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SMOKLER CENTER FOR HEALTH POLICY RESEARCH

# The Female/Male Differential in Life Expectancy

Leon Epstein

The study was supported by the Singer family

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1974-2004
THIRTY YEAR ANNIVERSARY

RESEARCH REPORT

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Jerusalem November 2007

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## Executive Summary

In Israel, as in almost all countries around the world, women tend to live longer than men. Based on a thorough review of the professional literature, this paper summarizes the key factors thought to account for this life-expectancy differential. It also explores changes in the female/male life expectancy differential over time and possible reasons for them.

The female/male differential in Israel is approximately four years, which is among the smallest in the world. In North America, the differential is 4–6 years, while in Russia it is 14.

The differential is believed to be due in part to genetics: already in the womb, more male fetuses are spontaneously aborted than are females. Moreover, the infant mortality rate is higher in males. However, genetics and biology cannot fully explain the life-expectancy differentials, as these vary substantially across countries, time periods, and social classes. Other factors include differences in the occupational mix, family and social roles, tendencies toward reckless driving and violence, and health related behaviors (particularly in the areas of smoking and alcohol use).

In most countries, the female/male differential has been narrowing over time; life expectancy continues to increase for both sexes, but is doing so more rapidly for males, while the female life expectancy curve has flattened out somewhat. Possible explanations for this trend include: education levels are increasing, to the greater benefit of men than women; fewer men are involved in risky occupations; and women are increasingly engaging in risky behaviors (such as smoking), which were traditionally predominately associated with men.

There are some important exceptions to the global trend of declining female/male differentials; these include Russia, Sweden, and the United Kingdom.

Higher female life expectancy is usually accompanied by higher rates of chronic illness and disability during the additional years of life. Thus the female/male differential for "healthy life expectancy" (i.e., the number of years a person can expect to live in good health) is smaller than for the traditional "life expectancy" measure.

Looking to the future, the paper concludes with a discussion of several major issues facing societies around the world:

- Under what conditions would increased longevity (for both men and women) be a desirable goal and, if so, what can be done to achieve it?
- What targeted efforts can be introduced to increase healthy male longevity specifically, thereby decreasing the male/female differential?

## Acknowledgments

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# 1. Introduction

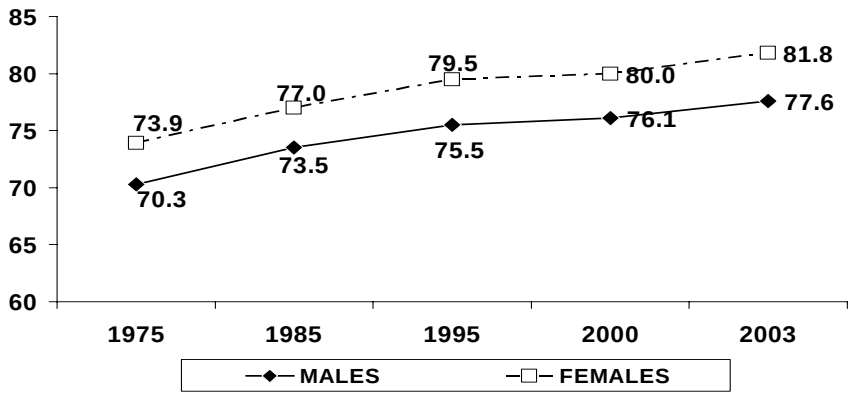
The life expectancy (LE) of both men and women has long been considered a valid measure of the health status of a population. Moreover, as life expectancy is influenced by the quality of the health (and other) services that the population receives, it is often used as one of the indicators of health system performance. LE needs to be analyzed against the background of the aggregate characteristics of the population (biological, social, cultural, and behavioral) and its environment.

This paper will concentrate on an intriguing question that scientists have still not managed to solve. An almost constant finding nearly everywhere it has been studied is that women have a longer LE than men do. This raises interesting questions about the reasons for the difference and also has important practical implications for a society in which women live longer, are often left without their partner, and very often do not have the familial support systems that they previously had.

# 2. What are the Facts?

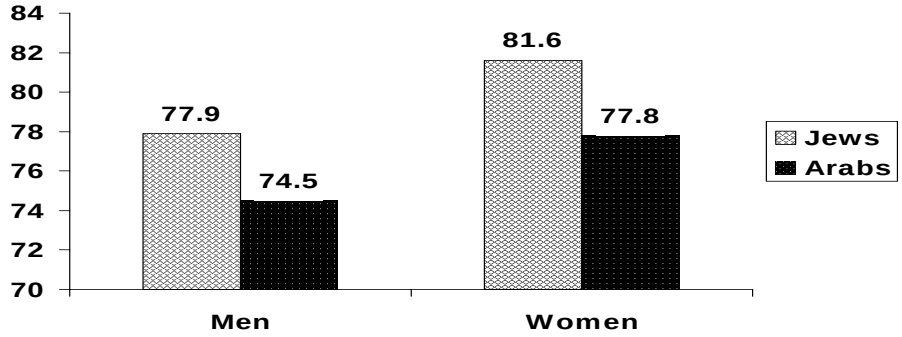
In Israel, while the LE of the total population has risen over the years (Fig. 1), the female/male differential is approximately four years and has remained constant in recent years (LE of 77.6 in males and 81.8 in females in 2003) (Ministry of Health, 2005). It is apparent in both the Arab and Jewish populations. Another interesting finding, which will not however be discussed in depth in this paper, is that the LE of Israeli men is one of the highest among the industrialized nations, whereas that of women is ranked much lower (Bin Nun, Berlovitz, and Shani, 2005).

**Figure 1: Life Expectancy in Israel 1975–2000**




The LE in the Arab sector is shorter (by 3.5–4 years) than it is among the Jewish population. Despite a constant rise over the past decades, in the LE of Jewish and Arab males and females alike, the deficit in the Arab population has remained (Fig. 2).

**Figure 2: Life Expectancy in the Arab and Jewish Population in 2002**




Between 1996 and 2003, the male and female LE in the Jewish population increased by almost two years in both sexes, whereas in the Arab sector it increased by only a year in women and decreased slightly in men. In addition, it is important to note that the difference in LE between Arabs and Jews (Table 1 – Ministry of Health, 2005) more than doubled in men (from 1.3 to 3.2 years) and increased by a year in women.

**Table 1: Difference in Life Expectancy between Jewish and Arab Men and Women, 1996 to 2003 (by number of years)**

| Year | Men | Women |
|---|---|---|
| 1996 | 1.3 | 3.1 |
| 2000 | 2.5 | 3.3 |
| 2003 | 3.2 | 4.0 |

The international picture reveals some interesting facts concerning the **level of LE** and the **differential** between men and women:

- The LE of women is almost always higher than that of men. Worldwide, the current mean LE for all people is 63 years: 61 for males and 65 for females (http://geography.about.com/library/weekly/aa042000a.htm). However, the range is tremendous – from 80 and 86, respectively, in Andorra to 36 in both sexes in Malawi (http://www.photius.com/wfb1999/rankings/life_expectancy_mf_0.html). All ten countries with the lowest LE in the world are in sub-Saharan Africa, where it has decreased considerably in the last decade, largely as a result of the AIDS epidemic (http://www.who.int/inf-pr-2000/en/pr2000-life.html).
- There is substantial variation in the extent of the disparity between males and females in different countries. It ranges from four to six years in North America to up to 14 years in Russia (http://www.who.int/inf-pr-2000/en/pr2000-life.html).

## 3. Changes in the Life Expectancy Differential

There has been a gradual narrowing of the gender differential in LE at birth in most industrializing countries since the 1970s (Trovato and Lalu, 1996). For example, in the United States, this narrowing of the gender gap has happened over a 25-year period[1] and is found in even the most recent data (for 2004 – Minib, Heron, and Smith, 2006).

A number of factors have been suggested to explain this convergence:

1. The increase in men's longevity has been greater than that of women; moreover, there appears to be a flattening of the LE curve in women and thus the gender differential has been reduced in the industrialized nations.
2. The higher the overall socio-economic level of the country, the smaller the female/male difference, the implication being that the narrowing of the differential may be in part due to economic growth
3. This is also borne out at the other end of the spectrum, in the developing world, where, as the socio-economic disparity in the population increases, so too does the LE differential. There are however important exceptions to be discussed later.
4. The major age factor that has contributed to the closing of the gap has been the substantial reduction of male mortality in the 25–59 age group.

Between 1989 and 1996, there was a dramatic and rapid fall in LE in countries of the former Soviet Bloc among both sexes, particularly males (thereby exacerbating the female/male differential). This deterioration was especially great in the Newly Independent States (NIS), essentially Russia. LE fell below 60 in at least two of the NIS countries (Reamy and Oreskovic, 1999).

A different perspective on the female/male differential in LE was provided by a study that reviewed the issue in Japan and Sweden. The study addressed the fact that in Sweden, as in many high-income countries, the gap had narrowed while this was not the case in Japan, where the gender-related difference had widened (Trovato and Heyen, 2003).
The explanations are to be found in differential mortality experiences:
In Sweden, the decrease in male mortality from heart disease, accidents, and lung and other cancers has been greater than expected and this has narrowed the gap. However, in Japan, the death rates for heart disease have declined to a similar degree in men and women, while the deaths from lung cancer have increased among men but decreased or increased very little among women. In addition, suicide deaths have increased faster in men. The combined effects of these trends seem to explain the widening of the LE gender differential in Japan.

[1] However, the 2003 data from the Centers for Disease Control (CDC) highlight a continuing disparity between African Americans and white Americans, with the female/male difference in the African American population widening (US Centers for Disease Control and Prevention, 2005).

There is a lesson to be learned from this example – the changes in the LE gender differential derive from a complex interaction of many factors that often act in different directions.

# 4. The Life Expectancy Differential and Morbidity

Another important observation is that while the lower male LE is associated with higher male mortality, the higher female LE is accompanied by increasing chronic illness and disability (Rieker and Bird, 2005). In light of this, there has been a growing debate as to the implications of increasing LE and its relationship to quality of life.

## 4.1 Measures of Life Expectancy

The classical measure of LE has been the estimated number of years that a person will live from birth. In recent years it has been realized that the total number of years lived is not the only, or possibly even the best, measure of longevity.

All measures of longevity are based on routinely collected birth, mortality, and morbidity data. Therefore, the validity of mortality and other data as a constituent of the longevity assessment is a prerequisite for its utilization. The issue has been highlighted by Blakely et al., based on their work in New Zealand (Blakely et al., 2005). They have identified a differential validity of the recording of deaths in different ethnic groups. While this is probably less relevant in Israel, the authors stress the need to check the data validity in heterogeneous ethnic populations.

One example of the alternative measures of LE is the use of **healthy life expectancy** (HLE), which is the number of years that a person can expect to live in good health (Mathers et al., 2002). Internationally it has been found that the female/male gap is lower for HLE than for LE, i.e., that while women are living "considerably" longer than men are, their healthy life span is not very different. Most of their "additional years" are characterized by poor health, as their health status steadily declines (due largely to chronic disease and disability) as they grow older and live longer. In the UK it has been noted that while LE has risen, so too has the number of years spent in ill health. This is even greater in women because of their longer basic LE. This increased from 10.1 years in 1981 to 11.6 years in 2001 (Hebert, 2004).

The gender gap for HLE appears to be highest in Russia, where it is 10 years (lower male LE), and lowest in parts of the developing world, where the differential in the healthy life span of men and women is relatively small. In some of these countries in North Africa, the Middle East, and Asia, women's HLE at birth may even be lower than men's. This is possibly due to higher female infant and childhood mortality, high maternal mortality, and factors related to the status of women in these societies. Because of AIDS, it has been estimated that HLE in some African countries has fallen to levels comparable with those of advanced countries in medieval times (http://www.who.int/inf-pr-2000/en/pr2000-life.html).

Similar thinking has led to the development of a measure of LE that is adjusted by an assessment of the quality of life, i.e., **quality adjusted life expectancy** (QALE). The principle here is that

while a person may live longer, it is preferable to obtain a measure that reflects not only the length of life, but also its quality. The use of the QALE has led to the need to develop appropriate and valid measures of quality of life. Calculations made on national data in the US showed that the female/male difference in LE at age 32 was 5.4 years. Adjusting for quality of life reduced the difference to 1.3 years (Kaplan and Erickson, 2000). This change probably reflects high levels of disability-related morbidity in the older women. Similar findings were obtained in a study of a random sample of residents in San Diego (Kaplan, Anderson, and Wingard, 1991).

While LE is based on mortality data, a recent study focused on **disability-free life expectancy** (DFLE) as an important measure when considering the possible improvement in population health. This additional measure takes into account that there are other factors besides mortality to be considered when assessing the health of a population. The DFLE advantage among persons with a higher education, as compared to those with lower education, was 8 years for men and 5.9 for women. The major conditions explaining these differences were arthritis, back complaints, asthma and chronic obstructive lung disease, and residual effects of heart disease and stroke. The authors therefore stress the need to relate to the social disparities (education) in non-fatal conditions when developing health policy at the population level (Nusselder et al., 2005).

As mentioned above, the usual measure of longevity has been LE at birth and this was considered to be largely dependent on the level of infant mortality. However, with the increase of LE and the aging of populations, it is realized that LE at age 65 may reveal interesting and important findings. The female/male LE differential at birth is found also at age 65. In 2000, LE at 65 was 16.5 years for US men and 19.4 for women (Munnell, Hatch, and Lee, 2004).

Interestingly, the differences in LE at 65 from one country to another and the patterns of female/male differences have changed over time. In 1980, the US led almost all developed countries for women and was in the middle of the distribution for men. Since then, however, the LE at 65 in other industrialized countries has increased far more than it has in the US.

The LE differential at 65 has very important personal and family implications; in addition, at the national level, it has a significant impact on pensions and other issues. Therefore, the future direction of LE at age 65 and its gender differences are critical to the cost estimations for the coming years. Behind this question are factors that are related to increased or decreased LE at 65. While the issues involved are complex, it does seem that two major factors affecting LE at this age, with possible differential gender implications, are the income levels of the lower socioeconomic strata and, as a major health impact measure, the rising level of obesity.

### 4.2 The Life-span Chronology of Life Expectancy Differentials

As LE relates to the entire life span, it is important to recognize the female/male mortality differential at different ages.

While LE has usually been measured from birth, it is of interest to note the development of this female/male difference over the life span:

1. It has been estimated that 120 males are conceived for every 100 females.
2. However at birth the ratio is 110:100. This is because more male fetuses are spontaneously aborted than females. In other words, the female/male differential apparently begins at conception.
3. The male/female ratio of live births is 106:100. The birth process is apparently more dangerous to male babies.
4. Infant mortality is higher in males than females (higher infection rates, greater probability of congenital abnormalities or birth trauma)
5. By age 35, there are equal numbers of men and women alive, however from then on men are at greater risk for serious illness, e.g., lung cancer, ischemic heart disease, stroke, chronic obstructive lung disease.
6. There are some interesting findings when the probability of living to different ages, in adulthood, is calculated (see Table 2). At age 60, women have a 10% higher probability of reaching age 80 (83% compared to 73%); 12% higher probability of reaching 85; and 8% of reaching 95 (30% compared to 22%). The situation is similar at age 65 and 70.

All the above data shows that the male/female mortality differential occurs somewhere between "womb and tomb."

### 4.3 Social Implications

The social implications of these LE and mortality differences are considerable in terms of the health, family, and economic needs of members of both sexes. In addition, the economic implications for society as a whole are considerable. Even in countries where post-retirement pensions are available, the female/male difference has relevance for manpower planning, actuarial pension calculations, and, in recent years, the need for the possibly differential calculation of life insurance policies.

**Table 2: Probabilities of Living to Different Ages in the United States**

| | Surviving to 80 % | | Surviving to 85 % | | Surviving to 90 % | | Surviving to 95 % | |
|---|---|---|---|---|---|---|---|---|
| Current Age | Male | Female | Male | Female | Male | Female | Male | Female |
| 60 | 73 | 83 | 58 | 70 | 39 | 52 | 22 | 30 |
| 65 | 75 | 84 | 60 | 71 | 41 | 53 | 22 | 31 |
| 70 | 79 | 87 | 63 | 74 | 43 | 54 | 23 | 32 |

Source: US Society of Actuaries, Annuitant Mortality Table A2000
Basis: A2000 set back two years.

### 4.4 What are the Factors Related to the Female/Male Life Expectancy Differential?

This is a complex issue and one that is not completely understood. The possible explanations that have been investigated are biological (in terms of genetic predisposition), cultural, behavioral,

and environmental factors. It has been stated that "being a male is the single largest demographic risk factor in developed countries" (Kruger and Nesse, 2004).

It is also very probable that none of the above alone is responsible for the differential – but rather that the differential is the result of a combination of factors, especially between the biological on one hand, and cultural, behavioral, and environmental on the other (Desjardins, 2004). This need to integrate the social and biological perspectives has been stressed by Rieker and Bird, who indicate that neither aspect alone has explained the gender differences in LE (Rieker and Bird, 2005).

1. **The Genetic Issue**: As already described, the genetic advantage of women seems clear, as male mortality is higher from the very beginning of human life (Desjardins, 2004). This genetic advantage has been related to the fact that, having two X chromosomes, the woman has the extra one to fall back on if the first is damaged (Waldron, 1983).

This is however very simplistic as other genetic factors may well play a role. It is thought that part of the genetic difference is associated with a better biological resistance to aging in women. In addition, the female hormones and their responsibility for the reproductive process have provided the woman with greater reserves to meet the process of aging. However, notwithstanding the fact that many biologic and genetic factors have been identified, the overall role that they play in longevity has eluded the scientific community.[2]

A recent study by a team in New York, involving Israeli scientists, has identified a genetic profile linked to aging in the Ashkenazi population. Its relevance for the female/male difference has not as yet been clarified (Atzmon et al., 2006).

2. **The Social-Cultural-Behavioral Issue**: While the biological factors described above have highlighted the risk associated with being a male, it is clear that the substantial differences within and among populations indicate that the difference is not purely biological, but rather that intervening social, cultural, and environmental characteristics may have a considerable impact. This may partially explain the relationship between parental/child longevity (see Footnote 2) as related to a shared environment, whether human or physical. This includes both factors that place the male at greater risk and those that are possibly protective to women (Kruger and Nesse, 2004).

[2] An interesting aside on the genetic issue was raised in the work of Gavrilova and Gavrilov, who studied what they termed as familial transmission of human life span (Gavrilova and Gavrilov, 2001). When considering mother-daughter transmission, they concluded that if the mother lived to 85, this was associated with a resemblance in the daughter's longevity. Below that age there did not appear to be an association. In the father-to-daughter transmission, the demarcation point was at the earlier age of 75. The implication of this observation seems to be that when parents reach an advanced age, this has implications for the LE of their daughters but possibly not for the male offspring. There therefore seems to be an importance to parental longevity when the offspring reach advanced age, but not before.

The female biological advantage has apparently been compromised in the past by women's status and life conditions. The status of women in the industrialized world has undergone substantial changes in recent decades and this has allowed them to regain and indeed increase the differential. It should however be stressed that there are still many countries in the world where this has not occurred, e.g., India and Bangladesh, where the difference in LE is only 0.6 and 0.1 years respectively (Desjardins, 2004).

So, which social and cultural factors are relevant in this context?

In the analysis that follows, we consider a wide range of factors, some of which are particularly relevant for understanding the female longevity advantage, while others are particularly relevant for understanding why the magnitude of that advantage has changed over time. Moreover, we identify factors that appear to have contributed to the general trend (i.e., a narrowing of the gap) as well as factors that appear to have attenuated that general trend. Finally, we also discuss factors that may have had a differential impact on men and women for only a subset of the population (e.g., low-income persons).

1. Socio-economic status (SES): Sweden is one of the countries where the advantages of the welfare state have been promoted and indeed the LE of the population is among the highest. Studies of the changes in LE over a 20-year period from 1980 have found that that the difference between the highest and lowest SES classes has increased in both sexes, but that this change has been greater in men. In other words, men in the lower SES groups have experienced a greater decrease in LE and thus the female/male differential has widened (Burstrom, Johannesson, and Diderichsen, 2005). Studies in Great Britain have produced similar findings (Woods et al., 2005; Bremner et al., 2000). As a result of the greater change for low-income men, the overall LE difference by gender has also increased.

2. Educational disparity between men and women and within each gender has been the focus of a number of studies. Using US data, Manton et al. found that mortality was higher (controlling for disability) in both males and females who had a lower education. In addition, those with higher education had a better level of functioning than those with a lower education (Manton, Stallard, and Corder, 1997). A Danish study found a significant difference in LE by educational level in both men and women. However, the gradient in LE in men was greater than that in women. This may relate to the overall higher LE in women as, at a lower educational level, LE was higher than in men (Bronnum-Hansen et al., 2004). Another interesting aspect studied is that while the LE differential was related in both sexes to length of schooling, this difference was far greater amongst men. Therefore, while the implications of the educational differential apply to both genders, it is greater in men and subsequently the female/male LE difference is accentuated among low education groups.

3. Social differences between men and women: The economic and social progress that has occurred in the industrialized world had brought with it a substantial reduction in the social

differences between men and women. This has included, inter alia, increasing involvement of women in the workforce (which has improved their socioeconomic status) and the sharing of aspects of parenting. In addition, the decrease in the birth rate and the improved medical supervision of pregnancy and labor have changed previously important factors that once had a negative impact on women's health (Desjardins, 2004).

4. An interesting Israeli study has been reported in this connection. A study was carried out in kibbutzim to consider the competing biological and social hypotheses for the LE differences by gender. The rationale was that kibbutz society provides similar social roles for men and women – at least more so than the regular societal frameworks. While female LE is still higher than that of men, the difference is much less than that reported in other societies (Leviatan and Cohen, 1985). The possible implications are intriguing. Does it mean that there is a biological factor in female/male LE differences but that it is mediated by the social environment, or do men – even in this "socially leveling" society – still behave differently, so that the LE difference by gender remains, even though it is smaller?

5. While male behavior has been held responsible for the LE differential, an interesting study has been conducted among monks and nuns, who may be assumed to lead less dangerous lives than others do. In this study, Prof Mark Luy of Rostock, Germany, examined records of 11,500 deaths of monks and nuns. While there was still a difference in LE, it was much smaller – with the LE of monks being some five years greater than that of males in the general German population. The researcher concluded that the lifestyle characteristics of the monks contributed to their higher longevity, while these had less of an impact in the case of the nuns. He considered that while it was reasonable to assume that men "simply don't care for their health as women do" usually, this may be mediated in monks by their living environment (http://www.Klosterstudie.de/index-Dateien/english_guide.htm).

6. Behavioral factors: It has been hypothesized that the past "male-excess" mortality and resultant lower LE are related to what have been termed "man-made diseases." This has included excess exposure to work-associated hazards in the occupations traditionally filled by men. The question however arose that women were increasingly becoming part of the workforce and it could have been expected that this would level out the difference. However, it is now clear that they have taken far less hazardous occupations upon themselves (Desjardins, 2004).

Furthermore, one researcher has characterized the difference thus: "Women relate to their bodies, their health and their lives in a much different way to men. To caricature, women seek beauty. Men seek strength and power; thus a woman's body must remain young and healthy as long as possible, whereas a man's body must be submitted to risks and challenges from an early age." While this may not be a politically correct statement these days, it illustrates the possible differential attitude of the sexes to their role, status, and health.

An additional, if piquant, hypothesis has been raised in relation to the implications of the sex drive in men. Genetic researchers consider that males have a greater potential underlying longevity but that it is their "relentless pursuit of sex that sends them to an early grave." It should however be stressed that the definitive research, at this stage, has been done on worms (Motluk, 1997).

### 4.5 Specific Health-related Behavior

1. **Smoking**: The prevalence of cigarette smoking has been higher in men than in women and the tremendous morbidity and mortality impact of smoking can explain a considerable amount of the LE difference (Bobak, 2002). We also know that smoking in women has been on the increase. Does this contribute to the narrowing of the male-female longevity gap? Perhaps, but the amount that women smoke has remained less than that of men and therefore the impact of smoking on the gap may not have changed greatly (Desjardins, 2004).
   An interesting finding was reported in a study in Pennsylvania, US. The authors constructed life tables for male and female non-smokers, having excluded trauma-induced deaths. The LE estimates of non-smoking men and women were virtually identical (Miller and Gerstein, 1983). When tobacco-related mortality was excluded, the LE differences between Western and Eastern European countries and between sexes were almost eliminated (Bobak, 2002). These and other authors further hypothesize that with the substantial increase in smoking among women, and especially among teenagers, there will be a leveling out of LE differences in the future unless smoking prevention proves effective. This has received some confirmation from a recent study on lung cancer where the gender differences have been seen to be narrowing (Fu et al., 2005). It has been estimated that doubling the per capita tobacco consumption would correspond to an approximately 6.7% reduction in the population's LE, and that this would be greater in women than men. (Shaw, Horrace, and Vogel, 2005) These authors calculated that by reducing their consumption by two cigarettes per day women would raise their LE by one year.

2. **Alcohol**: A difference in alcohol consumption in men and women has been described internationally. A study reviewing the LE differences in 161 countries highlighted the fact that the differential was strongly correlated with the per capita alcohol consumption and its complications such as cirrhosis of the liver (Templer, Griffin, and Hintze, 1993). It has also been noted that the substantial decline in LE in the NIS following the socio-political changes at the end of the 1980s was related, inter alia, to the increase in alcohol consumption (Reamy and Oreskovic, 1999), which had previously decreased; this applies to men in particular.

3. **Physical activity** has been found to be related both to reduced incidence of diabetes and to lower mortality in diabetics. The rising incidence and prevalence of diabetes internationally is important in this context. Males and females with higher levels of physical activity have a greater LE and live longer free of diabetes than those with sedentary lifestyles (Jonker et al., 2006). The implication is that, regardless of whether or not a person has diabetes, increasing physical exercise can increase LE.

The fact that women today engage in less physical activity at work and during their leisure than they did several decades ago[3] may explain part of the leveling of the LE curve in women, especially in relation to the rising rates of diabetes and obesity.

4. **Other risk-taking behavior**: In addition to smoking and alcohol, men are more likely than women to engage in other risk-taking behavior. One example is their tendency toward more reckless driving habits and subsequent involvement in road accidents. Such behavior may also be linked to other causes of violent death (suicide and homicide) – particularly when related to alcohol consumption (Desjardins, 2004; Stillion and McDowell, 2001/2002) – and could be one of the factors contributing to the higher male mortality rates.

5. **Obesity and overweight**: Obesity has long been known to be a health risk. A paper produced by the Framingham Heart Study has reported on the impact of obesity and overweight on LE. They found it to be related to a substantial decrease in LE and increase in mortality, similar to that found with regard to smoking. Are more men obese? This fall in LE was greater in women than in men, especially when associated with smoking and possibly related to the leveling of the LE curve in women. As the increased mortality risk occurs over all ages, there are large increases in premature mortality. At age 40, obese women had increased their risk of dying by age 70 by 115%. For men the increase was of 81% (Peeters et al., 2003). Could this excess risk in women, along with the increase in obesity rates over time (particularly for women), be a partial explanation for the closing gender gap in LE in the industrialized world?

6. An additional factor in food consumption relates to per capita **fruit and vegetable consumption**. In developed countries, the consumption increases with age and the positive effect on LE is relatively greater in men than in women (Shaw, Horrace, and Vogel, 2005). This may be attenuating the female LE advantage.

7. **Medical care**: It is well known that women utilize health and medical care services more than men do. A study of the gap in LE between Eastern and Western European countries found that "conditions amenable to medical intervention" explained a considerable proportion of the LE differential between East and West. In addition, this differential was greater for men than for women, thus increasing the female/male LE difference in the East. It may be that the collapse of the health care system in the former Soviet Union (FSU) and other Eastern European countries has had a more negative effect on men than on women, in part because of the greater prevalence among men of health care problems that could be addressed by a well functioning health care system. This factor could also have important implications for future health care planning (Velikova, Wolleswinkel-van den Bosch, and Mackenbach, 1997).

[3] Both men and women have gone through a transition from more active to more sedentary lifestyles. However, men went through this transition several decades earlier than women.

8. An additional factor related to health care consumption and LE was the **consumption of pharmaceutical products**. Shaw et al. (2005) found that medicinal drug usage has a "positive effect on life expectancy at middle and advanced ages." They estimated that doubling the per capita pharmaceutical expenditure would add about 2.7% at age 40 (411 days for women and 360 for men). The authors calculated that in the US the predicted increase in LE from increased pharmaceutical expenditure decreases with age. This is probably related to the existing increase in use of drugs due to age-related chronic disease. As men tend to consume pharmaceutical products more than women do, this factor may be attenuating the longevity differential.

## 5. What about the Future?

Behind the discussion on the differences in LE for men and women lies the question whether they can be reduced and, if so, at what cost. When considering the data that have been presented it can be seen that:

1. The female LE advantage has been known for a considerable time.
2. In most of the developed world, the differential has been reduced in recent years with a general increase in LE both at birth and at age 65.
3. There seems to be a leveling off of the female increase and this, rather than a greater male improvement, is the major factor in this reduction.
4. In Israel, however, the female/male difference has become, if anything, slightly larger. A recent WHO report stated that:

   "A person born in Israel in 2002 can expect to live 79.4 years on average: 81.4 years if female and 77.3 years if male. […] Between 1980 and 2002, people in Israel gained just over five years of life.

   "The trend in life expectancy (LE) in Israel over the last two decades, based on estimates reported by Israel, shows that the rate of gain by men in the country kept pace with the Eur-A average for men while their LE remained slightly higher than the Eur-A average. In contrast, women in Israel gained LE at a faster rate than Eur-A women over the same period.

   "WHO also estimates that, on average, people in Israel can expect to be healthy for about 90% of their lives. They lose on average eight years to illness – the difference between LE and healthy life expectancy (HALE). Since women live longer than men, and since the possibility of deteriorating health increases with age, women lose more healthy years of life (nine years) than men do (almost seven years). Nevertheless, a longer life expectancy for women in Israel compared with men gives them almost two more years of healthy life than men." (WHO report:

   http://www.euro.who.int/eprise/main/WHO/Progs/CHHISR/burden/20050131_3).

The possibility of reducing the gap therefore has to be considered in terms of both the need to reduce the gap and the potential for doing so. However, the international literature has in recent years been occupied with a broader issue.

## 5.1 Should Society Engage in an Attempt to Increase Life Expectancy and, if So, to What Age?

The very fact that such a question is being asked is certainly related both to the general issues as well as to the female/male differential.

An interesting societal aspect of this question has been discussed from the point of view of the life insurance industry. It seems that the actuarial calculations are based far more on the expected male life morbidity and mortality than that of the female (Panko, 2000). This is possibly the result of the lack, until recent years, of adequate data on female morbidity. Therefore, if the male increase is considered as the norm, when this is not actually the case, should the female life insurance rates be raised in order to compensate for the flattening of the curve? The "logic" for this would be that the insurance industry is having to pay out at an earlier than expected time due to the non-continuation of the improvement in female LE. While this may be considered a peripheral issue in the overall question, it does highlight the need to consider the subject beyond the health-related aspects. It also has a definite implication for state sponsored pensions and other age-related benefits.

Two issues need, therefore, to be considered:

- Reducing the female/male LE differential
- Increasing overall LE

## 5.2 Reducing the Female/Male Life Expectancy Differential

The potential for reducing the differential lies in the answers to three questions:

- What are the reasons for the longstanding difference?
- What is causing female LE curve to flatten?
- What are the reasons for the relatively larger increase in male LE?

In reviewing the above questions, we need to consider six established categories that affect LE in general and probably the gender difference too (Friedland, 1998). These are – as discussed – smoking, earnings (i.e., socio-economic differences), nutrition (notably, in recent years, obesity), genetics, medical developments, and the societal infrastructure (inter alia, education and environmental hazards). The authors however indicate that the solution will not be found in one single factor, but in a combination of factors in a specific population. The message therefore seems to be that any intervention that will have even a modicum of success will require further detailed research that may well need to be specific to a country and particularly to the sub-groups within it, e.g., the 70% prevalence of obesity in Arab women over age 60 in Israel. Other authors have especially emphasized the need to integrate the social and biological determinants of gender differences in health. To this should certainly be added the lifestyle factors that have been discussed in this paper.

However, additional factors make for further complications. Most studies relate to the characteristics of a population at the time of the investigation and use them to project future

trends. Preston (quoted in Friedland, 1998) has raised the important role of a cohort effect – whether birth cohort or time-period specific cohort. An example of the former, while a relatively small number, is the thalidomide issue. The time-period cohort effect may well be illustrated by the change in coronary heart disease (CHD) morbidity in recent decades and at specific ages or by the impact of the HIV/AIDS epidemic. It is, however, of great importance to realize that the accurate assessment of their effects requires valid data, especially longitudinal, that is often lacking concerning former time periods.

In summary, therefore, it seems that the processes determining the female/male LE differential are not clearly understood and there is a need for further research, especially related to the integration of the social and biological factors. However, in order not to delay, the potential effects of the known lifestyle, disease, and other factors impacting on LE could well be addressed by careful planning and intervention. This must take into account the value of such efforts. Closing the gap with resultant longer male LE but with no increase in Healthy Life Expectancy is not the desired outcome.

### 5.3 Increasing Overall Life Expectancy

In a special issue of the *Journal of the American Geriatrics Society* published in September 2005, the possibilities, concerns, and consequences of a future increase in longevity were considered. Kinsella (2005) quoted United Nations projections that the LE will increase by some 25 years in the next three centuries, based on the past decades of change and present socio-demographic data. However, in the same issue, Louria highlights the significant societal issues that arise. These include large increases in the absolute numbers of the old and very old, with the consequent implications for health expenditures and other societal financial support systems that will have to change drastically to allow for the increase in the aged population. In addition, disability and lessened quality of life associated with considerable aging must be taken into account. The stress is laid on the need to begin consideration of these issues in the present. This article relates to the benefits and drawbacks of increasing overall societal LE, as well as the possibility of increasing LE in males without increasing HLE. Such a substantial increase in LE would place a tremendous load on the young in society to have to support the change. Intergenerational responsibility will perforce take on a new meaning (Gordon, 2004).

Should society therefore declare increased LE to be a goal? The extremes lie between letting nature follow its course (with the probability of an increase that will plateau) and an attempt by society to maximize LE over and above what will naturally occur. This dilemma is related especially to the possibility that increased LE will not be accompanied by a concomitant rise in HLE. This has been noted in this paper. It presents a challenge to society in all its frameworks and not only to the technical methodology associated with increasing longevity.

## 6. Conclusion

At the end of this review, it can be stated that while much is known, a question mark remains over much of this field. The desire to reduce the female/male differential in LE is understandable and seems to be happening in much of the industrialized world. However, the cost both in human quality of life and economically to society as a whole deserves further investigation and understanding. The desire to live longer has long been a dream; however, the benefit to the individual and society needs to be reconsidered.

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