Inequalities in Health: The Value of Sex-Related Indicators

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My laboratory has previously shown that the sex differences in tumor incidence in Europe can be related to the female social condition and that the pattern of this relationship varies according to the different historical contexts. In this article, I have extended the study worldwide to all cancer registries, and I present the sex differences in life expectancy at birth. A close link between the health of the populations and socioeconomic and cultural factors was confirmed. The sex-related indicators had a distribution independent from the parent variables cancer incidence and life expectancy; thus, they carry complementary information and provide an additional, sensitive probe for monitoring the health of the populations. ***Key words:*** **cancer, cultural factors, epidemiology, health inequality, indicator, life expectancy, sex, social conditions, socioeconomic factors.** ***Environ Health Perspect*** **111:421–425 (2003). doi:10.1289/ehp.5698 available via** ***http://dx.doi.org/*** **[Online 1 November 2002]**

Inequalities in health continue to be a major problem in the world. Health differences exist between sexes, between social groups within countries, and between countries. The patterns of these health differences change as living conditions evolve (Hertzman and Siddiqi 2000; Marmot and Bobak 2000; Marmot and Feeney 1997; Tomatis 2001), as demonstrated by the sharp decline in life expectancy—as well as the widening gap of life expectancy between sexes—in Eastern Europe during the recent political transition (Marmot and Bobak 2000; Nolte et al. 2000a, 2000b). Thus, observing inequalities in health allows us to better understand how changes in society translate into changes in health. For their universal relevance, the health inequalities between sexes are of particular importance. In previous reports, my laboratory has shown that the sex differences in tumor incidence between European countries can be related to the female social condition: the greater the social equality between males and females, the lower the difference in cancer incidence between the sexes. The female condition was measured by a quantitative sociologic index. However, the study of regional variations in Italy has indicated that this process follows different pathways in different countries, thus requiring explanations rooted in socioeconomic and historical contexts (Benigni et al. 2000, 2001). In this article, I have extended the study of sex differences in cancer incidence worldwide to all cancer registries; a larger perspective is also gained by considering the sex differences in life expectancy at birth.

Data and Analysis

Data. The global cancer incidence (age standardized rate per 10,000 inhabitants) for males and females was retrieved from the compilation of cancer registries of the International Agency for Research on Cancer (Parkin et al. 1997). The life expectancy at birth was retrieved from the *Encyclopedia Britannica* (2000).

The sex differences were expressed as normalized indices:

$$\Delta\text{N} = \left(\frac{\text{male cancer incidence} - \text{female cancer incidence}}{\text{male cancer incidence}}\right)$$

$$\Delta\text{LIFE} = \left(\frac{\text{female life expectancy} - \text{male life expectancy}}{\text{male life expectancy}}\right)$$

For both indices, positive values indicate male disadvantage, whereas negative values indicate female disadvantage.

Strategy of the analysis. This study consists of three separate analyses. In the first analysis, I considered the distributions of the ΔN values, relative to 183 cancer registries from 50 countries. The subject of the second analysis was the distribution of the ΔLIFE values in 139 countries; in this case, one ΔLIFE value corresponded to one country. The reasons for keeping the first and second analyses separate was that the data available were classified differently (regions and countries, respectively). Therefore, separate analyses were more adequate for using all of the available information.

The third analysis compared the distributions of ΔLIFE, ΔN, cancer incidence (male and female separately), and life expectancy (male and female separately). This analysis was performed at the level of the least detailed variable, that is, at the country level. The ΔN and the cancer incidence values were averaged by country. The countries (statistical units) considered in this third analysis were those with values in all six variables (n = 50).

Table 1 shows the ΔLIFE values and the ΔN values averaged by country. The ΔN values for the cancer registries are available from the author on request.

Results and Discussion

Sex difference in cancer incidence. An inspection of the ΔN values (standardized sex difference in cancer incidence) points to the complexity of interpreting the modulating factors. For example, cancer registries from three extremely different countries, such as Brazil, Uganda, and Sweden, are in a very narrow interval of ΔN (Goiania, Brazil, 0.071; Kyadondo, Uganda, 0.073; Sweden, 0.074). The differences in society, culture, and economic development make it difficult to find a common explanation. However, underlying regularities start to emerge when the data are grouped into geographical areas (Figure 1). An analysis of variance confirmed the effect of the geographical distribution on ΔN (F = 17.30; p < 0.0001).

Previous work from my laboratory (Benigni et al. 2000, 2001) has shown that the distribution of tumor profiles in Europe closely follows the cultural (historical) geography of the continent and that the sex differences in cancer incidence parallel a socioeconomic indicator of the female condition. The starting hypothesis of this work is that cultural/socioeconomic factors influence the ΔN distribution worldwide. The geographic repartition selected for the cancer registries (Figure 1) that I had subjectively decided upon follows the general lines of the cultural/socioeconomic repartition accepted by modern historical research. Such historians as Fernand Braudel have expanded on the existence of clearly recognizable "civilizations"; these are able to maintain their specificity in fields ranging from everyday life to art and culture over extremely long periods of time (Braudel 1972, 1981, 1995). Within this perspective, the geographic classification selected in this work is a proxy for a cultural/socioeconomic classification of the cancer registries' areas.

The numerosity and representativity of the available cancer registries also put constraints on the geographical classification. Using all of this information, I based the classification on seven areas. South Asia and East Asia are clearly characterized (Figure 2). Latin America includes Costa Rica, Puerto Rico, and South America. Pacific registries are available only from Australia, New Zealand, and Philippines. African and Middle Eastern registries were collected together only because of the paucity of the data points. European and North American countries could have been collected under the same heading; however, they

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Table 1. ΔLIFE values and the average ΔN values (when available) for all countries considered.

Area/country	ΔLIFE	ΔN
Africa (sub-Saharan)		
Niger	–0.022	
Burkina Faso	–0.015	
Kenya	–0.001	
Malawi	0.008	
Somalia	0.010	
Rwanda	0.013	
Guinea	0.022	
Sudan	0.033	
Cameroon	0.040	
Burundi	0.041	
Namibia	0.043	
Nigeria	0.044	
Ethiopia	0.050	
Cote d'Ivoire	0.054	
Madagascar	0.054	
Senegal	0.055	
Mozambique	0.057	
Gabon	0.063	
Uganda	0.064	0.074
Congo	0.065	
Togo	0.067	
Zimbabwe	0.068	0.010
Eritrea	0.072	
Ghana	0.073	
Gambia	0.073	
Mali	0.076	0.283
Sierra Leone	0.077	
Tanzania	0.084	
South Africa	0.087	
Angola	0.097	
Congo Democratic Republic	0.100	
Chad	0.104	
Central African Republic	0.106	
Mauritania	0.126	
North Africa/Middle East		
Tunisia	0.026	
Algeria	0.032	0.377
Syria	0.042	
Saudi Arabia	0.043	
Iraq	0.047	
Israel	0.051	0.027
Morocco	0.059	
Kuwait	0.061	0.042
Egypt	0.062	
Qatar	0.064	
Turkey	0.070	
Lebanon	0.074	
Jordan	0.085	
South Asia		
Afghanistan	–0.028	
Nepal	–0.027	
Bangladesh	0.000	
India	0.018	0.023
Pakistan	0.032	
Iran	0.036	
Indonesia	0.047	
Myanmar	0.051	
Sri Lanka	0.056	
Malaysia	0.057	
Singapore	0.060	0.052
Thailand	0.074	0.129
East Asia		
Mongolia	0.046	
China	0.047	0.348
Cambodia	0.057	
Laos	0.058	
Vietnam	0.061	0.370
Hong Kong	0.074	0.298
Taiwan	0.082	
Japan	0.083	0.413
North Korea	0.102	
South Korea	0.117	0.451
Pacific		
Papua New Guinea	0.017	
Philippines	0.060	0.091
South (Latin) America		
Paraguay	–0.044	
Argentina	0.048	0.128
Cuba	0.050	
Dominican Republic	0.066	
Honduras	0.067	
Nicaragua	0.074	
Ecuador	0.075	–0.152
Peru	0.075	–0.207
Panama	0.077	
Costa Rica	0.077	0.133
Colombia	0.081	–0.079
Chile	0.082	
Guatemala	0.084	
Haiti	0.084	
Mexico	0.086	
Uruguay	0.093	0.208
El Salvador	0.109	
Puerto Rico	0.128	0.285
Brazil	0.189	0.155
Bolivia	0.199	
Western countries[a]		
Iceland	0.050	0.092
Malta	0.061	0.177
Greece	0.069	
United Kingdom	0.071	0.143
Sweden	0.073	0.074
Denmark	0.073	0.068
Australia	0.075	0.226
Netherlands	0.076	0.240
Ireland	0.077	0.156
New Zealand	0.081	0.055
Norway	0.082	0.160
Switzerland	0.086	0.288
Austria	0.087	0.203
Italy	0.089	0.312
Germany	0.090	0.270
Belgium	0.093	
Canada	0.093	0.184
United States	0.094	0.242
Portugal	0.099	
Finland	0.102	0.174
Spain	0.107	0.377
France	0.109	0.365
Eastern Europe		
Macedonia	0.061	
Yugoslavia	0.078	0.273
Romania	0.088	
Bulgaria	0.092	
Albania	0.095	
Croatia	0.107	0.366
Czech Republic	0.111	0.311
Slovenia	0.113	0.325
Poland	0.127	0.296
Slovakia	0.132	
Hungary	0.145	
Former USSR		
Tajikistan	0.088	
Uzbekistan	0.090	
Georgia	0.101	
Armenia	0.102	
Moldova	0.109	
Turkmenistan	0.112	
Azerbaijan	0.118	
Kyrgyzstan	0.125	
Kazakhstan	0.140	
Belarus	0.156	0.402
Ukraine	0.177	
Estonia	0.182	0.346
Lithuania	0.184	
Latvia	0.200	0.341
Russia	0.241	

USSR, Union of Soviet Socialist Republics. The geographical classification was used in the analysis of the ΔLIFE distribution and in the final principal component analysis. [a]The classification selected is a proxy for a cultural/socioeconomic classification (see details in the text).

are very numerous, so it was possible to check for their similarity/dissimilarity as groups.

Once reorganized geographically, the data lend themselves to a range of considerations. Worldwide, the majority of locations have positive ΔN (male disadvantage). Negative ΔN (female disadvantage) occur only in a number of developing countries in Africa, South Asia, and South America. The two large areas with similar socioeconomic patterns (Europe and North America) are in the same range of ΔN values and have no significant difference (*t*-test, $p = 0.8$). Figure 2 shows the data for the two most populated areas in the world, South Asia and East Asia. It appears that, despite their geographic contiguity, South and East Asia are quite different in terms of ΔN distribution: East Asia has statistically significantly higher values (*t*-test, $p = 0.0118$). These observations on the large scale already suggest that the sex differences in tumor incidence are influenced not only by socioeconomic characteristics but also by cultural patterns. The existence of a global difference between East and South Asia is striking in this respect, despite the fact that East Asia inlcudes countries with very different levels of socioeconomic development. Within East Asia, the homogeneity of the Japanese ΔN values is remarkable and points to a link with its cultural and ethnic homogeneity.

ΔN seems to simultaneously depend on socioeconomic and cultural factors. Among the Pacific countries, a considerable difference between Australia (Western Australia, 0.192; Victoria, 0.220; Capital Territory, 0.222; South Australia, 0.224; Tasmania, 0.247; New South Wales, 0.248) and New Zealand (non-Maori, 0.054; Maori, 0.055) is apparent, together with a strong within-country homogeneity.

India has both positive and negative ΔN (Figure 2), paralleling the internal diversity of this vast country. Positive ΔN values (male disadvantage) are relative to (in decreasing order) Kerala cancer registries (Karunagappally, 0.252; Trivandrum, 0.202) and Bombay (0.048). Kerala is the Indian state where women have the highest social status; the Bombay region leads India in modernization. The difference with the other locations characterized by negative ΔN (female disadvantage) and more subordinate female condition speaks clearly in favor of a correlation between ΔN and the female condition.

Singapore has three ethnic cancer registries: the Indian register has a negative ΔN (–0.167); the Malay community has an intermediate ΔN (0.082), and the Chinese community has a high ΔN (0.241). The opposition between Indian and Chinese ΔN values in Singapore is similar to that between India and China, thus pointing to the involvement of a strong cultural effect in the three ethnic communities.

In North America, Canada has average ΔN values lower than those of the United States

(0.184 vs. 0.242); the difference is close to statistical significance (t-test, $p = 0.07$). However, this difference is entirely because of the very high ΔN of the African-American cancer registries, which constitute the whole upper end of the ΔN distribution in North America (New Orleans, LA, 0.350; Connecticut, 0.356; Los Angeles, CA, 0.383; San Francisco, CA, 0.384; Detroit, MI, 0.399; Surveillance, Epidemiology, and End Results, 0.401; Atlanta, 0.437; central Louisiana, 0.463). After excluding these registries, there is no difference between Canada and the United States. The male disadvantage in cancer incidence in the African-American community is in agreement with other health indicators (e.g., life expectancy) (Elo 2001). The homogeneity of ΔN points to the persistence of a strong socioeconomic and cultural unity in the African-American community, despite the social and geographical mobility of the American society, and the lack of geographic contiguity among the registries. The existence of cancer registries for various ethnic groups in the United States may provide rich material for further studies. For example, there is a statistically significant trend with increasing ΔN in the following order: American Indians < Hawaiians < Japanese and Chinese communities < Hispanics < whites < African Americans ($F = 16.0$; $p < 0.0001$).

In Europe, we have previously demonstrated a remarkable homogeneity of ΔN within the countries, together with differences among countries (Benigni et al. 2000, 2001). Figure 3 shows these differences for the countries with multiple cancer registries.

In South America, a difference is apparent between countries on the Pacific Ocean (negative ΔN: Trujillo, Peru, –0.223; Lima, Peru, –0.190; Quito, Ecuador, –0.151; Cali, Colombia, –0.079) and on the Atlantic Ocean (positive ΔN: Goiania, Brazil, 0.070; Belem, Brazil, 0.087; Concordia, Argentina, 0.127; Costa Rica, 0.132; Montevideo, Uruguay, 0.207; Puerto Rico, 0.284; Porto Alegre, Brazil, 0.306). A large variability also characterizes sub-Saharan Africa and the Middle East; unfortunately, the paucity of the data is a serious obstacle to their analysis.

Overall, the above results are in agreement with the large amount of evidence indicating that cancer has a predominantly environmental origin (Benigni and Giuliani 2000; Liechtenstein et al. 2000; Sokal et al. 2000; Tomatis et al. 1997) and adds further support to it. More specifically, these results support the starting hypothesis of this analysis, that cultural and socioeconomic factors influence the sex difference in cancer incidence.

Sex difference in life expectancy. The normalized sex differences in life expectancy at birth (ΔLIFE), arranged by geographical areas, are plotted in Figure 4 (data for individual countries shown in Table 1).

ΔLIFE values refer to countries, whereas many of the ΔN values are relative to subcountry areas (regional cancer registries). Moreover, ΔLIFE values are available for all the countries ($n = 139$), whereas the number of countries covered by the cancer registries is limited ($n = 50$). Although the grouping into geographical areas was somewhat different, the underlying criteria were identical. In this analysis, it was possible to separate sub-Saharan African countries from North African and Middle Eastern countries. I defined South Asia and East Asia in the same way, but more representatives were available than in the preceding analysis. Because North America had only two representatives, Canada and United States, it was merged with Western Europe. An indirect support to this decision was the fact that North America and Europe showed no significant difference in terms of ΔN distribution. As a consequence, Australia and New Zealand were also included in the Western countries group (in the ΔN analysis, both North America, and Australia and New Zealand had enough data points to be considered separately). New groups were formed by Eastern European and former USSR (Union of Soviet Socialist Republics) countries, respectively, because of the specific characters of their recent and less recent history during the Communist Era and the Russian empire, and because the numerosity of the data points allowed us to check for specific effects on the ΔLIFE distribution.

A clear pattern emerges in this analysis; the distribution of ΔLIFE, like ΔN, follows the geographical distribution. This is confirmed by an analysis of variance ($F = 13.07$, $p < 0.0001$).

In the majority of cases, there is male disadvantage (positive ΔLIFE), with the exception of a few developing countries (Niger, Burkina Faso, Kenya, Afghanistan, Nepal, and Paraguay). Africa, the Middle East, and South Asia form a kind of large belt of countries where either the male disadvantage is low or there is female disadvantage. The male disadvantage increases in the order East Asia < South America < Western countries < Eastern Europe < former USSR. During their recent political transition, many Eastern European and former USSR countries have undergone a very

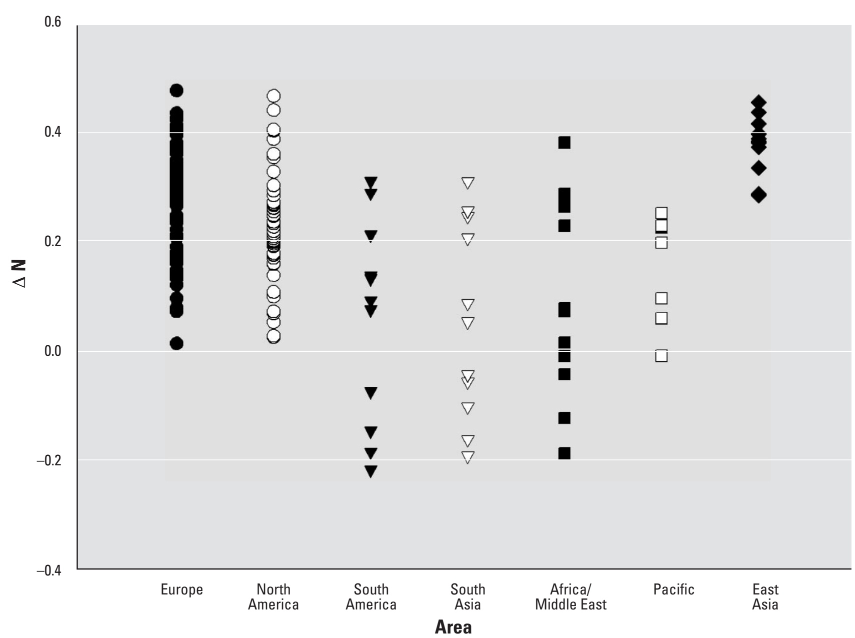

Figure 1. ΔN distribution: all cancer registries.

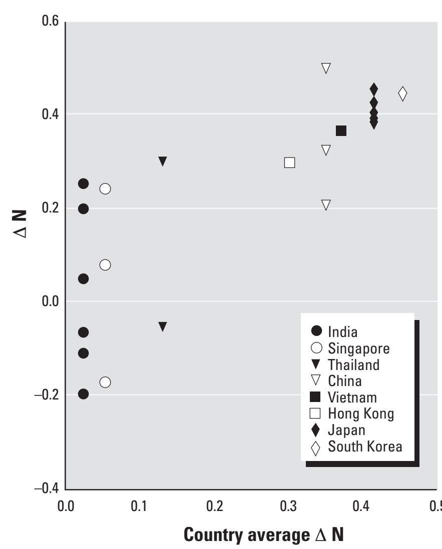

Figure 2. ΔN distribution: South Asia (India, Singapore, and Thailand) versus East Asia (China, Vietnam, Hong Kong, Japan, and South Korea). Country average ΔN is the average value of the ΔNs relative to the countries shown in the figure.

rapid and dramatic decrease in life expectancy, especially for the male population. This phenomenon has attracted the attention of many investigators, and the concomitant action of material deprivation, stress, and stress-related behaviors (e.g., increased alcohol consumption) has been hypothesized (Marmot and Bobak 2000; Reamy and Oreskovic 1999). This is an extremely cogent example of the direct effect of the societal organization on health. In the present context, what is important to notice is that the differences among countries change gradually and consistently according to the differences in socioeconomic and cultural characteristics.

The case of the former USSR countries is particularly significant. On one hand, there is a general and coordinated increase of ΔLIFE values with respect to the surrounding areas, with the maximum ΔLIFE (0.241) shown by Russia. Simultaneously, a second effect is apparent: the values of the central Asian countries are systematically lower than those of the European part of the former USSR (Tajikistan, 0.088; Uzbekistan, 0.090; Georgia, 0.101; Armenia, 0.102; Moldova, 0.109; Turkmenistan, 0.112; Azerbaijan, 0.118; Kyrgyzstan, 0.125; Kazakhstan, 0.140; Belarus, 0.156; Ukraine, 0.177; Estonia, 0.182; Lithuania, 0.184; Latvia, 0.200; Russia, 0.241). Although there is a general increase in ΔLIFE values, these central Asian countries continue to show some similarity with the neighboring countries of East and South Asia.

Life expectancy, cancer incidence, and sex-related indicators. For the 50 countries with cancer registries, a quantitative comparison was performed of life expectancy (male and female), cancer incidence (male and female), and sex differences in cancer incidence and life expectancy. To highlight the major trends underlying the data, these variables were analyzed with principal component analysis (PCA), the mathematical technique of election for summarizing complex data sets and displaying the essential information in a few dimensions. Moreover, PCA is highly effective in separating the main trends (first components) from the noise in the data (Benigni and Giuliani 1994; Lebart et al. 1984). In fact, PCA generated a two-dimensional plot (Figure 5), which summarized 77% of the relationships (variance) among countries. The original data were in six dimensions, so it was not possible to have—just by eye—an overall view of the data. Table 2 shows the correlations among the six variables, and Table 3 shows the correlations of the original six variables with the new axes and permits their interpretation.

The first axis (principal component 1; PC1) summarizes the coordinate variation of the life expectancy and cancer incidence for both sexes (correlations in Table 3). As shown in Table 2 , life expectancy in males and females is highly interrelated, as are cancer incidence in males and females. At the same time, the group of two life expectancy variables and the group of the two cancer incidence variables are globally much more related with each other than to the two variables ΔLIFE and ΔN. This indicates that, worldwide, the major difference among countries is between those with low life expectancy and low cancer incidence (low PC1 values, Africa and South Asia) and those with high life expectancy and high cancer incidence (high PC1 values, mainly Western countries). The increase in tumor incidence in both sexes as life expectancy increases is a well-known pattern of the developed societies (Parkin 1998).

The second effect highlighted by PCA is coordinate variation of the sex-related indicators, both correlated with PC2 (Table 3). This indicates that the second important fact underlying the data is the tendency toward a disadvantage for the same sex simultaneously for cancer incidence and life expectancy. This effect, although already apparent in this worldwide analysis, becomes of major importance in the Western countries, where life expectancy and cancer incidence have a limited variation and sex-related differences are the major difference among countries. Figure 5 shows how the PC1 variation for the Western countries is limited, whereas the variation along PC2 is large.

One important advantage of PCA is that it identifies and separates the different independent effects acting in the data (Benigni and Giuliani 1994; Lebart et al. 1984). As shown by Figure 5, the variations in life expectancy and cancer incidence (PC1) are unrelated to those in the sex differences (PC2): for the same value of PC1, there are both countries with high PC2 (male disadvantage) and low PC2 (female disadvantage). Therefore, the two categories of indicators are probes for different phenomena.

Conclusions

Overall, the evidence from the geographical distribution of the sex differences in cancer incidence and life expectancy suggests that there is a close link between the health of the populations and socioeconomic and cultural factors. This was demonstrated formally by the two analyses of variance of the cultural/socioeconomic classification of world areas versus

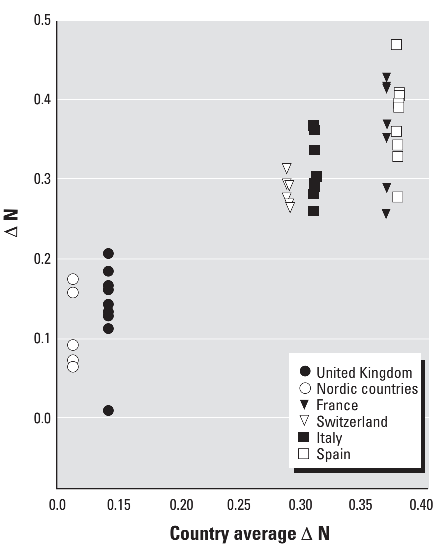

Figure 3. ΔN distribution: European countries with multiple cancer registries. The Nordic countries are Iceland, Norway, Sweden, Finland, and Denmark. Country average ΔN is the average value of the ΔNs relative to the countries shown in the figure.

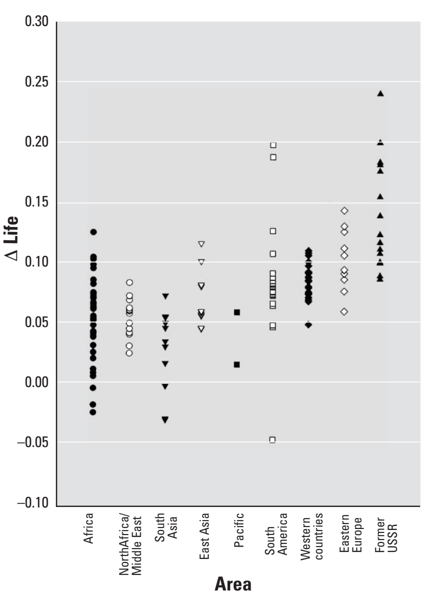

Figure 4. Distribution of the sex differences in life expectancy (ΔLIFE). See Table 1 for geographic classification.

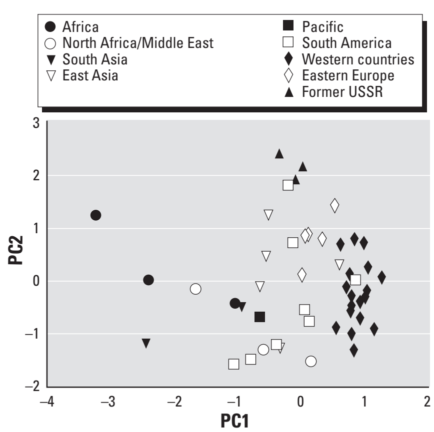

Figure 5. PCA analysis of six health indicators, relative to 50 countries with cancer registries (Table 1). PC1 orders the countries from low life expectancy and low cancer incidence to high life expectancy and high cancer incidence. PC2 orders the countries from low to high male disadvantage for both ΔN and ΔLIFE (see text for details).

both the ΔN distribution and the ΔLIFE distribution. This demonstration was also supported by the large amount of anecdotal evidence provided in this report. The changes in the society appear to greatly influence the health conditions.

In previous works on the sex difference in cancer incidence in Europe (Benigni et al. 2000, 2001), my laboratory found that it was correlated with the female condition. This type of approach, based on the comparison with quantitative descriptors of the female condition, and more in general of the relationships between sexes, may profitably be extended to analyze other cases for which enough data points exist (e.g., United States; Canada; some European countries such as the United Kingdom, France, and Spain; and Japan). Studies on the sex differences within countries should be compared with the studies between countries; expanding the research beyond one social context helps to elucidate causal relationships. In this respect, it can be anticipated that a comparison between East Asia and South Asia can provide very interesting evidence. At the same time, the specific socioeconomic, cultural, and historical context should be taken into account. For example, the sex equality in cancer incidence (ΔN around zero) is found both in affluent societies such as the European Nordic countries, where women have attained a high degree of social equality, and in rural and underdeveloped societies where the women have a subordinate role. Thus, the reasons for sex equality in cancer incidence may be very different. One can hypothesize a model articulated as follows:

- "Natural state" in underdeveloped societies, with similar exposure patterns for males and females, and similar cancer incidence (ΔN around zero)
- Underdeveloped societies with females in a subordinate role, and disadvantage for the females (negative ΔN)
- Developed countries with subordinate female role, which may correspond to industrialized countries where the males face more hazardous exposures or more dangerous life styles (positive ΔN)
- Developed societies with equality in lifestyle and health conditions (ΔN around zero)
- Societies experiencing critical transitions, with males exposed to more hazardous lifestyles (positive ΔN).

The analysis of different societies, and at different levels (among and within countries), may shed light on these articulated and nonlinear patterns.

An important result is that the sex-related indicators have a distribution independent from the parent variables cancer incidence and life expectancy; therefore, they carry additional, complementary information. Moreover, within relatively homogeneous socioeconomic and cultural areas (e.g., the Western countries), the variation of cancer incidence and life expectancy is less than that of the sex-related indicators: the latter acquire a primary importance as sensitive probes for health conditions. The development of new methods and new tools is crucial to epidemiology (Shy 1997; Taubes 1995). Although the standard epidemiologic approaches are usually effective in solving quite heavy localized "exposures," they face serious difficulties in a variety of situations, including both large-scale issues, such as the construction of a theory for social epidemiology able to explain how social determinants generate the disease in the individuals (Krieger 2001), and smaller-scale issues, such as the uncertainties in the explanation of the large difference in the relative risk of lung cancer from cigarette smoking in American and Japanese men (Stellman et al. 2001). The sensitivity of the sex differential health indicators to even minor differences in social and cultural factors across countries suggests that they can be a useful probe for environmental factors in the epidemiologic studies, as well as an efficient tool for the monitoring and forecasting activity of public health agencies and governments.

Because the sex differential health indicators are context sensitive, a final clarification is necessary. On one hand, they measure—in an absolute way—if a certain situation is characterized by factors leading to female or male disadvantage. In this sense, they are very useful probes. On the other hand, the same value of ΔLIFE or ΔN can be reached through different historical processes and in different contexts. Thus, studies aimed at understanding the origin of specific situations, and attempts to modify such situations, should always be based on a historical and sociocultural perspective focusing on the specificity of that context.

Table 2. Relationships (correlation coefficients) among health indicators.

	LEm	LEf	CIm	CIf	ΔLIFE	ΔN
LEm	1.0	0.98	0.46	0.49	0.21	0.0
LEf		1.0	0.60	0.53	0.42	0.15
CIm			1.0	0.80	0.41	0.39
CIf				1.0	0.13	–0.21
ΔLIFE					1.0	0.43
ΔN						1.0

Abbreviations: CIf, cancer incidence in females; CIm, cancer incidence in males; LEf, life expectancy in females; LEm, life expectancy in males.

Table 3. Factor loadings (correlation coefficients).

	PC1	PC2
LEm	0.80860*	–0.43127
LEf	0.90195*	–0.16633
CIm	0.87863*	0.31433
CIf	0.79287*	–0.17512
ΔLIFE	0.24456	0.81924*
ΔN	0.20639	0.78034*
Variance explained (%)	0.50	0.27

Abbreviations: CIf, cancer incidence in females; CIm, cancer incidence in males; LEf, life expectancy in females; LEm, life expectancy in males. The six health indicators (relative to 50 countries with cancer registries) were analyzed with PCA. The majority of the information (77%) was summarized in only two dimensions, PC1 and PC2. The values are plotted in Figure 5. The factor loadings are the correlation coefficients of the six health indicators with their PCs (summary indicators). High correlation coefficients (asterisks) indicate that PC1 summarizes the information carried by the life expectancy and cancer incidence indicators, whereas PC2 summarizes the information carried by the sex difference indicators.

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