"The increase in female survival at reproductive ages:

An appraisal of the contribution of maternal mortality."

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Abstract

The maternal mortality disparity in the world is greater than in any other health indicator. We study the abridged life expectancy between ages 15 and 50: Its historical time trends for developed and some developing countries, and quantify the contribution of maternal mortality. Five years of gain in this abridged life expectancy were gained mainly during the twentieth century in the developed and some developing countries. Of this gain in the abridged life expectancy between ten to thirty percent is due to maternal mortality, varying from country to country, and in Sub-Saharan countries the possible gains might be even bigger. The assessment of the timing and contribution of maternal mortality in the survivorship of reproductive aged women along with the changes in other causes of death could further our understanding of the particular circumstances that propitiated the increase in survival through the decline in maternal mortality.

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1. Background and Significance

The arrival of the first year in human history when women all over the world can expect to enjoy longer life expectancy at birth than men has been long delayed (1). If the interest is confined to reproductive ages 15 to 50, this anticipated year of higher average number of years lived by women than men has been further deferred. A key component of the expected female advantage is the progress that can be achieved if maternal mortality is reduced. Not only because it increases the likely of survival of the mother's children, but also the death of an adult is an event of great social loss (4). More to it, the achievement of low levels of maternal mortality in a population has shown to create incentives to invest in education and skills of its members and encourage human capital accumulation, and the opposite occurs in settings with still high female mortality (16).

Maternal mortality is a very good indicator of society's overall healthcare system, because pregnant women survive where safe, clean and 24-hours available surgical facilities have well-trained staff and the needed equipment and antibiotics (8). Thus, great disparity is still present in the world in terms of maternal mortality levels between developed and developing countries, this more than in any other health statistic measure (6, 21). Additionally, maternal mortality statistics from developed countries underestimate incidence, on average by a third, and the inaccuracies are much greater in developing countries (28, 11, 12). The World Health Organization (2007) estimates that there were 536 thousand maternal deaths worldwide in 2005, with 99% occurring in low-income countries. For developing regions, the maternal mortality ratio (MMR) is estimated at 450 deaths per 100,000 live births, but the highest regional MMR is found in Sub-Saharan Africa (920) and next in South Asia (620).

While strikingly high, MMRs were similarly high in European and North American countries at the beginning of the 20th century. Loudon (1992) reports MMRs for England

and Wales for 1847-1981 to be as high as 612 in the 1848, declining to 282 by 1939 and then 10 by 1981. He estimates Ireland's MMR to be 660 in 1871-80 and reaching half this level around 1940 and then dropping to 16 a decade later. Similarly USA's MMR from 1915 to 1953 shifted from 608 to 17 and in Sweden from 1090 in 1756-60 to 6 by 1950. The pattern of a dramatic drop in MMRs in the first part of the 20th century is common to a number of Western countries, including the Australia, Denmark, France, the Netherlands, Norway, and New Zealand, and automatically invites the questions of why and how? If the factors behind the maternal mortality transition, which is replicated in all these Western countries, can be identified, the knowledge may be transferable to improving maternal survival in the developing world (30, 29, 7).

The Millennium Development Goal for maternal health (MDG-5) targets to achieve a 75% reduction in the maternal mortality in the developing world by 2015. This optimistic view of reductions in maternal mortality levels is based on the historical declines in short time frames in the Western world. In more recent years in transitional countries as Thailand, Malaysia and Sri Lanka significant reductions in maternal mortality have also occurred and expanded this optimism (27, 18). However, some concerns have been made about the one-size-fits-all strategy to achieve the MDG-5 reductions (3), since the approaches and policies to reduce MMR need to be context specific, and it is important to look at the broad epidemiological stage of the population.

The reductions in maternal mortality are part of greater shift in causes of mortality and morbidity that occurred predominantly during the twentieth century recognized in the framework of the demographic and epidemiologic transitions (22, 19). While today's industrialized countries have largely progressed through both transitions, some regions of the developing world lag behind in their population's health, notably much of Sub-Saharan African and parts of South Asia and Latin America. The assessment of the timing and contribution of maternal mortality in the survivorship of reproductive aged women along with the changes in other causes of death could further our understanding of the particular circumstances that propitiated the increase in survival through the decline in maternal mortality.

The focus of this paper is three folds: firstly, to assess the historical changes observed in female survivorship in the reproductive age range 15 to 50; secondly to quantify the specific contribution of maternal mortality to the increase in survivorship; finally, this paper studies historical trends in developed countries and in some developing countries with data of acceptable quality, and the current trends in countries with deficient data as those from Sub-Saharan Africa. The paper is divided into five sections with this introduction as the first. Secondly the data and methods sections are presented, followed by results subdivided into three parts. The discussion is found as the last part of the paper.

2. Data

Five data sources are used in this study: The Human Mortality Database (HMD, 2009), INDEPTH demographic surveillance sites (2002, 2004), the World Health Organization mortality database (36), the Demographic and Health Surveys (DHS, 2009) and the model-based data from the book by Samuel Preston (1976) *Mortality Patterns in National Populations.*

Life tables for developed countries come from the HMD (2009). The HMD project contains detailed time series of mortality data and life tables for populations with virtually complete registration and census data. Annual period life expectancies were extracted from these database and life expectancies between 15 and 50 were calculated from them.

The second data source is on cause of death during the second half of the twentieth century taken from the WHO (2009). From this database we extracted the number of registered deaths by cause (death statistics are coded according to the 7^{th} to 10^{th} revision of the International Classification of Diseases (ICD)), sex and age-group (0, 1, 2, 3, 4, 5-9, ..., 80-84 and age 85 and over) for the 1950s to the first years of the new century. For the purpose of this analysis, we have aggregated causes of death into seven major categories: Violent deaths (accidents, homicides and suicides), cardiovascular disease (disease of the circulatory system), infectious disease, maternal mortality, neoplasm,

respiratory disease, tuberculosis, with a group of "Other causes" for the remaining causes not accounted previously. Detailed aggregation of the causes based on the ICD codes is given in Appendix 1. This data source was used to assess the declines in mortality into its contributing causes of death in developing countries: Chile, Egypt, Mexico, Philippines, Thailand and Yugoslavia. The selection of these six countries corresponds to length of their cause of death series, and the quality of the data (32).

The published life tables from INDEPTH (2002, 2004) were used to study the current situation of survival between ages 15 and 50 in the developing world. The INDEPTH life tables are based on empirical data for Sub-Saharan African populations assessed around 1995-1999 in 19 different sites, as well as the information from another surveillance site in Matlab, Bangladesh.

The DHS (2009) were used to assess the maternal mortality contribution in the survival between ages 15 and 50 in Sub-Saharan Africa. DHS are nationally-representative household surveys. Maternal mortality is included in some DHS by asking female respondents to list all their sisters, and whether or not each of them was still alive at the time of the survey or if pregnant at death (or as a consequence of childbirth). Information on maternal mortality rates and over-all causes of deaths from 31 countries mainly in Sub-Saharan Africa were included in the analysis. Problems with quality of DHS data has previously been emphasized (31), thus in this analysis only the most recent DHS data are used and no time trends are analyzed. The main focus here is to estimate the current maternal health situation, in terms of maternal mortality and life expectancy, in Sub-Saharan Africa.

Finally, the model-based data from the Preston (1976) book was used to disentangle the declines in mortality into its contributing causes of death, focusing in maternal mortality, in developed countries. The model-based data are based from information assembled by Preston and his collaborators (26). While the data from the former book does not adequately reflect mortality patterns in one of the populations of interest, there are still

likely important lessons to extract from the patterns of developed countries in the early 20th century.

3. Method

Maternal mortality is usually measured independent of other causes of death as maternal mortality ratios or rates (10). However, also measures of lifetime risk, or probability of dying, can combine information on deaths from maternal causes when competing causes of death are taken into account (35). The focus of this study is on this latter type of measures. To assess the contribution of maternal mortality over an aggregate measure of mortality, we look initially at overall trends of mortality. The average number of years lived by a population from age 15 to 50 , denoted as ${}_{35}e_{15}$ [1], is calculated as:

$$ {}_{35}e_{15}(t) = \frac{\int_{15}^{50} \ell(a,t)da}{\ell(15,t)} , \qquad (1) $$

where $\ell(a,t)$ is the survival function at age a at time t. If no mortality occurs between ages 15 and 50 then the average number of years lived between these ages is 35. On the opposite the higher the mortality the farther the average will be from 35. This measure has shown to be particularly useful in the study of maternal mortality because it is conditional on survival to age 15 and takes into account all forms of mortality (37, 35). In the text the average number of years lived, or life expectancy, between ages 15 and 50 is also referred shortly as abridged life expectancy.

Cause of death contribution of the change over time of the abridged life expectancy can be calculated in a similar fashion as the technique of decomposition of life expectancy at birth. From equation [1] it can be deducted that life expectancy between ages 15 and 50 is analogous to a life expectancy at birth from a table that starts at age 15 and finishes at age

[1] If a life table is available this measure can be calculated as the difference between the person-years lived above age 15 minus those at age 50 divided by the survivors at age 15.

50[2]. To calculate the cause-contribution to the change in life expectancy, we use a decomposition technique (2). Two broad demographic methods are combined in this technique: cause-deleted life tables and cause-decomposition to changes in life expectancy. Let a dot over a variable denote the derivative with respect to time. If there are *n* independent causes of death under study, then the overall survival function in equation [1] can be seen as the product of all the cause-specific survival functions: $\ell(a,t) = \ell^1(a,t)\ell^2(a,t)\cdots\ell^n(a,t)$. The change over time in life expectancy ${}_{35}e_{15}(t)$ is calculated as:

$$\dot{{}_{35}e_{15}}(t) = \sum_{i=1}^{n}\int_{15}^{50}\dot{\ell^i}(a,t)\ell^{-i}(a,t)da \qquad (2)$$

where $\ell^i(a,t)$ and $\ell^{-i}(a,t)$ are the probabilities of surviving from age 15 to age *a* at time *t* when only cause of death *i* and when all other causes, $-i$, are operating, respectively.

4. Results

Our results focus on answering two main research questions.

4.1. What was the pattern of mortality and survival for females aged 15 to 50 in the late 19th century and all of the twentieth century?

The reduction of mortality started in the middle of the 19th century and continued to the middle of the 20th century among many developed countries (24, 34). Figure 1 presents these trends for developed countries and highlights the values for Sweden. The average number of years lived by Swedish females from age 15 to 50 hovered between 31 and 32

[2] The ratio of conditional survival to age 15 in equation (1) is equivalent to a life expectancy of a life table where only death rates between ages 15 and 50 are studied and in both cases:

${}_{35}e_{15}(t) = \int_{15}^{50} e^{-\int_{15}^{a}\mu(x,t)dx}da$, where $\mu(x,t)$ is the age-specific death rate at age *x* and time *t*.

years before 1918, but started to increase after the Spanish flu pandemic of 1918, reaching close to 34.5 years by 1950. The abridged life expectancy then increased very slowly to almost 35 years over the next half century.

[Figure 1 about here]

Similar changes in abridged life expectancy also happened in other parts of the industrialized world. However, there was great variation before the end of the first half of the twentieth century. Sweden is initially the leader with the lowest mortality among women aged 15 to 50 in 1880, but moves to the middle by 1920 and finally converges with the rest of the countries by late 1950s with values of abridged life expectancy above 34 years. It is interesting to note in Figure 1 the relatively common slope or pace of change in ${}_{35}e_{15}$ for these countries and their common shift around 1950s toward having near-complete survival from age 15 to 50. Furthermore Figure 1 seems to suggest that irrespective of the starting year or level when the transition began, the abridged life expectancy ends up being above 34 years by 1950s. Transitions that started later appear to catch up, improving at a faster rate, e.g. Japan. On the opposite, the mortality retrocession observed in Russia has caused the average number of years lived between ages 15 and 50 to return to values below 34 years at the turn of the new century.

Compared to developed countries, developing countries had a much later transition. As shown in Figure 2, the trend of female life expectancy between ages 15 and 50 observed in the selected six developing countries is somewhat similar. Egypt, Chile, Mexico, and Thailand, with data available since 1954, started the transition at a level around 33 years, when Sweden had already been approaching the end of its transition. Philippines soon joined the group in 1963, with a level of abridged life expectancy of 33.7 years. Yugoslavia started its transition at a much higher level, around 34.1 with data available from 1961. In Chile, Thailand, and Mexico ${}_{35}e_{15}$ increased at a pace that was comparable to Sweden when its life expectancy was at similar levels. Egypt and Philippines, nonetheless, showed a relatively slower trend of increase. In Yugoslavia, the abridged life expectancy approached the Swedish level at the end of 1970s, Chile converged by the

end of the 20th century and continues to show a tendency of further increase. Thailand expectedly documented a drop in the average number of years lived between 15 and 50 starting early 1990s, due likely to the impact of the HIV/AIDS epidemic (13). Lastly, data from the 19 INDEPTH sites represented various levels of female abridged life expectancy in 1997 which are accordant to the historical values seen in Sweden a century ago.

[Figure 2 about here]

4.2. How much did reduced maternal mortality contribute to the survival of reproductive-aged women in the twentieth century?

Based on the foregoing results, it has been shown that female survival between ages 15 and 50 increased considerably in developed countries. An increase that could be hypothesized arises partially from declines from maternal mortality. However, so did male survival for the same age range which is not affected by maternal mortality. Appendix 3 shows a detailed illustration of this similar transition for both females and males in the studied countries. By comparing the trends in maternal mortality ratios (MMR) with those of the abridged life expectancy, it is possible to observe the delayed arrival of the MMR transition. Figure 3a, 3b and 3c include both the information available for the twentieth century for ${}_{35}e_{15}$ as well as for maternal mortality ratios as documented by Loudon (1992) for England and Wales, Sweden and United States respectively.

[Figure 3a, 3b and 3c about here]

In the set of Figures 3a, 3b and 3c it is possible to see the lagged decline in maternal mortality ratios as compared to the increase in abridged life expectancies of more than one decade. It is until the life expectancy has reached a level near 33 years that maternal mortality ratios decline. This suggests that it is at an advanced stage of the epidemiological transition (23) when maternal mortality changes alongside the other

causes of death affecting this age range. Using cause–eliminated life tables and decomposition methods outlined in the methods section it is possible to assess the specific contribution of maternal mortality in the rise of the female survival between ages 15 and 50.

We first utilize model-based data from Preston (1976). The reference time period is from 1930s to 1960s and reflects mortality patterns for the industrialized world and countries with reasonably reliable vital statistics. As shown in Table 1, the highest level of mortality available in this model gives a life expectancy between 15 and 50 of 29.6 years which goes to 34.5 years at the lowest level of mortality. Based on these data, the gain in abridged life expectancy is 0.45 years when maternal mortality is eliminated, which contributes to 10% of the overall survival gains between 15 and 50.

[Table 1 about here]

The contribution to the change in female ${}_{35}e_{15}$ from different causes of death is also illustrated with data from Chile, Mexico, Philippines, Egypt, Thailand, and Yugoslavia. As seen in Figure 4 and Table 2, the increase in this life expectancy between the two time points ranges from half a year in Yugoslavia (between 1959 and 1989) to 2 years in Chile (between 1954 and 2003). The contribution of eliminating maternal mortality to these increases varies between 7% and 30%, in line with the 10% contribution from the Preston model. In Figure 4 it is also possible to see that in Thailand maternal mortality ranked as the top cause contributor of the change in ${}_{35}e_{15}$ only after the category of Other Causes. It should also be mentioned the important role of the decline in Tuberculosis and Respiratory Diseases in the increase in survival for this age group.

[Figure 4 & Table 2 about here]

A final assessment of the levels and contribution of maternal mortality in Sub-Saharan Africa is carried by analyzing DHS data for this continent. Figure 5 and Table 3 include estimated life expectancy between ages 15 and 50 for 31 countries and its likely increase

from eliminating maternal mortality. The levels of life expectancy between ages 15 and 50 vary from 27 to 33 years in these populations. Similarly the possible gain in this measure by eliminating maternal mortality fluctuates from 0.15 of a year in Central African Republic to 1.5 years in Chad. Or equivalently, from a percent contribution of the total change in the abridged life expectancy of 0.04% to 0.46%, in those two countries respectively. As mentioned in the data section a great limitation of these results is the quality of the DHS maternal mortality data. Nevertheless, as observed in Figure 5 a great majority of the countries can foresee an increase in the abridged life expectancy of half a year if maternal mortality was eliminated. This latter number mirrors what has been observed in other developing countries and in the developed world.

[Figure 5 & Table 3 about here]

5. Discussion

Our results for Sub-Saharan African countries (DHS) are limited by their data quality. However, they show similar levels seen in developed countries, in some cases more than a century ago. The present international comparison of female mortality, maternal and of all causes, shows the abysm disparity currently observed in the world. These are likely the biggest differences ever seen, due the increase in survival between ages 15 and 50 in developed and some developing countries and the stagnating situation (in some cases retrocession) observed in the African continent.

A limitation of this study is the fact that there is wide regional variation in the causes of maternal deaths (17): with Africa and Asia having haemorrhage as the primary cause, while hypertensive disorders is the leading cause in Latin America and the Caribbean. However, our results can not be disaggregated for all the studied regions and to preserve comparisons we decided to analyze overall maternal mortality.

Around 5 years of abridged life expectancy can be gain between 15 and 50. The present results show that in Sub-Saharan Africa, in some cases the possible gains are greater.

Maternal mortality is a clear contributor to the increase in life expectancy in this age range, and monitoring its levels and its changes should be put at the top of priorities of all countries lagging behind.

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Appendix 1. Specific data manipulations for the ICD codes in the WHO mortality database. Six countries (WHO codes in parenthesis) were selected from the WHO mortality database: Chile (2120), Thailand (3380), Egypt (1125), Mexico (2310), Philippines (3300), Yugoslavia (4340).

Table A1. Cause of death grouping and ICD codes used for calculating the cause-specific contribution to the change in life expectancy between ages 15 and 50.

Cause of death	7th ICD	8th ICD	9th ICD	10th ICD
Accidents, Homicides & Suicides	E800-E802, E810-E835, E840-E965, E970-E999	E800-E807, E810-E823, E825-E845, E850-E877, E880-E887, E890-E978, E980-E999	E800-E848, E850-E888, E890-E999	A00-A14, A20-A99, B00-B99
Disease of the Circulatory System	400-402, 410-416, 420-422, 430-434, 440-447	390-398, 400-404, 410-414, 420-438, 440-448, 450-458	390-398, 400-404, 410-414, 420-438, 440-448, 450-458	A15-A19
Infectious Disease	020-074, 080-096,100-108, 110-117, 120-138	000-009, 020-136	000-009, 020-139	C00-C99, D00-D48
Maternal Mortality	640-689	630-645, 650-662, 670-678	630-648, 650-676	J00-J99
Neoplasm	140-205, 210-239	140-239	140-239	I00-I99
Respiratory Disease	480-483, 490-493, 500-502	460-466, 470-474, 480-486, 490-493, 500-508, 510-519	460-466, 470-478, 480-519	A34, O00-O95, O98-O99
Tuberculosis	001-008, 010-019	010-019	010-018	V00-Y99
Remaining Causes (*)				

Source: WHO (2009).

Notes: The group "Remaining Causes" accounts for the rest of the life expectancy change not explained by the above listed seven cause groupings. HIV/AIDS is included in this group.

Appendix 2. Population files

Mexico in year 1977 did not have population information, Philippines 1977 is aggregated on 10 year age-groups, which were distributed in half for each 5-year age group. When compared the years with available mortality information and population information priority was given to those with mortality information and mid year populations were calculated with nearby populations assuming a fixed population growth rate of change. For example, if *N(t)* was the first year with population data, and *h* years before there was information on mortality then *N(t-h)* was calculated as,

$$N(t-h) = N(t)e^{r(-h)}, \qquad (1)$$

where the growth rate is calculated as the population growth from time *t* to time *t+1*,

$$r(t) = \ln\left[\frac{N(t+1)}{N(t)}\right]. \qquad (2)$$

Finally to construct death rates the mid year population was obtained by calculating the average of each two consecutive years.

Appendix 3. ***Changes observed for the female population compared to those for males.***
Figure 1A shows that Swedish males between ages 15 and 50 experienced similar gains as did females from 1880 to 2005. Swedish men do have a survival disadvantage, however, of just under half a year after the 1950s. Similar trends were observed in other countries. However, before 1920 the pattern is different in Italy, where males maintain a survival advantage over females between ages 15 and 50 (not shown).

[Figure 1A about here]

A similar female advantage is also observed in the selected 6 developing countries. Compared to the female abridged life expectancy, between mid 1950s and late 1970s, only moderate increase was observed in the male population of Philippines, Thailand, and Egypt. Male survival during the reproductive ages started to drop since early 1990s in Thailand, at the time when HIV epidemic started to generalize. A faster transition, however, was documented in Chile and Mexico at a pace comparable to that in Sweden when its abridged life expectancy was at similar levels, with Chile increasing particularly fast in the early 1970s. As among females, Yugoslavia started with a high level of male life expectancy between ages 15 and 50, close to that in Sweden, but it didn't change significantly during the three decades when data are available, hovering around 34 years

In Figure 2A, the female and male abridged life expectancies for the 19 INDEPTH sites is presented. In these sites, maternal mortality is relatively high. Survival of females during their reproductive ages, however, is not necessarily worse than males. In fact, in most of the 19 INDEPTH sites, female ${}_{35}e_{15}$ values are either equal to or higher than those for males, except in 4 sites: three in Tanzania (Morogoro, Dar es Salaam, and Rufiji), and the Matlab treatment area in Bangladesh. As observed in Figure 2A the three sites from Tanzania have also high prevalence of HIV/AIDS in their population. Tanzania has reduced infant and child death rates, but not maternal mortality (9), which might be part of the explanation of the observed life expectancy levels. Because the demographic surveillance sites in the INDEPTH network are for local areas and not nationally representative, it is difficult to link this selective one-time view with the time-

series patterns observed for other countries studied. Nevertheless, levels and the gap in life expectancy between ages 15 and 50 among females and males is similar to that of historical data from developed countries.

[Figure 2A about here]

Based on the comparison of average number of years lived from age 15 to 50 by females and males in industrialized countries for 1880-2005, we observed that the epidemiologic transition impacted the health of both males and females around the same time. Using INDEPTH demographic surveillance life table data, we compared cross-sectional survival rates among childbearing-aged women and men in 19 sites and still found gender-balanced ratios. In the majority of the sites (15), female abridged life expectancy values were actually the same or slightly higher than those of males.

In the developed world, at then end of the first half of the 20th century, when maternal mortality ratios dropped substantially and the survival of females of childbearing ages increased (see Figures 3a, 3b and 3c), males also experienced improved survival prospects at the same ages. However, a remaining half a year gap between females and males remained for the rest of the century. In this regard, lower maternal mortality could be one part of the explanation of better survival rates among reproductive-aged women.

It appears that secular changes in the distributions for the two causes of death over the 20th century counterbalanced each other to produce a gender-neutral ratio in the values of the abridged life expectancy in the first half of the twentieth century. Although beyond the scope of this study, it is possible to hypothesize that a possible explanation for the parallel gains in male and female survival in these ages is two fold; firstly, the progress made in causes of death that affect both females and males (e.g. tuberculosis and respiratory disease). Secondly, the counter-acting gain from a reduction in a cause of death that primarily affects males, such as violence. However, when the progress in male violent deaths is compared to those that females experienced by reducing maternal mortality, they remain short of the mark. Without decomposing mortality trends for

contributions from these causes of death, the impact of reduced maternal mortality on overall female survival, as well as of reduced violence-related mortality on male survival, may well go unrecognized.

Table 1. Contribution of maternal mortality to the change in female life expectancy between ages 15 and 50 ($_{35}e_{15}$) for model-based data from Preston (1976).

	Maternal mortality contribution
$_{35}e_{15}$(high mortality)	29.6
$_{35}e_{15}$(low mortality)	34.5
Change in $_{35}e_{15}$	4.9
Contribution of maternal mortality	0.45
% Contribution	10%

Source: based on Preston (1976); Authors' calculations.

Table 2. Maternal mortality-contribution to the change in life expectancy between ages 15 and 50 ($_{35}e_{15}$) in selected developing countries from the 1950s to the early 2000s

Country	Chile	Egypt	Mexico	Philippines	Thailand	Yugoslavia
Year (t_1-t_2)	1954-2003	1954-2000	1955-2005	1963-1978	1955-2002	1959-1989
$_{35}e_{15}(t_1)$	32.93	33.33	32.63	33.72	32.87	34.06
$_{35}e_{15}(t_2)$	34.85	34.43	34.53	34.35	34.07	34.62
Change in $_{35}e_{15}$	1.92	1.1	1.9	0.62	1.2	0.56
Contribution of Maternal Mortality	0.27	0.11	0.21	0.11	0.35	0.04
% Contribution	0.15	0.1	0.11	0.17	0.3	0.07

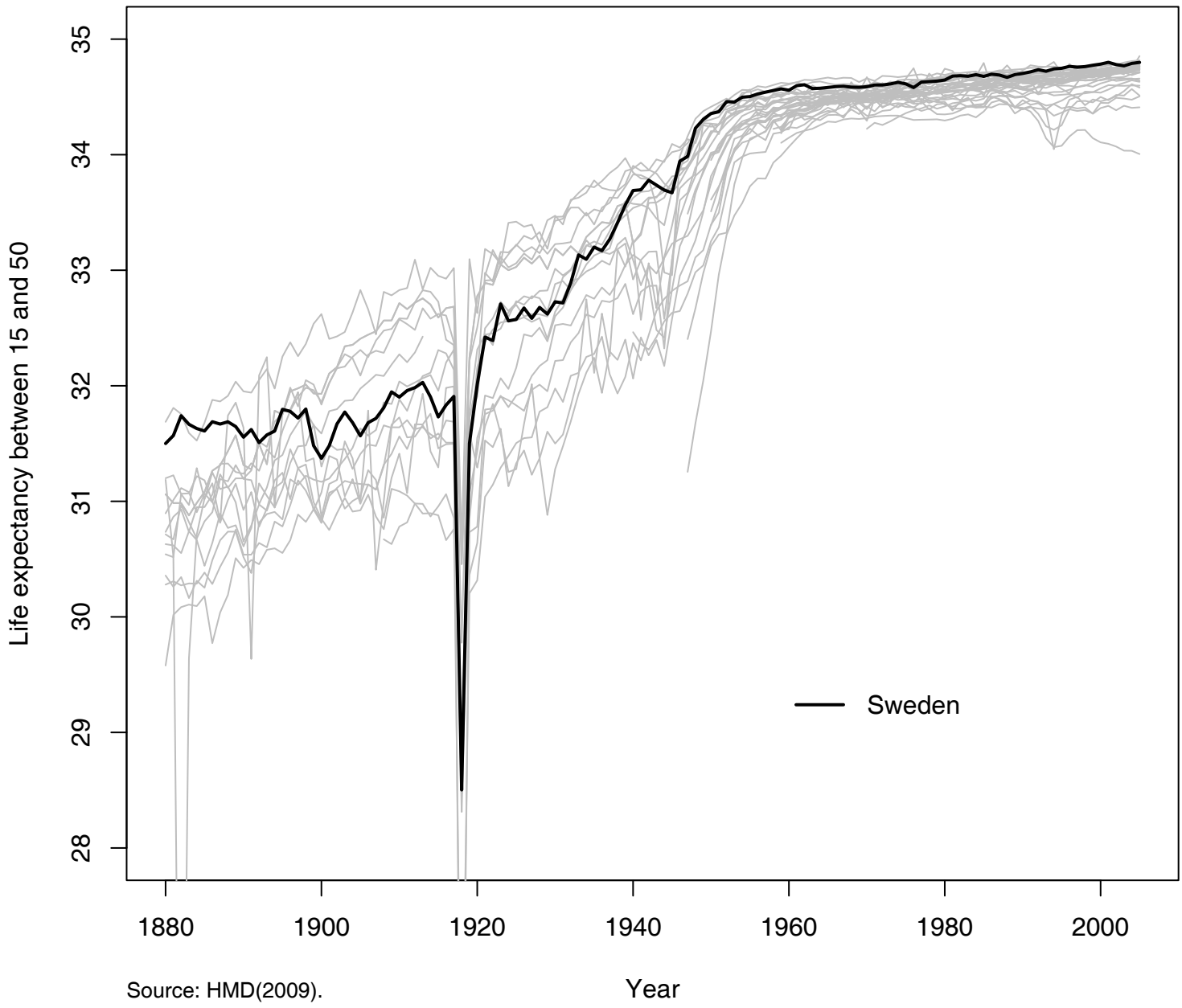
Source: based on WHO (2009); Authors' calculations

Table 3. Female life expectancy between ages 15 and 50 ($_{35}e_{15}$) in life tables with all causes of death and maternal mortality eliminated ($_{35}e_{15}$-MM), Sub-Saharan countries.

Country	Year	3-letter code and year	$_{35}e_{15}$	$_{35}e_{15}$-MM	Difference	Percentage of total change
			A	B	C=B-A	C/(35-A)
Benin	2006	BEN06	33.22	33.64	0.42	0.24
Burkina Faso	1998/99	BFA99	32.32	32.91	0.59	0.22
Central African Republic	1994/95	CAF95	31.29	31.44	0.15	0.04
Cameroon	2004	CMR04	31.57	32.22	0.65	0.19
Chad	2004	TCD04	31.66	33.18	1.52	0.46
Congo	2005	COG05	31.59	32.26	0.66	0.20
Congo Democratic Republic	2007	COD07	31.72	32.33	0.61	0.18
Cote d'Ivoire	2005	CIV05	31.29	31.75	0.46	0.12
Eritrea	1995	ERI95	31.82	33.03	1.21	0.38
Ethiopia	2005	ETH05	31.57	32.28	0.71	0.21
Gabon	2000	GAB00	32.67	33.12	0.45	0.19
Ghana	2007	GHA07	32.95	33.29	0.34	0.17
Guinea	2005	GIN05	32.18	33.19	1.01	0.36
Kenya	2003	KEN03	31.57	31.95	0.38	0.11
Lesotho	2004	LSO04	30.08	30.51	0.43	0.09
Madagascar	2003/04	MDG04	33.31	33.77	0.46	0.27
Malawi	2004	MWI04	29.28	30.20	0.92	0.16
Mali	2006	MLI06	32.78	33.40	0.62	0.28
Mauritania	2000/01	MRT01	33.29	33.96	0.66	0.39
Namibia	2000	NAM00	32.67	32.96	0.29	0.13
Niger	2006	NER06	32.67	33.59	0.92	0.39
Rwanda	2005	RWA05	31.42	32.09	0.67	0.19
Senegal	2005	SEN05	33.36	33.75	0.39	0.24
South Africa	1998	ZAF98	31.58	32.25	0.67	0.20
Sudan	1989/90	SDN90	33.54	34.04	0.51	0.35
Swaziland	2006	SWZ06	27.87	28.38	0.50	0.07
Tanzania	2004	TZA04	31.55	32.13	0.57	0.17
Togo	1998	TGO98	32.83	33.24	0.40	0.19
Uganda	2006	UGA06	30.89	31.40	0.52	0.13
Zambia	2007	ZMB07	28.71	29.21	0.50	0.08
Zimbabwe	2005/06	ZWE06	28.98	29.32	0.34	0.06

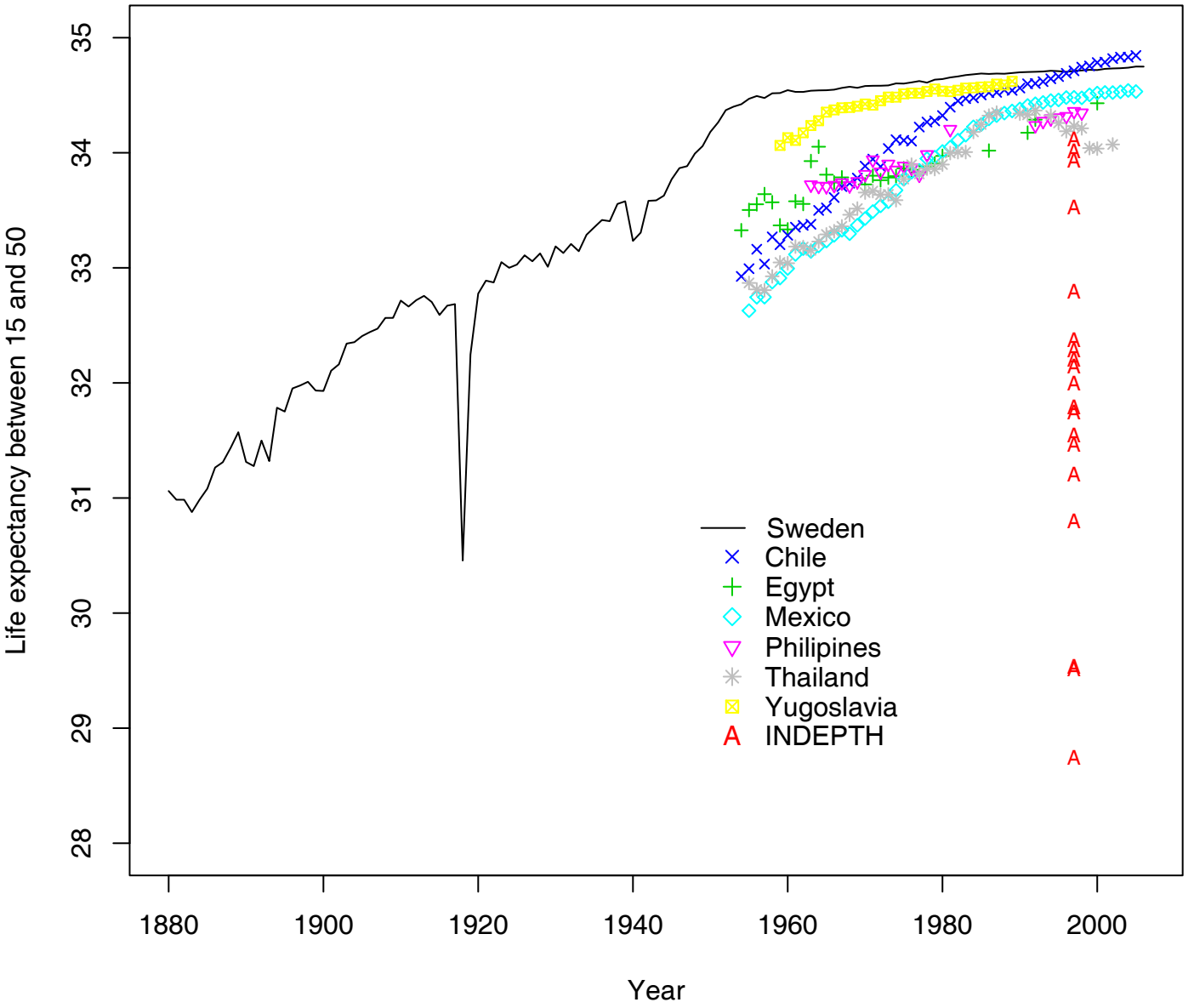
Source; based on DHS data, author's calculations.

Figure 1. Average number of years lived by females from age 15 to 50 in industralized countries, 1880–2005. Trends for Swedish females are highlighted.



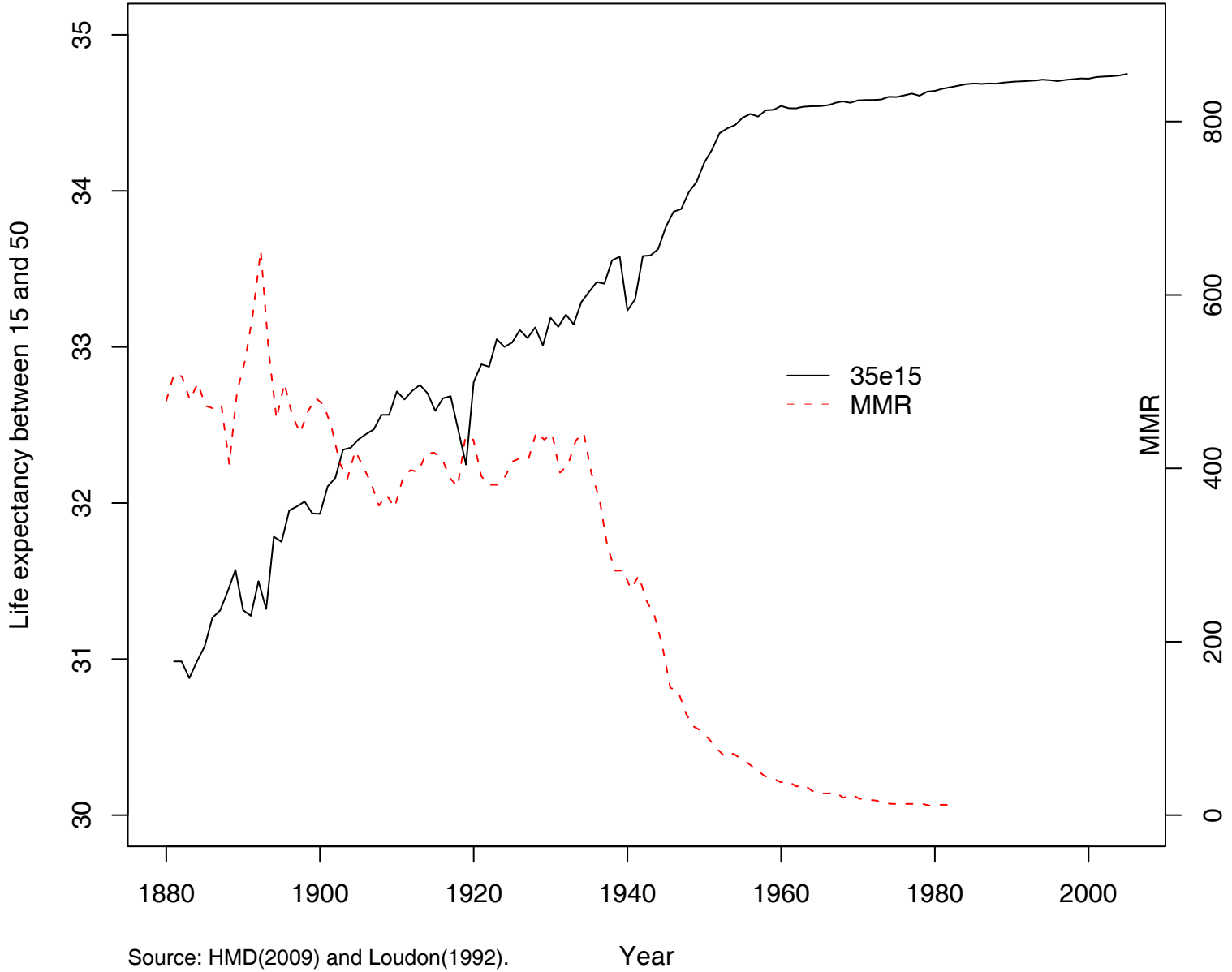
Source: HMD(2009).

Figure 2. Average number of years lived by females from 15 to 50 for Sweden (1880–2006), from 1961 to 1978 Chile, Egypt, Mexico, Philipines, Thailand and Yugoslavia, and the INDEPTH(A) demographic surveilance sites in 1997.



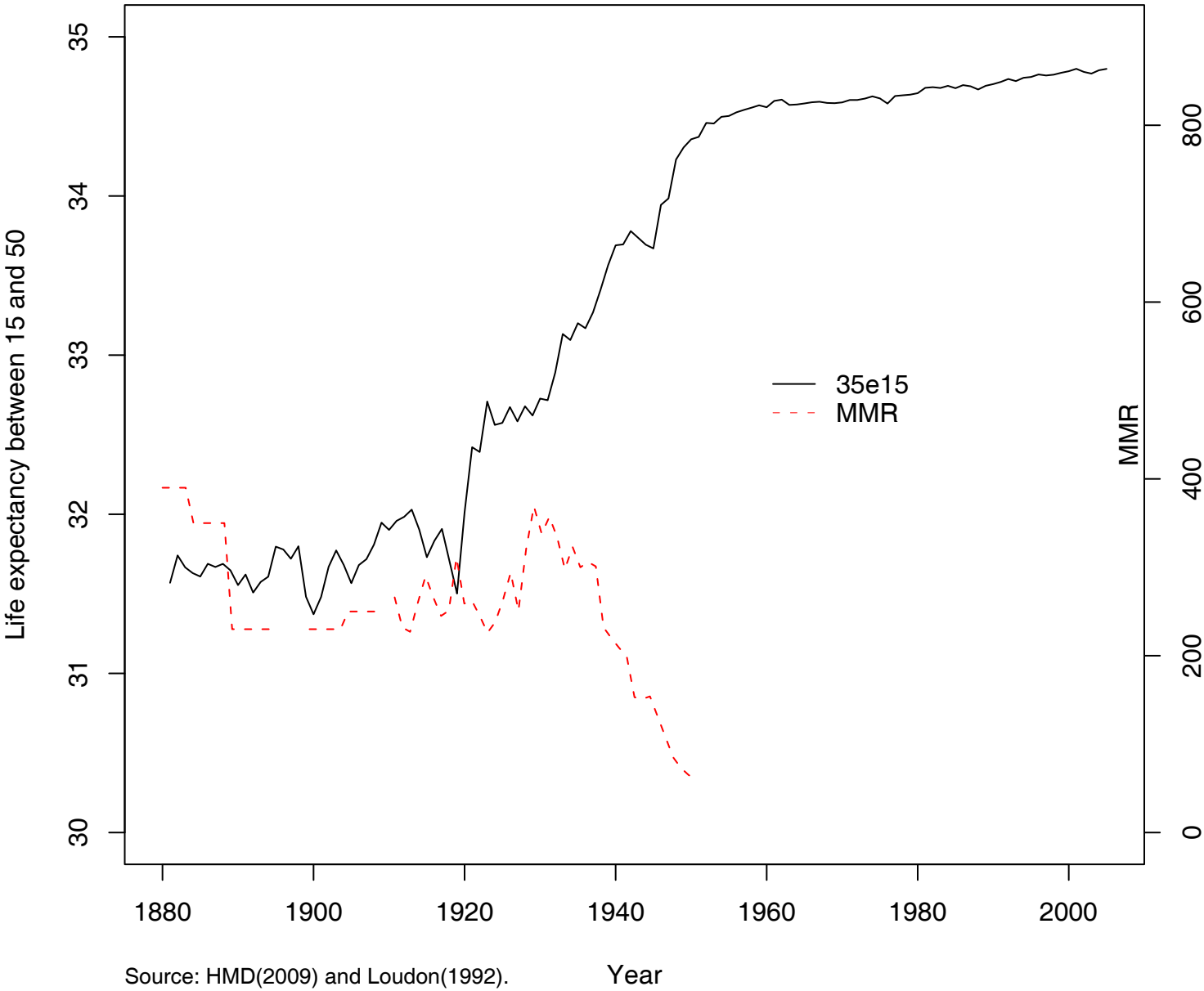
Source: HMD(2009), INDEPTH(2004) and WHO(2009).

Figure 3a. Female life expectancy between 15 and 50 (35e15) and Maternal Mortality Ratios (MMR) for England and Wales between 1880 and 2005.



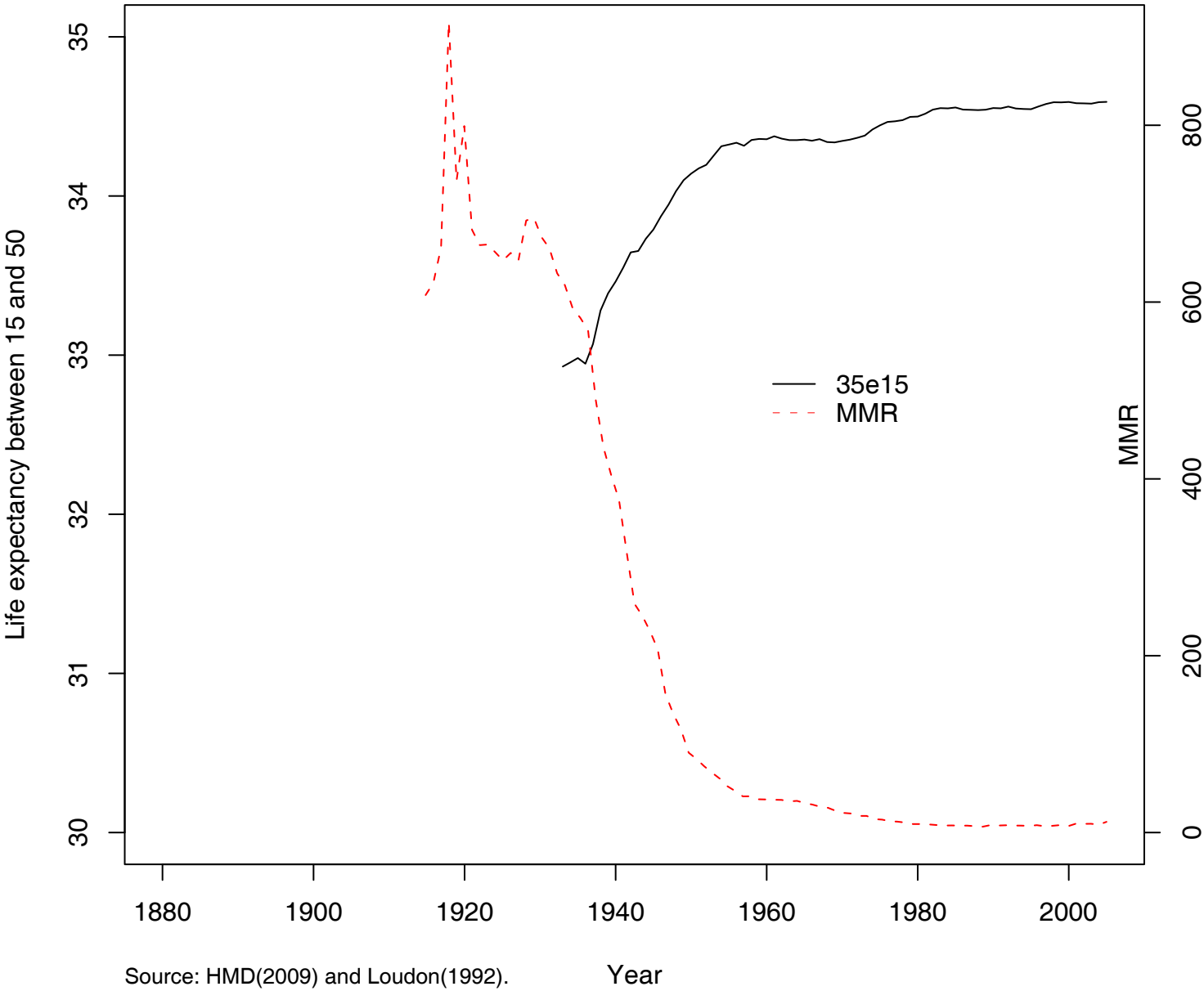
Source: HMD(2009) and Loudon(1992).

Figure 3b. Female life expectancy between 15 and 50 (35e15) and Maternal Mortality Ratios (MMR) for Sweden between 1880 and 2005.



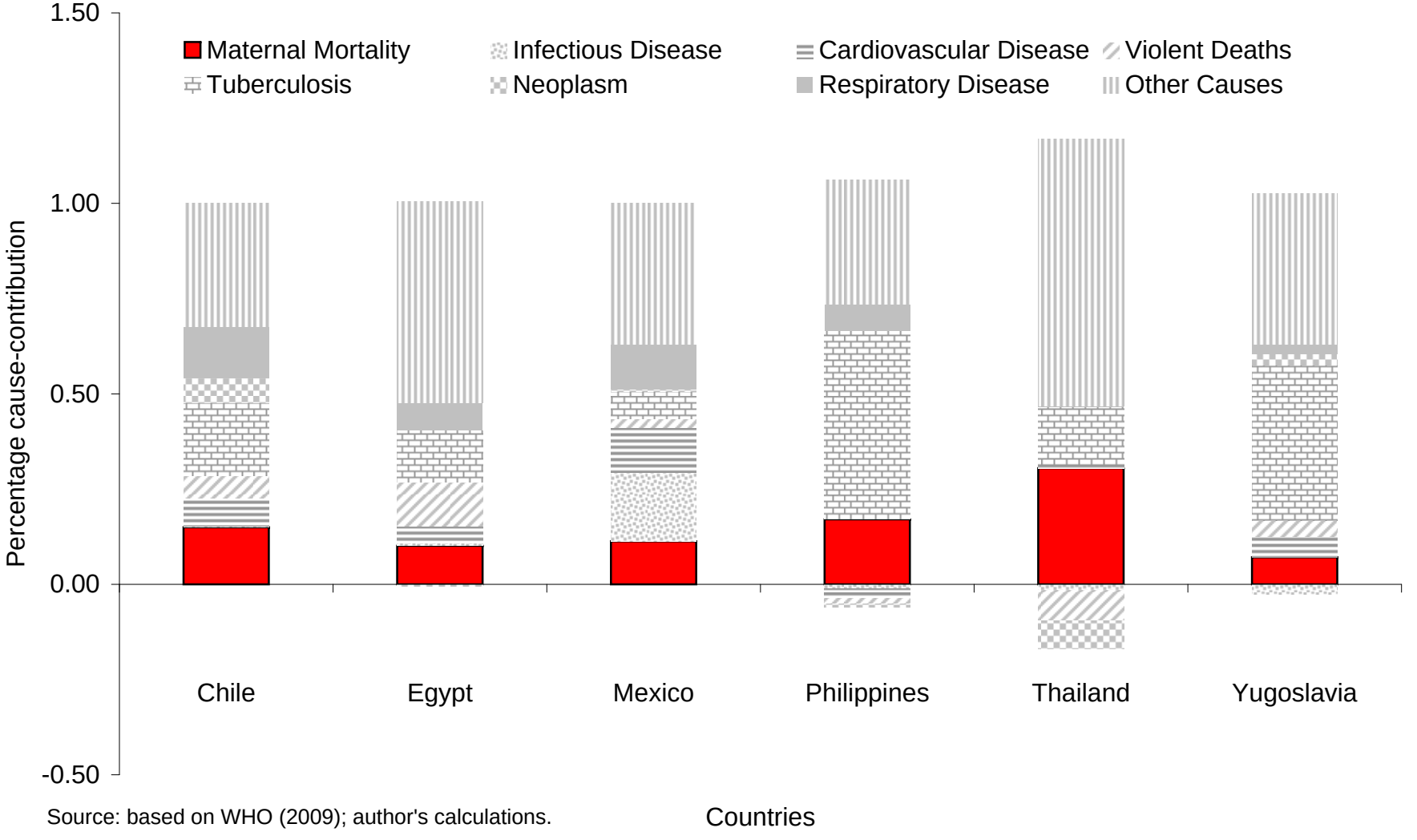
Source: HMD(2009) and Loudon(1992).

Figure 3c. Female life expectancy between 15 and 50 (35e15) and Maternal Mortality Ratios (MMR) for United States between 1880 and 2005.



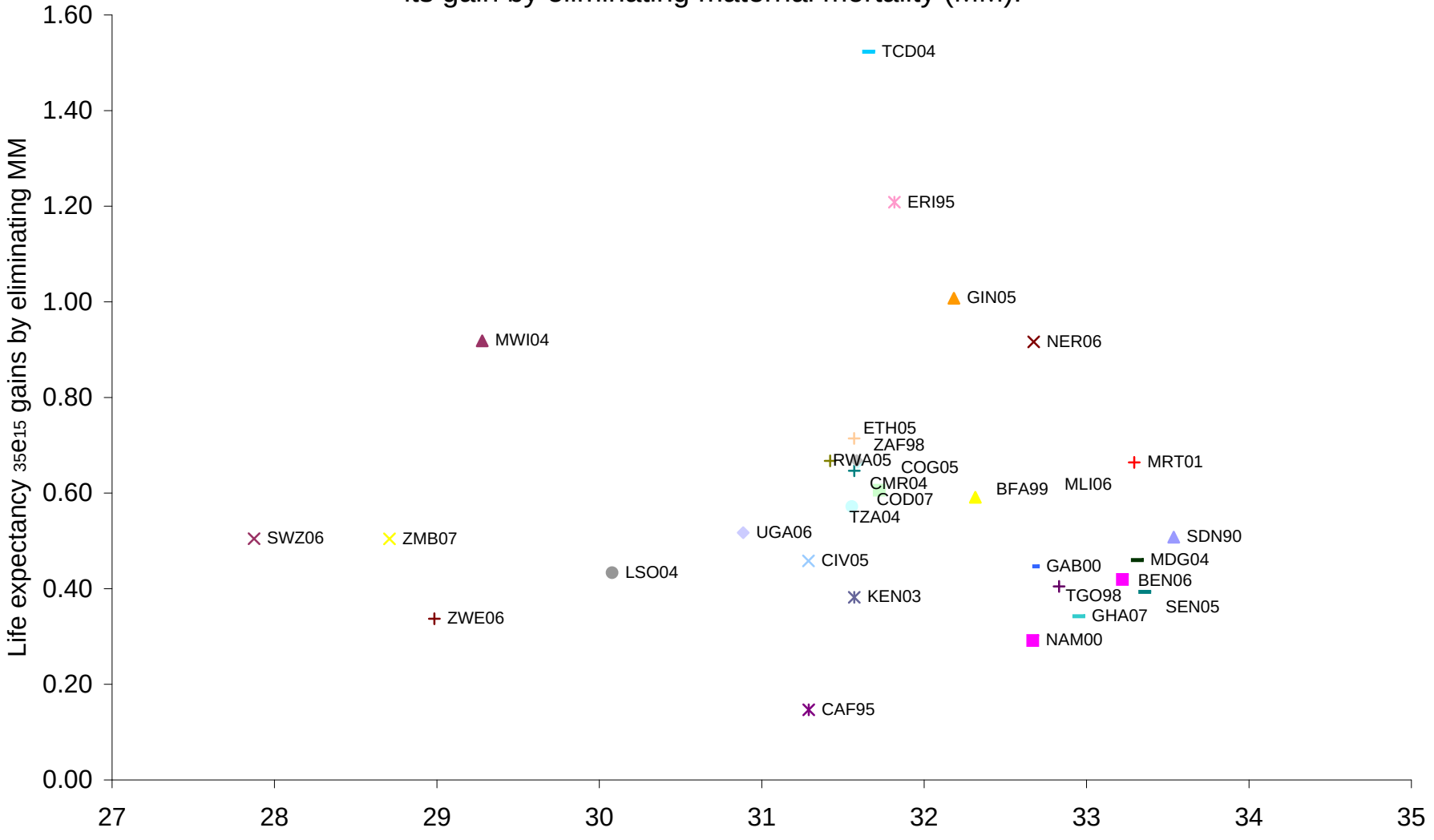
Source: HMD(2009) and Loudon(1992).

Figure 4. Percentage cause contribution of the change in female life expectancy between ages 15 and 50 in selected developing countries from the 1950s to the early 2000s.



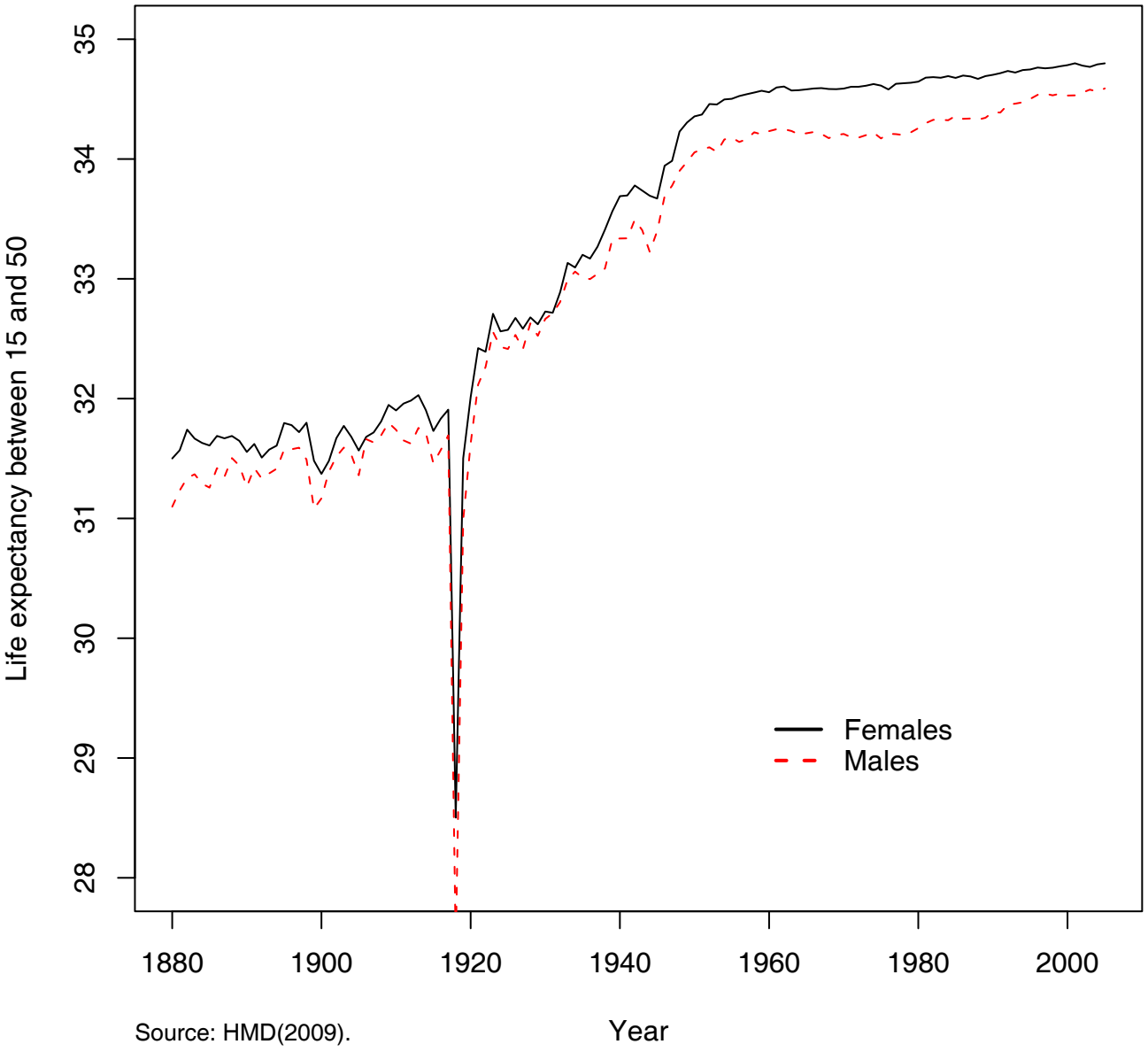
Source: based on WHO (2009); author's calculations.

Figure 5. Female life expectancy between 15 and 50 in sub-Saharan Africa ($_{35}e_{15}$) and its gain by eliminating maternal mortality (MM).



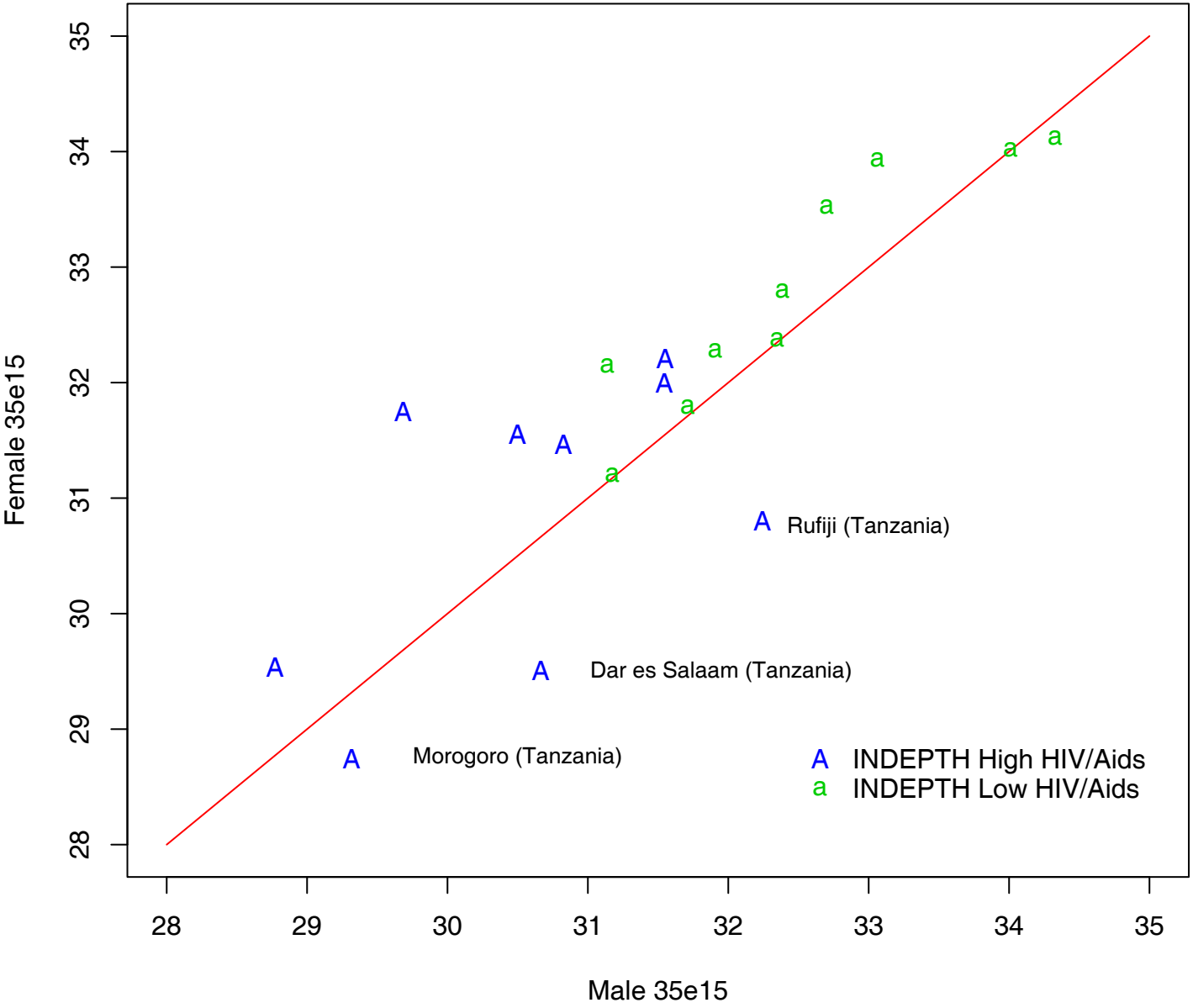
Source: Based on DHS data, author's calculations. 3-letter codes found in Table 2.

Figure 1A. Average number of years lived by Swedish females and males from age 15 to 50, 1880–2005.



Source: HMD(2009).

Figure 2A. Female and male life expectancies between ages 15 and 50 for INDEPTH sites, 1995–1999.



Source: INDEPTH(2001)