the groups of 5-9 years and 10-14 years change order, the rates are very similar in these 2 groups—especially after 1972—and they decline consistently.

In males, the mortality in the 1-4 year group declines in such a way that after 1984, it is lower than in the 20-24 year group, and after 1992, than in 15-19 year group. At the end of the period, the rate in the 1-4 year group approaches that of the 5-9 and 10-14 year groups. At that point, mortality in men 20-24 years is double that of boys 1-4 years, and the mortality in males 15-19 years is 1.6 times greater. The rates in males aged 15-19 and 20-24 years have periods of increase, leveling, and decline throughout the series. At the start there are periods of increase, but from 1980-1991 there is little change in mortality. Rates once again increase toward the end of the period, and in the final year of the series rates are similar to those in 1980.

In females, 1-4 year mortality decreases in such a way that rates are similar to those in the 15-24 year group after 1995. The rates in the latter group also

have a declining trend throughout the series and are much lower than the rates in males of the same age by the last year. Some periods of slight increase may also be found in the first half of the series in females aged 15-24 years, but rates level in the second half of the series.

The rate ratios evidence a growing gap in mortality between males and females aged 15-19 and 20-24 years. Although the rate ratio is close to 1 at the start of the period, it reaches a high point of 3.14 in 2002 in the 20-24 year age group. After 2002 this difference begins to diminish slightly, but starting in 2008 it once again widens, reaching 3.06 at the end of the period in this same age group. A similar pattern is noted for the 15-19 year group, with a high point of 2.63 in 2000 and then 2.40 at the end of the period.

Using 1960 as the reference point, Table 1 summarizes the percent variation in mortality each decade of the study. As can be seen in the upper portion of the table, mortality in children 1-4 years of both sexes experienced the greatest reduction, reaching 88% at the end of the period with respect to 1960. Mortality reductions are similar in males and females until the 15-24 year age group; at that point reductions are much less in males. Rates in young men 15-24 years had the least percent change, as well as a number of periods of increase. Indeed, the periods of mortality reduction from 1980-2012 were insufficient to produce a sustained decline in mortality for these age groups after 1980. Rates in females aged 15-24 years reduced greatly by the end of the period, although not as much as in the other age groups.

Morality Trends by Age, Sex, and Cause Group. The analysis by cause was carried out using 3 large cause groups: group I (communicable, maternal, and nutritional conditions), group II (noncommunicable diseases), and group III (injuries). Trends were analyzed according to sex and 2 age groups, 1-9 years and 10-24 years. Mortality cause data were not found for the years 1971-1976.

Mortality Trends by Sex and Cause Group, 1-9 Years. As Figure 2 denotes, at the start of the period the highest mortality for the ages 1-9 years in both sexes is in group I, although groups II and III are also significant in the mortality composition. In boys and girls, the mortality trends for group I causes define the behavior of all-cause mortality given the group's greater participation in mortality composition. However, in girls all-cause mortality remained steady because of the smaller reduction in group II and especially group III mortality from 1979-1991, descending once again after 1991 when group II and III mortality began to drop. After 1984, the group I mortality rate was always less than that of group II and approached that of group III, overtaking the latter at the end of the period. In boys, all-cause mortality drops steadily because of the reduction in mortality rates in group II and to some degree group III. Group I rates are always lower than group II rates after 1979 and are lower than group III rates after 1991.

The lower portion of Table 1 shows percent variation calculated using sources with cause information. The percent variation indicates reductions in mortality as a result of group I causes in both females and males, reaching more than 90% at the end of the period. Group II causes had smaller but still important mortality reductions of about 70% over the period. Group III causes had differences between the sexes, with the reduction noted consistently in males. At the end of the period a reduction of more than 40% in both sexes was observed.

Because of the dramatic reduction in group I mortality, this group explains only 15% of mortality in 1-9 year olds at the end of the period, compared with more than 60% at the start. The smaller reductions in mortality as a result of group II and III causes gives them greater importance in the composition of all-cause mortality: Group II causes go from accounting for 30% to more than 50% of all-cause mortality and group III from 10% to 30% approximately. The pattern is similar in both sexes.

Mortality Trends by Sex and Cause Group, 10-24 Years. From the start of the period important differences between males and females aged 10-24 years can be observed (Fig. 3).

In men and boys, the highest mortality is attributable to group III causes, and all-cause mortality changed according to trends in that cause group. There was a sharp increase in group III mortality starting in 1967. After 1977, group III mortality declined and then leveled, followed by an increasing trend between 1990 and 2002, which corresponds with an increase in all-cause mortality for those ages. Starting in 2004 the group III rates again increased until the end of the period. Total mortality also increased in this period. Mortality as a result of group II and III causes tended to reduce or remain steady over the period, but not enough to influence the direction of all-cause mortality.

In women and girls, the highest mortality at the start of the period is attributable to group II causes, followed by group I and then group II causes.

Table 1. Percent Variation in Mortality Rates by Sex, Age Group, and Cause, Argentina, 1960-2012

	1970		1980		1990		2000		2010		2012	
	M	F	M	F	M	F	M	F	M	F	M	F
Percent variation in all-cause mortality												
1-4 y	−23.7	−25.7	−63.5	−66.7	−74.8	−78.8	−83.2	−85.0	−85.8	−88.7	−87.1	−89.0
5-9 y	−11.8	−20.7	−41.8	−49.5	−60.3	−63.8	−67.7	−71.7	−72.6	−75.5	−75.4	−76.0
10-14 y	−4.2	−17.3	−34.0	−39.2	−46.9	−60.2	−56.3	−62.1	−59.2	−58.8	−56.9	−67.5
15-19 y	−7.7	−11.6	−28.5	−36.4	−39.2	−57.0	−28.7	−61.7	−29.3	−58.5	−21.7	−53.9
20-24 y	−1.5	−13.6	−26.4	−41.7	−32.6	−54.1	−24.7	−64.8	−24.5	−63.5	−18.4	−62.2
Percent variation by cause group												
1-9 y												
Group I	−20.0	−16.4	−72.1	−71.6	−84.0	−86.2	−93.0	−93.7	−94.2	−95.4	−96.1	−96.3
Group II	−21.6	−28.4	−41.1	−53.6	−60.3	−59.2	−68.3	−66.2	−69.9	−73.3	−71.7	−71.2
Group III	19.8	25.8	4.8	22.2	−17.6	−21.7	−32.0	−32.3	−50.3	−43.3	−50.5	−48.1
Total	−15.8	−16.7	−53.7	−69.8	−69.1	−73.1	−78.4	−80.7	−81.7	−84.7	−83.4	−85.0
10-24 y												
Group I	−43.9	−36.9	−69.0	−65.0	−76.6	−80.4	−78.0	−84.0	−76.9	−81.7	−78.1	−83.5
Group II	−21.3	−15.3	−29.5	−32.6	−42.1	−49.5	−51.6	−62.8	−48.0	−57.4	−47.1	−59.8
Group III	31.6	41.6	−5.9	1.2	−18.1	−28.9	8.8	−19.1	4.7	−22.5	18.9	−11.0
Total	−1.4	−12.2	−26.5	−38.0	−37.9	−56.9	−28.9	−62.1	−29.4	−59.6	−22.8	−59.0

Note: Percent variation is calculated with respect to 1960.
Group I = communicable, maternal and nutritional conditions; group II = noncommunicable diseases; group III = injuries.
Source: Authors' elaboration based in data from official publications,[17-35] mortality classification resources,[36,37] and the mortality and live birth databases of the Office of Statistics and Health information of the Argentine Ministry of Health.

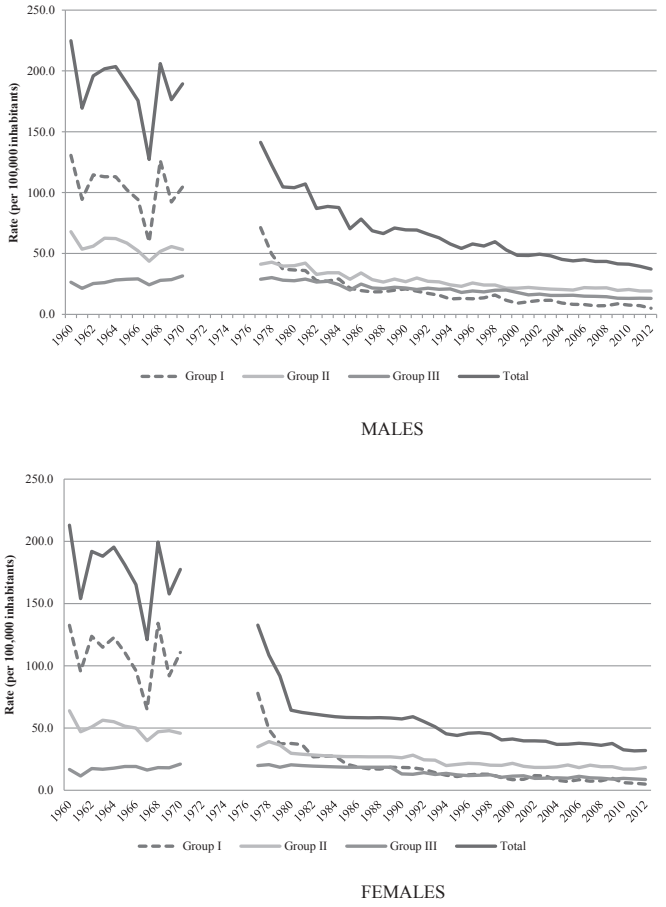

Figure 2. Mortality trends by sex and cause group, children 1-9 years, Argentina, 1960-2012. (Source: Authors' elaboration based in data from official publications,[17-35] mortality classification resources,[36,37] and the mortality and live birth databases of the Office of Statistics and Health information of the Argentine Ministry of Health. *Note*: No information could be obtained for the 1971-1976 period. Group I = communicable, maternal and nutritional conditions; group II = noncommunicable diseases; group III = injuries.)

Group I and II mortality tended to decline over the period, especially until 2001 and 1994, respectively. However, the mortality as a result of group III causes increased from 1990-1999 and then remained steady for the rest of the period. These different mortality profiles produced a leveling in all-cause mortality from 1989-1999, followed by a small period of decline and then a new increasing trend until 2010 as a result of slight relative increases in group II and III mortality and leveling in group I rates. At the end of the period, group I causes had the lowest mortality rates, whereas rates as a result of group II and III causes were at similar levels.

Percent change (Table 1) indicates an important reduction in group I causes in both males and females, reaching 80% in both sexes. However, the greatest reductions were achieved by 1990. In males, group II mortality tended to reduce, but somewhat erratically; the greatest reductions were achieved by 2000. In females the reduction in group II causes was more marked, but also achieved by 2000, after reaching 60%. In both sexes, group III mortality increased during the period 1960-1970 and declined when the series restarted. However, in males, mortality as a result of group III causes never reduced more than 20% compared with the first year of the study and increased over some periods. By the end of the study period, group III mortality was 19% higher than it was in 1960. In females, reductions occurred compared with the first year of the study, although after fluctuations throughout the period, only an 11% reduction in group III mortality can be identified.

In males, the small contribution of group I causes in mortality composition continued to diminish over

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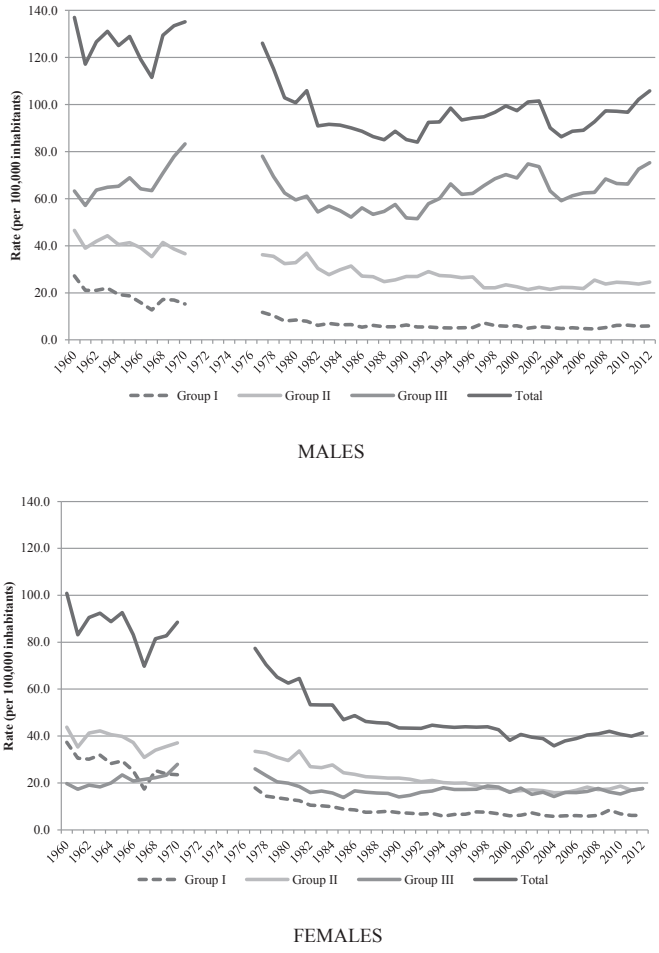

Figure 3. Mortality trends by sex and cause group, young people 10-24 years, Argentina, 1960-2012. (Source: Authors' elaboration based in data from official publications,[17-35] mortality classification resources,[36,37] and the mortality and live birth databases of the Office of Statistics and Health information of the Argentine Ministry of Health. *Note*: No information could be obtained for the 1971-1976 period. Group I = communicable, maternal and nutritional conditions; group II = noncommunicable diseases; group III = injuries.)

the period, going from 20% to 5%. The percentage resulting from group II causes also declined, from 35% to 20%. These reductions therefore imply an increasing contribution of group III mortality, going from 50% to 75%. In females a decline in group I causes can be noted in the mortality composition, from 35% to 15%. The group II causes made up approximately 45% of all-cause mortality over the period, with little variation. Group III causes therefore became more important in the mortality composition in females, going from 20% to 40%.

Similar mortality levels resulting from group I and group II causes can be noted between males and females. Therefore, the male-to-female rate ratio indicates a growing gap between the sexes as a result of group III mortality. The ratio reached its high point in 2002 with an injury mortality rate 4.86 times greater in males than females; at the end of the period the rate remained 4.29 times higher.

DISCUSSION

This study describes the mortality trends in young people aged 1-24 years in Argentina over the course of 65 years, a perspective not found in other studies.

These results are similar to those reported by Viner et al.[1] In Argentina, the same dramatic reduction in mortality in those aged 1-4 years is seen, becoming lower than mortality in males 15-19 and 20-24 years, and equal to mortality in females 15-19 and 20-24 years—this latter result was not

seen in Viner et al's study—with general decreasing trends in all ages and sexes. What is also different in our study is that the mortality in males aged 15-24 shows periods of stagnation and increase in the last 3 decades of the series.

In terms of mortality in young adults in Argentina, our results coincide with those of Mychaszula,[4] who observes an increase in mortality from 1991-2001 in males 15-19 years and a smaller decrease in mortality in the period in comparison with 1980-1990. In particular, our results affirm the findings of Serfaty et al[6] who saw an increase in the mortality of males 15-24 years between 1991-2000, and Yunes and Zubarew,[7] who documented an increase in mortality rates in this age group between 1980-1996. The pattern of reductions is similar to that seen in Rojas Cabrera et al,[3] who used other years of comparison, but in their work the reduction in females 10-14 years is less than that of young women 15-19 years in Argentina.

In our cause analysis, group I mortality in 1-9 year olds reduced such that at the end of the period rates were lower than in the other cause groups, reaching a 97% reduction. In both sexes groups II and III causes took on greater importance in the composition of the mortality. These trends are similar to those reported by Viner et al,[1] who also noted that from 1980 onward, the group I and group II causes together represent 75% of all-cause mortality, with little change in the second half of the series. A similar phenomenon can be noted in our results.

Group III causes were clearly the most important in males 10-24 years, although this cause group was also important in females. These results closely follow those of the study by Viner et al[1] for Central and South America. The authors also reported an increase in the importance of group III causes in young men and women, accounting for 70% and 30% of all-cause mortality by the end of the period, respectively. Worldwide in 2004, the first 3 causes of mortality in young men aged 15-24 were traffic accidents, violence, and self-inflicted injuries.[39] In that year, the primary causes of mortality in South America and the Caribbean were homicide/war/intentional injuries, unintentional injuries, and suicide/self-inflected injuries.[40] Similarly, in a study of 26 countries over 40 years, it was reported that mortality as a result of violent causes peaked in the 15-24 year age group; additionally, an increase in the proportion of mortality attributable to these causes increased over the period.[41]

Regionally, injury mortality affects young men disproportionately. In low- and medium-income countries in the Americas in 2004, a ratio of 26:1 was noted between young men and young women aged 15-24 years in mortality resulting from violence, accounting for 42% of deaths in young men and 9% of deaths in young women.[39] The region of the Americas has been called the most violent in the world, with the highest homicide rates found in young men aged 15-24 years.[40] In 2008, 90% of all homicides in the Americas occurred in males, although the homicide rate in females is also high compared with other regions.[42]

Specifically in Argentina, mortality in those aged 10-29 years during 1990-2010 was twice as high in males as in females, with external causes representing 70% of all deaths in young men aged 15-24 years.[9] Serfaty et al[6] found that for people 10-24 years of age in the period 1990-2000, although rates were higher in males, mortality as a result of external causes increased in both sexes and went from 28% to 50% of all-cause mortality.

In all age groups and in both sexes, the largest mortality reductions were achieved by the first half of the period, something also reported by Viner et al.[1]

Observations, Limitations, and Strengths. Historical events are the backdrop of all health phenomena. The last military dictatorship in Argentina (1976-1983) left 30,000 "disappeared"; were these deaths to be included in the vital records, many would fall into the category of injury mortality in 15-24 year olds.[43] Additionally, it was difficult to locate certain vital statistics for the period 1970-1979, although no good historical explanations for this lack could be found. Lastly, the group III mortality increase starting in the 1990s and peaking in 2002 coincides with the years of economic crisis in Argentina, a finding that was also noted in homicides in the city of Buenos Aires.[11]

It was necessary to use 6 ICD classification systems in this study; each ICD revision implies a loss of comparability with the previous version.[44] However, our use of 3 large cause groups likely softens these incompatibilities. Indeed, our results coincide with those of other authors[1,3,4,6,7,9] and do not appear to have large jumps as a result of changes in ICD revision or list.

Similarly, little fluctuation in mortality rates that could be the result of changes in or diversity of sources was noted. The years in which the information quality was most questionable were 1961 and 1967, in which the number of deaths with cause

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information was 22% less than the deaths reported for all-cause mortality. Jumps in the trend can be noted for these years, although jumps can also be identified between other years that used the same information source. Fluctuations have been reported in infant mortality for the period 1955-1970,[45] which may perhaps also be the case for aged 1-4 mortality in those years. The abrupt decrease in aged 1-9 mortality for the period 1977-1980 may also indicate a problem with the sources used. Although requiring caution be exercised in the more detailed analysis of the results, these limitations should not impede making observations regarding the overall trend.

CONCLUSIONS

Important reductions in mortality have been made in the second half of the century, but these reductions are not homogenous by age group and sex. Even in the groups with the greatest changes in mortality, reductions slowed, halted, or reversed in the second half of our series. The most disadvantaged group is clearly that of young men aged 15-24 years.

This descriptive study analyzes the variations in mortality profiles over an extended period. By constructing a time series with infrequently used data and employing international codes in mortality classification, this work makes it possible to compare the epidemiological profiles of Argentina with those of other countries. It therefore offers methodological considerations for the construction of extended time series using data available in Argentina. In particular, the study highlights the evolution of mortality in young men, contributing knowledge for the construction of actions and public policy that could change the ways of living and dying in this segment of the population.

ACKNOWLEDGEMENTS

The authors thank demographers Martín Moreno and Cristina Massa and statistician Carlos Guevel for their theoretical and methodological contributions, as well as Colin Mathers and Doris Ma Fat for their aid in understanding the WHO procedure for the classification of causes of death. Although these contributions were invaluable, the conclusions of our study are our own and do not implicate these researchers in any way.

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