Paper prepared for the International Seminar on
Vulnerable Populations:Definitions, Categories and Empirical Analysis
organized by the IUSSP Scientific Committee on Historical Demography and
the Ecole des Hautes Etudes en Sciences Sociales (EHESS) Paris, 15-16 July 2005

Health and Wealth in Uzbekistan in a comparative perspective

By
Michel Garenne (1)
and
Sophie Hohmann (2)

(1) IRD/ISD, Paris
(2) EHESS/INED, Paris

Email : mgarenne@bhdc.jussieu.fr / so_hohmann@hotmail.com

Running head: Health and Wealth in Uzbekistan

Revised 16 May 2005

Abstract:

The study investigates the magnitude of mortality differentials in Uzbekistan, a former soviet country of Central Asia, and compares with similar indicators from sub-Saharan Africa. Data are derived from Demographic and Health Surveys. A "wealth index" was built from data on goods owned by households and quality of housing, and scaled from 0 to 12. Mortality differentials were computed separately for children (survival of children) and for young adults (survival of parents). Death rates were analyzed according to an absolute measure of wealth (the wealth index) and to a relative measure (mean value plus or minus two standard deviations). Results show that wealth is distributed very differently in Uzbekistan, with a symmetric distribution around a mean index of 5.5 modern goods owned. In Africa, on the contrary, the wealth distribution has a lower mean (2.5) and is highly skewed towards the left, which reveals a high proportion of very poor people. However, despite major differences in wealth distribution, the relationship between mortality indicators and the wealth index bore much similarity in the two situations. The magnitude of relative mortality differentials was of the same order in both cases, with gradients ranging from 2.5 to 1 for child mortality and 1.5 to 1 for adult mortality. However, the absolute values of mortality indicators remained lower in Uzbekistan than in Africa at the same level of wealth. A similar relationship was found between nutritional status and the wealth index in both cases. On the contrary, there were no difference by wealth in use of health services and level of education in Uzbekistan, whereas wealth gradients were steep in Africa for the same variables. Results suggest that mortality differentials were primarily due to nutritional status, and not to use of health services. A study from 19th century France, when modern health services did not exist, went in the same direction. The discussion focuses on mortality determinants and health policies that could have produced this pattern.

Key Words: Mortality differentials, Inequalities, Vulnerability, Wealth index, Health, Mortality, Child Survival, Adult mortality, Nutritional status, Uzbekistan, Central Asia, Africa

Introduction

Health and wealth: data sources

The complex relationships between health and wealth have been studied for almost two centuries. In his pioneer study of French urban mortality, Villermé (1830) already found that mortality in Paris neighbourhoods was closely related with poverty. Since the early days of industrialization, social and economic vulnerability has been consistently found to be associated with various indicators of health, and in particular mortality. In their classic study in the United States, Kitagawa and Hauser (1973) found a strong relationship between income (assessed in the census) and mortality (from vital registration). This type of analysis, based on 340 000 deaths occurring in May to August 1960 matched with the 1960 census, is one of the rare study available linking directly mortality and income at a national level. It requires matching different files (vital registration and census), which is difficult, and even impossible in many countries because of confidentiality issues, unless there is a computerized system of population register.

Most of our data linking health and wealth come from specially designed surveys. However, in demographic surveys focusing on health, income is usually not measured, and in most economic surveys measuring income, demographic outcomes are not considered. Another approach to study the relationship between health and wealth is to consider household amenities instead of income. First, questions on household goods and characteristics are much easier to collect than income, and are readily available in many demographic surveys with health outcomes. Second, data on household amenities are often considered more robust for analysis than pure income data: they summarize the economic history of the household better than does the current income, and are independent of the local currency, which fluctuations make comparisons difficult and changing. This has been the strategy promoted by the World Bank and the Demographic and Health Surveys (DHS) over the past few years. Filmer and Pritchett (2001) recommend a single index based on the first principal component of a basket of household amenities. The DHS now provide a Wealth Index for recent surveys, which allows one to compute quintiles of wealth associated with each household surveys. However, mortality differentials by wealth are seldom presented in DHS survey reports, and are available only in some of the most recent surveys. Garenne and Hohmann (2003) have proposed a simpler wealth index, based on the sum of the modern goods owned by the household. This index seems to provide similar gradients with respect to health indicators, and has the advantage to allow comparisons over time in the same country, and between countries, whereas the principal components are more abstract, and allow only differential analyses by quintiles, or other percentiles for a given survey.

Heath transition framework

Mortality has been undergoing a major decline over the past 150 years all over the world, with only minor exceptions until the AIDS epidemic. This “health transition” has been widely documented, and is the framework that we will use for our analysis. Mortality differentials according to wealth appear as the product of two historical dynamics: the economic growth and the mortality decline, both of which being different in the various strata of societies. During the development process, household income increases, households cumulate goods and mortality declines for a variety of reasons discussed below. In the wealthier strata of the society improvements are more rapid than in the poorer strata, so that at any point in time one finds a gradient in income, wealth and health indicators, and a close statistical relationship between health and wealth. In any country, there are obviously numerous exceptions to this general pattern for selected diseases (especially those related to individual behaviour such as smoking, obesity, and sexually transmitted diseases), and for selected social strata. However, the general pattern seems to prevail all over the world. More important, countries have had different development strategies and different successes in economic terms and in the field of public health. For instance, China in the 1960’s and 1970’s had major achievements in health without any major increase

in income, as was the case in Cuba. This situation might also occur in non socialist countries, and for instance Senegal had a major mortality decline over the 1950-1999 period without any increase in income per capita measured in parity purchasing power (DHS surveys, and Maddison, 2003). Historically, rapid increases in income per capita often translate in stronger health inequalities, and the situation tends to prevail for some time unless appropriate public policies compensate for the gaps and redistribute some of the nation's wealth to the poorer strata. In this regard, one could expect major differences in the magnitude of health and wealth gradients between countries following a so-called liberal approach and countries following a so-called socialist approach.

The main determinants of health and mortality are nutritional status, preventive and curative medicine, and personal behaviour. Of course, others factors may also play a role, such as the ecology of diseases and the complex interactions between diseases dynamics and populations, but most of the improvements in health and mortality over long periods of time can be accounted for by the four main factors. Improvements in nutrition have been stressed by McKeown (1977) as the single most important factor of mortality decline in England and Wales between 1840 and 1960. However, long term demographic series show clearly that the main improvement in life expectancy (the core of the health transition) started around 1860, when major improvements in hygiene were done, in particular water and sanitation, when the germ theory of diseases was developed, and when concerted efforts were put in place to control infectious and parasitic diseases. Preston and van de Walle (1978) have shown that water and sanitation put in place in the later part of the 19th century had long term cohort effects on mortality in French cities. A clear evidence of the impact of water and sanitation is the control of cholera by the end of the 19th century (Duffy 1992; Bourdelais, 2001). Further improvements in preventive and curative medicine occurred all along the 20th century, and by 1960 most infectious diseases were under control in developed countries, with a low mortality impact compared to a century before. The same policies were applied throughout the world with various successes, and mortality is now low in all countries with a good nutrition, a good public health system, and good services of preventive and curative medicine. Therefore, most of the differentials in mortality indicators could be attributed to either or a combination of basic factors: nutrition, hygiene, preventive and curative medicine. Differential access to food resources, to water and sanitation, to preventive and curative services could all account for differences in health outcomes, and in particular in mortality indicators. Differential access in medical services is often stressed as the main factor of mortality differentials in the demographic literature, but it should be kept in mind that differences in nutrition could play a similar role. This will be central to our argument in this analysis.

Health and wealth in socialist countries

Little is known about income and wealth differentials in mortality in so-called socialist countries of Europe and Asia, since these were not carrying out surveys like in the West during the socialist period. Most of the information on mortality differentials in these countries was at that time limited to classic age and sex patterns, urban versus rural, and regional differences. However, a few recent articles based on sample surveys provide some information on income differences. Using data from a 1992 survey in 12 provinces of China, based on a large sample of households (about 20 000), Zimmer and Kwong (2004) found that bank savings and household amenities were predictors of self-assessed health status, self-care limitation and chronic conditions among older persons. However, the magnitude of the differences remained small, and often not significant in rural areas. In Kazakhstan, using aggregate data at the regional (*Oblast*) level, Becker et al. (2003) found a negative effect of urban wages on adult mortality above age 60, and a negative effect of ownership of automobiles on adult mortality above age 30. In Uzbekistan, Ismail and Micklewright (1997) studied child anthropometry in three regions. They found more stunting in Ferghana valley and in Karakalpakstan than in Tashkent city. Although their study was limited (N= 1298 children), and not always consistent with the results from later DHS surveys, they found that the differences between areas were reduced after controlling for dwelling characteristics and agricultural assets, an indication of their possible impact on children retarded growth.

DHS surveys conducted in Central Asia find differentials similar to those observed in African with respect to urban / rural differentials: the average ratio of rural to urban under-five mortality was

1.32 in the five DHS surveys conducted in Central Asia, compared to a ratio of 1.36 in 66 DHS surveys conducted in sub-Sahara Africa (data for the DHS web site). Relationship with level of education could not be compared in a similar way since there were too few women with no level or primary level of education in Central Asia. None of DHS survey has so far directly addressed the issue of income and wealth differentials in Central Asia, though some use other indicators of poverty such as the qualitative question "making the ends meet".

Purpose of the study

The purpose of this study is to document the magnitude of mortality differentials in Uzbekistan, a former soviet country of Central Asia, and to compare these differentials with those found in Africa. The aim of this comparison is to investigate the similarities and the differences between the two social and historic situations in order to investigate the ultimate causes of mortality differentials. Uzbekistan was colonized by Russians since the second part of the 19th century, and modern health systems as well as the economic system were imported from Russia, a situation quite similar to that of Africa, where modern health and economic systems were brought up by European colonizers (primarily British, French and Portuguese) at about the same time. This comparison provides a unique opportunity to compare mortality differentials in a socialist situation with that in so-called liberal regimes. We will also compare these contrasted situations with that of a pre-transitional society, France of early 19th century, where access to efficient preventive and curative services did not exist.

Background on Uzbekistan

Uzbekistan is the most populated country of Central Asia. Is it located at the crossroads of major cultures (Persian, Turk, Mongol, Indian, Russian, Chinese), and was for centuries the main node of the silk routes (Poujol, 2001). Its population history is complex, and the country as it is now has a long urban tradition, with major cities such as Samarqand and Bukhara. Central Asia has a rather dry climate, however watered by numerous rivers descending from the nearby mountains part of the Himalaya system. The climate is tropical and favourable to many tropical parasitic diseases such as malaria, shistosomiasis, leishmaniasis and Guinea worm (*richta*).

Central Asia was colonized by the Russian empire in the second part of the 19th century, a period corresponding roughly to the first phase of colonization in Africa by European powers (1880-1914). This first phase lasted for about 50 years (1867-1917), and was followed by sovietization, following the 1917 October revolution in Russia. The transition period (1918-1922) was associated with a severe famine, social unrest, massive out-migration, and major changes in the social structure (Buttino, 1990, 1993, 2003). The soviet period lasted for about seventy years, and ended when the country became independent after the collapse of Soviet Union (1991). Since then, the country is evolving in a complex economic and social situation, with many health implications (Davis, 1998; Kamilov et al. 2003).

With respect to public health, Uzbekistan was deeply influenced by these historical events. During the imperial period, the Russians brought the concept of modern public health, also called general hygiene, (*obshchaia gigiena*) which was to a large extent copied on the German system along modern principles emerging at that time in Western Europe (Gross Solomon, 1990 a,b). Public health was then synonymous with water and sanitation, and with the first attempts at controlling infectious and parasitic diseases. Public health efforts during this period were quite similar to those that Europeans tried to develop in their new colonies of Africa and Asia, in particular in the newly developed cities. The first modern health program was smallpox vaccination, which started in 1872 in Turkestan (Anonym, 1882). A small military hospital (*Lazaret*) was built in 1868 in Tashkent, and similar structures were built in 1872 in Samarqand, 1873 in Khiva, and in 1891 in Bukhara, and later in various other places. However, these new structures were primarily dedicated to military personnel and to the Russian urban population, and most likely had little effect on the Uzbek population. For instance, there were only 102 physicians in the whole country by 1917 (Kadyrov, 1976 and 1984). In

addition, the traditional medicine systems (Persian and Chinese in particular) were very developed and socially influential in Uzbekistan, and the colonial power could not change a long history in a few years, as they had done in Siberia (Carrère d'Encausse, 1981; Kadyrov, 1994).

With the sovietization of Central Asian societies, a new scheme emerged. In addition to advances in preventive and curative medicine, which were often copied from Europeans and sometimes pioneered by the Russians (such as the strategy against leishmaniasis), the soviet system emphasized on equity for all, in urban and rural areas, by providing universal and free health care, and by developing systematic and comprehensive strategies to fight tropical diseases (Abdullaev 1991; Dzalalova, 1972; Karasaev and Reznitskii, 1965; Šamsiev, 1972). In the 1920's, the emphasis was on social hygiene (*sotsial'naia gigiena*), which focused on social approaches to diseases and a comprehensive population and health information system, and modelled on the German *Soziale Medizin* approach. It was more and more replaced by a medical approach after 1930 (Gross Solomon, 1990 a,b; Rosen, 1949 and 1994, Semaško, 1922; Porter, 1999). This system, which lasted for seven decades, had a major influence on health outcomes. During the soviet period, population health improved dramatically, and for instance crude death rate was estimated at 8.8 per 1000 in 1950, as compared to 34 per 1000 in 1920 (Statistical Yearbook of Uzbekistan). Life expectancy was estimated at 73 years in 1970, much higher than in other Third World countries at that time, and close to Western Europe (WHO web site). In comparison with Africa, the main differences lied not so much in health programs, which were basically the same throughout the world, but rather in full population coverage and in equity in a variety of health and social indicators: water and sanitation, access and use of health services, preventive and curative medicine, as well as modern education (Field, 1967). Russians were also more successful at controlling tropical diseases in Central Asia than Europeans in Africa. Health policy was first centralized in Moscow, where a Commissariat of Health (*Narkomzdrav*) was instituted in 1918, which later became Ministry of Health. A similar structure was soon after built in Tashkent, for managing pubic health in the whole Turkestan. A Tropical Medicine Institute was built as early as 1924 in Bukhara, and later transferred to Samarkand, where it still exists. Medical studies were developed in several Uzbek universities, and large numbers of physicians were trained. Many district health services were installed, with main focus on monitoring infectious and parasitic diseases. A comprehensive health and demographic information system was developed, and seems to have functioned well over the years. Systematic research on population and health was developed, and numerous epidemiologic studies were published in local scientific journals. Guinea worm (dracunculosis) was controlled by cleaning water tanks (*hauz*) as early as 1931 (Musabaev & Nievski, 1967; Čičenin, 1974). Shistosomiasis was also brought under control, and malaria was strongly reduced in the 1950's. By the end of the decade, there were only sporadic cases of malaria (11 registered in 1960) as compared with 200 000 to 700 000 annual cases between 1925 and 1950. The Russian hygienists developed an innovative strategy to control leishmaniasis (Abdiev and Shamgunova, 2001).

In the education sector, successes were also remarkable. When only a minority (about 15%) of the population could read and write in 1922, literacy was almost universal by 1939. This was achieved by making primary schooling compulsory in 1934, and by setting up schools all over the country. Training was done primarily in Russian, though the Uzbek language was not neglected, and started to be written with a Latin alphabet since 1928 (as the Turkish language in Turkey at about the same time), whereas it was written in Persian characters before. However, another change was made after 1936, and the Cyrillic alphabet was used for writing Uzbek thereafter (Fourniau, 1994).

Another difference with Africa is that Christian missionaries did not play a role in the health and education system. First, Uzbekistan was deeply Muslim when Russians invaded the country, and the imperial power was careful in not hurting religious feelings, a strategy they learned earlier when they colonized the Tatar steppes in the 18th century. Furthermore, the Christian priests (Orthodox and others) had a purely religious function, and served primarily the expatriate Russians as well as various minorities (Peyrouse, 2003 and 2004). During the communist period all religions (Christians and Muslims) were persecuted, though with ups and downs. In any case, during the soviet period the social sector was taken over the state, which had a deep commitment to serve the whole population. Of course, health and education policies had a major political dimension in the soviet system, and social services were viewed as a main tool to win population adherence to the new policies. We will see later the results of this policy on social indicators.

In Africa, on the contrary, Christian missionaries played a major role in health and education, and were the main actors in rural areas until independence (Lapeyssonie, 1988, Arnold, 1988). As a result, the divide between urban and rural areas was greater than elsewhere, and closely related to socioeconomic status. In urban areas the population could find quality health and education services, and had higher income, whereas in rural areas income was lower, and access to health and education services depended on the proximity to a mission, or occasionally to public clinics and schools.

Economic policies also differed markedly between Central Asia and Africa. If both were dominated by cash crops (cotton in the case of Central Asia) and exports of primary commodities, with minor industrialization, the modalities were very different. During the soviet period, agriculture was state controlled in Uzbekistan (and still is to a large extent), and most farmers worked in collective farms, and received a meagre but regular salary, as well as various social benefits and small income from private land plots. In most African countries, agriculture remained overall private, even though the state often controlled the prices of main exported products. Farmers received an irregular income, depending on erratic production and international market prices (coffee, cocoa, cotton, peanut oil, palm oil, etc.). As a result, they were less likely to cumulate goods.

In addition to different economic systems, the soviet period in Central Asia was also associated with higher income and better socio-economic indicators than in Africa. In his classic comparison of Central Asia and North Africa, Egrétaud (1959) found that income was much higher in 1953 Uzbekistan than in colonized Algeria. His comparison goes beyond pure economic comparisons, and he stressed also the higher social status of farmers working in collective farms of Uzbekistan (kolkhoz and sovkhoz) than their North-African counterparts, as well as more advanced status of women in Central Asia, despite the same dominant religion. Furthermore, the process of integration of local elites (*korenizatsiâ*) was far more advanced in Central Asia since 1922, so that by the time of independence most higher positions could be held by Uzbeks nationals, which was not the case in sub-Saharan Africa.

In addition to differences in colonial development, Central Asia also differed from sub-Saharan Africa in a number of historical characteristics which could have an effect on health and wealth dynamics: a stronger and more homogenous social structure, an ancient and powerful feudal society, an homogenous Muslim religious affiliation, and a long urban tradition,

Data and Methods

Data for conducting the empirical analysis on the relationship between wealth and mortality were provided by Demographic and Health Surveys (DHS). Uzbekistan conducted two DHS surveys, in 1996 and 2002. Both contained information on wealth, nutrition, and information on child and adult survival. Information on wealth came from a series of questions on household goods and amenities, a list of which is provided in Table 1. Information on child mortality came from maternity histories of women aged 15-49 interviewed in the survey. Information on adult mortality was provided by survival of mother and father available in the household member file for all children under age 15.

The comparison was conducted on similar data from 30 African countries, the list of which is given in Table 2. DHS questionnaires are well standardized and use basically the same type of information for wealth indicators, child survival and adult survival. Adult survival was available in 27 countries (out of 30), that is the same list as for children with the exception of the three countries for which the last DHS available was from DHS-I type (conducted before 1990): Botswana, Burundi and Liberia (questions of parents survival were introduced only in DHS-II round of surveys).

A wealth index was built for each of the country selected for the study. The method to build the wealth index was the same as that developed earlier for Morocco by the authors (Garenne and Hohmann, 2003). The wealth index is a sum of dummy variables, where 1 indicates a modern good, and 0 the contrary. It varies from 0 to 14, the maximum rarely being achieved by any household. The minimum (0) describes a situation of households who have no modern goods (nothing modern in their dwelling, no electricity, no radio etc.), whereas large numbers (10 and above) describe the situation of households living on modern standards (modern dwelling, running water, electricity, flush toilet, radio, means of transportation etc.). Smallest values refer to situations of extreme social vulnerability, of households with very low cash income, who never had access to modern goods, and had never been

able to cumulate even the smallest modern capital, or those who lost everything. As soon as households can gather some goods (a radio, a tin roof, a bicycle, etc.) their wealth index increases to larger values. The wealth index is therefore not only a measure of current income, but also of past income, and seems to summarize in a way the economic history of the household.

Some minor differences were noted in the list of household goods and amenities, however without any consequence for our analysis. In Uzbekistan, 12 of the 14 items were available, since two were missing (time to get water and type of toilet facility). In the African countries, there were some differences between surveys, especially for wall and roof material, available in a minority of countries. The country in which the largest number of items was missing was Liberia (1986 DHS survey). Altogether, the mean number of items available in African countries was basically the same (11.9) as in Uzbekistan (12.0). The minor differences had no importance for our analysis, and it will be seen later that the mean wealth index was much higher in Uzbekistan than in Africa.

Child mortality was expressed simply as the proportion of children who died among the mothers interviewed. Brass and Coale (1967) have shown that this indicator is a close approximation of life table probability of dying. In this case, we have used the proportion of children who died for all women aged 15-49. This is therefore a close approximation of q(10), the probability of dying between birth and age 10 years. In multivariate analysis we have used the age of the mother as a control, although without any change in the differentials.

Similarly, adult mortality was expressed simply as the proportion of parents (either mother or father) who have died among the children age 0-14 interviewed. This indicator is a close approximation of life table probability of dying for women between age 27 and 34 and for men from age 31 and 38. In a first step we considered mother and father survival separately. However, since there was no striking difference in the magnitude of differentials according to wealth for both sexes, we used the composite indicator of both sexes combined in the final analysis, adult mortality being defined as death of either or both parents. As for the study of child survival, in multivariate analysis of adult mortality we used the age of the respondent as a control, although without any change in the differentials.

Absolute mortality differentials were expressed as the mortality level (children or adults) according to the wealth index. Estimates were first calculated for single values of the wealth index, then for grouped values (0-1, 2-3, 4-5, 6-7, 8+). The multivariate analysis was conducted using a linear logistic model, with age as a control (age of mother for child mortality, age of children for adult mortality) and the wealth index. This allowed to estimates slopes of mortality differentials, and to conduct a variety of statistical tests. Other controls were also used (urban residence, sex of child or parent), also without any change in the magnitude of the differentials.

In addition to mortality differentials according to the absolute value of the wealth index, we also used mortality differentials according to a wealth scale. The wealth scale is simply a 5-category grouping based on mean (m) and standard deviation (s) of the wealth index distribution, thresholds being: m – 2s, m-s, m, m+s, m+2s. This allows to measure mortality differentials according to the relative situation of the household in the society (and not according to absolute level of poverty). We also present results by relative mortality ratios (observed value / baseline), the baseline being the expected value of the corresponding mortality indicator for a wealth index of 10, that is for wealthy persons.

For Uzbekistan, we first considered separately the two surveys, then we grouped them to improve the precision of statistical estimates since there was no difference between the two surveys with respect to mortality differentials, even though wealth distribution and mortality levels changed somewhat between 1996 and 2002.

For African countries, we analyzed separately each of the 30 surveys (27 for adult mortality), then we merged them together by applying a weight proportional to the population of each country in year 2000. This provided an African estimate, which represents about 80% of the sub-Saharan Africa populations (81% for child mortality, and 79% for adult mortality).

In addition to mortality indicators, we also considered nutritional indicators. Most DHS surveys provide weight and height for children and for adult women. For children, we considered weight for age as an indicator of malnutrition, since it combines stunting (retarded growth, or low height for age) and wasting (low weight for height). We used the Z-score of weight for age for children above age 12 months (12-59 months or 12-71 months depending on survey). We selected the

bottom threshold of 12 months since empirically the prevalence of low weight for age is stable above age 1 year, whereas it fluctuates markedly in the first year. For adults, we used only stunting, which was measured by the raw value of height in cm for persons age 18 and above (18-49 for women and 18-59 for men when available).

Results

1) Wealth distribution

The distribution of wealth was remarkably different in the two situations (Figure 1). African countries exhibit a large proportion of households in extreme poverty, that is with virtually no modern goods: 44.4% of households had a wealth index equal to 0 or 1, whereas only 1.5% of households were in the same situation in Uzbekistan, that is 30 times less. A large majority (83.7%) of Uzbek households had at least 4 modern goods, whereas only a minority (26.2%) of African households did so. The shape of the distribution was radically different: a regular bell shaped distribution for Uzbekistan, but a highly skewed distribution towards extreme poverty for Africa. Uzbekistan appears in a transitional situation, where households hold about half of modern goods in the list, whereas Africa appears at the beginning of economic development, with only a minority enjoying modern goods.

The mean wealth index was 5.59 in Uzbekistan (standard deviation = 2.03), whereas it was about half in Africa (mean= 2.41, standard deviation = 2.31). Inequalities expressed as the coefficient of variation (s/m) were stronger in Africa (CV= 0.96) than in Uzbekistan (CV= 0.36). These differences in mean wealth index go in the same direction as the corresponding differences in income per capita, measured as GDP-PPP (gross domestic product, in parity purchasing power) estimated by OECD experts (Maddison et al., 2003) for year 2000: 3408 $ for Uzbekistan and 1143 $ for sub-Saharan Africa (in constant 1995 USD). In summary, Uzbekistan appears as much wealthier and with less inequalities than the average of sub-Saharan African countries.

2) Child mortality differentials

Child mortality differentials according to wealth exhibit a typical Logit-Linear pattern in both situations (Figure 2, absolute scale). For Africa, after fitting with a Logit-Linear model, the range of variation goes from 241 per 1000 [233 per 1000 in the raw data] for the poorest households (wealth index = 0) to 48 per 1000 [42 per 1000 in the raw data] for the wealthiest (wealth index = 12). In Uzbekistan, the number of households in the two extreme categories was too small for direct calculation of mortality. The same Logit-Linear model produces estimates of 125 per 1000 for no goods and 38 per 1000 for the maximum number of goods. Therefore, at the same level of wealth, mortality always appears as lower in Uzbekistan, about half the level in Africa for the poorest strata, a third lower at medium level of wealth, and about 20% lower for higher levels.

Taken as a ratio of mortality level to a baseline value of 62 per 1000 for Africa and 46 per 1000 for Uzbekistan (values predicted for a wealth index = 10), the gradient of mortality ratios appears quite similar in the two situations: range of 1 to 3.8 in Africa, and 1 to 2.7 in Uzbekistan. (Figure 2, relative scale). This indicates that the magnitude of mortality differentials is similar in the two situations.

Furthermore, the multivariate analysis allows to precisely test the hypothesis of differences in gradients, after controlling for age. The slope if the Logit-Linear model was –0.159 for Africa and –0.122 in Uzbekistan, the difference being not significant (P= 0.757). This shows that in two different situations of soviet Central Asia and liberal Africa, the magnitude of child mortality differentials according to wealth remained similar, even though the level of mortality was much lower in the former situation at any given level of wealth.

3) Adult mortality differentials

The same analysis was conducted for adult mortality. Adult mortality differentials according to wealth also exhibited a typical Logit-Linear pattern in both situations, though the gradient was less pronounced (Figure 3, absolute scale). For Africa, after fitting with a Logit-Linear model, the range of variation went from 91 per 1000 [109 per 1000 in the raw data] for the poorest households (wealth index = 0) to 40 per 1000 [63 per 1000 in the raw data] for the wealthiest (wealth index = 12). The pattern of adult mortality differentials was somewhat disturbed by HIV/AIDS, in addition to random fluctuations. If countries with high HIV/AIDS seroprevalence were removed, the pattern became smoother. However, in countries with high HIV/AIDS seroprevalence, relative risks of adult mortality exhibited two modes: one for the very poor, and one in the upper-middle range (wealth index = 5-7), which explains in part the irregularities seen when all African countries were combined together.

The same Logit-Linear model for Uzbekistan produced estimates of 42 per 1000 for no goods and 19 per 1000 for the maximum number of goods. Here again, as for child mortality, mortality appeared as lower in Uzbekistan at the same level of wealth, about 41% the level in Africa for the poorest strata, and about 35% the level for higher levels of the wealth index.

Taken as a ratio of mortality level to a baseline value of 62 per 1000 for Africa and 22 per 1000 for Uzbekistan (values predicted for a wealth index = 10), the gradient of mortality ratios appeared quite similar in the two situations: range of 1 to 1.7 in Africa, and 1 to 1.9 in Uzbekistan (Figure 3, relative scale). This indicates that the magnitude of mortality differentials was again similar in the two situations.

Furthermore, the multivariate analysis also allowed to precisely test the hypothesis of differences in gradients, after controlling for age. The slope of the Logit-Linear model was –0.074 for Africa and –0.067 in Uzbekistan, the difference being not significant (P= 0.918). This shows again that in two different situations of socialist Central Asia and liberal Africa, the magnitude of adult mortality differentials according to wealth remained the same, even though the level of mortality was lower in the former situation at any given level of wealth. If only African countries with low prevalence of HIV had been taken into account, the mean level of mortality in Africa would have been 25% lower, but the patterns and the gradients according to wealth would have remained basically the same, and similar to those in Uzbekistan.

Table 3 summarizes the main differences between the situations: despite major differences in income, wealth distribution and level of mortality, the gradient according to the wealth index remained basically the same in Uzbekistan and in Africa.

4) Differentials in access and use of health services

The fact that differentials were of the same magnitude is surprising at first glance, since one expected large differences in access and use of health services between the two situations. Indeed, empirical data provided by the Population Reference Bureau web site, and also based on DHS surveys, confirm that Uzbekistan, as well as other Central Asian countries, showed no differential by wealth in a series of indicators of access and use of health services: contraceptive use, antenatal care, delivery care and vaccination coverage were the same for all levels of wealth in Uzbekistan, and likewise all women had basic education irrespective of their socio-economic status (Table 4). In contrast, African countries exhibited major differences in access and use of preventive and curative services, as well as in modern education. In Africa, risk ratios of the richest fifth to the poorest fifth were always higher than one: 3.1 to 1 for use of modern contraception; 1.6 to 1 for use of antenatal care; 3.0 to 1 for delivery care; 1.8 to 1 for vaccination coverage, and 2.6 to 1 for modern education. If mortality differentials according to wealth were similar in the two situations, they could not be accounted for by access to health services, since there were virtually no differentials in Uzbekistan.

5) Comparison with a pre-transitional situation

To further scrutinize for the lack of role of differentials in access and use of health services in mortality differentials we pursued the comparison in a pre-transitional society where access and use of

modern health services simply did not exist. We refer here to the study conducted in Paris already mentioned in the introduction. Villermé (1830) was the first to conduct an in-depth analysis of mortality differentials based on statistical and demographic methods. His study focused on Paris neighborhoods (twelve *arrondissements* at that time), in the early years of the 19th century (1817-1826). He computed mortality rates, expressed as the ratio of population to deaths, by arrondissement, and found major differentials. He took great care in analyzing the determinants of these differences. Answering to classic questions raised by medical theories of the time, he showed that distance to the river (Seine), sources of water supply, topography (height, orientation towards sun and winds), nature of soil, density of settlement, parks and open space, and size of dwelling units could not explain mortality differentials. On the contrary, he found a high correlation between mortality and poverty. The wealth indicator he used was the proportion of households who were not paying housing rental taxes (*locations non imposées*). Correlation of this wealth index with the mortality index was very high and there was almost a linear relationship between mortality level and proportions of poor households (r= 0.96).

We tried to put Villermé's findings into a modern framework, by computing mortality indicators, since he provided all the data to do so in his appendix. We found that crude death rate ranked from 24.1 to 37.4 per 1000 from wealthiest to poorest neighbourhood. Translated into life table indices using West model life tables, this will be a range of life expectancy from 29 to 39 years, a range of under-five mortality from 287 to 426 per 1000, and a range of adult mortality from 104 to 156 per 1000. Since the relationship between child and adult mortality was linear with respect to crude death rate (r= 0.999 in both cases), we relied on crude rates for our estimations. Model life tables mortality functions indicate that relative risks for child and adult mortality would be almost identical to those of crude rates.

We ranked neighbourhoods by wealth and grouped them together in order to have five classes of about 20% inhabitants each (a proxy for quintiles). The mortality risk ratio ranged from 1.00, 1.07, 1.16, 1.35 and 1.50 in these five classes (table 5). However, this is only an underestimation of mortality gradient according to wealth, since all neighbourhoods had poor people, even though their proportions had a wide range, from 7 to 38%.

Since the relationship between proportions of poor people and mortality was linear, we ran a regression line between the two variables. This allowed to compute mortality for the poor (proportion of poor = 1) and for the wealthiest (proportion of poor = 0). Results from this extrapolation show that mortality ratios ranged from 1 (no poor) to 3.26 (all poor), with intermediate values of 1.57, 2.13 and 2.70 for intermediate values corresponding to 25%, 50% and 75% poor (Table 5). This is the range of magnitude found in Uzbekistan for similar indicators, though here in a pre-transitional society. Here again access and use of modern health services could not explain differentials in mortality indicators, since there was no modern health services at all. An obvious alternative explanation of differential is nutrition, the other main determinant of mortality levels.

5) Differentials in nutritional status

In order to test the nutrition hypothesis, nutritional status was tabulated according to the same wealth indicator. In both Uzbekistan and Africa, nutritional status exhibited a linear relationship with wealth. For children, the average Z-score of weight for age among children aged 12-71 months ranged from -1.04 for the poorest (wealth index = 0) to +0.03 (no stunting) for the wealthiest (wealth index = 12). In words, the poorer the family the more likely the child to be malnourished, and no evidence of stunting or wasting was found for the wealthier strata (Figure 6). This gradient was similar in Africa, although with a higher slope. For the average of African countries, the mean Z-score for the poorest was -1.83 (wealth index = 0) and was again nil (+0.05) for the wealthiest (wealth index = 12). In both situations wealthier people, those who are integrated in the modern economy and able to cumulate goods had no evidence of stunting or wasting. If the situation was worse in Africa for the poorest, both slopes were strongly positive (P< E-22 and E-50 respectively). The difference between the two slopes was statistically significant (P= 5.2E-7).

Similarly for adult women, the relationship between height and wealth was also linear in both cases (Figure 7). In Uzbekistan, women were somewhat taller than African women, but the gradient

with respect to wealth was the same. The linear relationship predicted a mean height of 158 cm for the poorest and 162 cm for the wealthiest in Uzbekistan, and basically 1 cm less in Africa (from 157 to 161 cm). Both slopes were significant (P= 4.3E-11, and E-50 respectively), but in this case the difference between the slopes was not significant (P= 0.754).

A similar gradient was found for the adult men in Uzbekistan, with values ranging from 170 to 172 cm from poorest to wealthiest, though the slope was less pronounced than for women, but still statistically significant (P= 0.017). Unfortunately, there were too few data sets from African men for comparison.

In summary, wealth differentials in mortality paralleled wealth differentials in nutritional status in both situations, and were clearly not associated with differentials in access and use of health services in the case of Uzbekistan.

Discussion

The DHS surveys provide a unique opportunity to conduct comparative analysis with the same data on wealth and health in different situations such as Central Asia and Africa. Our analysis show the similarities and differences in two situations where populations were colonized for similar durations and benefited from similar health programs, though with different modalities and coverage. One could argue that time since independence differs in the two situations (25 to 40 years versus 10 years by year 2000), and that trends in health indicators could be affected. However, the current health situation at the turn of the 21st century is far more the result of the public health efforts over the whole 20th century than of changes over the past few years. Second, trends in the post-colonial period are much influenced by previous trends, although some complex patterns have emerged, both in Africa and Central Asia (quote Garenne and Gakusi, 2003; Hohmann and Garenne, 2005). We know little on both health situations in Africa and Central Asia at the beginning of the 20th century, but they are likely to be similar, with high mortality and a heavy burden of tropical diseases, even though malaria was clearly more severe in Africa.

The overall health and economic situation of Uzbekistan is obviously very different from that of sub-Saharan Africa. First, the level of income is much higher, income distribution is more equitable, nutrition is better, level of education is much higher, the health system is far more developed, and access and use of health services is universal. If we had compared health outcomes according to wealth quintiles, as often done in the economic literature, one would have found a smaller magnitude of differences, and somewhat less differences between Uzbekistan and Africa. For instance, child mortality would range from 1 to 1.52 from the wealthiest to the poorest quintile in Uzbekistan, compared to 1 to 2.08 in Africa. This is primarily due to less inequalities in the population, since the mean wealth index from lowest to highest quintile would range from 3.0 to 6.7 in Uzbekistan, as opposed to 0.0 to 5.8 in Africa. For adults, the difference in wealth distributions played even a smaller role, and the mortality ratios from wealthiest to poorest quintile would range from 1 to 1.51 in Uzbekistan, compared with 1 to 1.33 in Africa.

The main result of this study, however, is the similarities in the slopes of mortality and nutritional indicators according to an absolute measure of wealth (the wealth index). This analysis shows that mortality differentials remained quite similar, which means that despite its outstanding achievements the socialist health system has not resolved all the sources of health differentials. Our main argument is to say that this seems likely to be due to differences in nutritional status. One could argue further that is probably due to early age nutritional status, since most of the stunting develops prior to 36 months and since we found differences according to wealth in nutritional status among children as among adults. This means that if the poorest strata of the Uzbek population enjoys universal education and health care, they are still penalized by poorer nutritional status. A detailed analysis of the effect of nutrition on health in Uzbekistan is beyond the scope of this paper, and would require more specific data than demographic indicators currently available.

There are many indications that nutrition has been somewhat neglected in Uzbekistan compared to other achievements. Stunting does exist, and in the 2002 DHS survey 28.7% of under-five children were below the -2 standard deviation threshold (2.5% in theory). The 2002 DHS survey found a high prevalence of anaemia: 49.2% of children age 6-59 months had some anaemia

(haemoglobin level < 12 g/dl), and 1.0% were severely affected (< 7 g/dl). Goitre (iodine deficiency) is still prevalent in the country. In the same 2002 DHS survey, there was a strong gradient in some of the food consumed indicators with respect to income status measured by "making the ends meet". Compared to those with higher income (defined by "easily making ends meet") poorer households (defined by "in great difficulty") ate less milk products, eggs, red meat, beans and peas, nuts and seeds and fresh vegetables. For protein foods (milk product, eggs, red meat) the gradient of median weekly consumption was one to two from poorer to wealthier households, with regular increase in the two intermediate categories (defined as "some difficulty" and "little difficulty" in making ends meet). Ten percent of the poorer families reported that they had one or more days without eating in the last six months, compared with 5 percent for the medium low and medium high, and 3.9% for the wealthier families. This gradient by income status was the strongest gradient of all variables investigated in the food consumption survey (age, urban residence, region, level of education and ethnicity).

Nutrition was a source of concern in the medical establishment of the country. Numerous documents in the archives of Uzbekistan, for the various provinces (*oblast*), report complaints of poor resource allocation for foods, poor food supply and lack of diversity in the soviet public institutions: sovkhoz, kolkhoz, cantines, schools, child care centres etc. Food diversity has been found again and again as a main source of under nutrition (Arimond and Ruel, 2004). Even though Uzbekistan was a net supplier of fruits, vegetable and meat, most of the higher quality food was exported to Russia and other republics (Mahkamov and Romančenko, 1976).

It would be misleading to deny the importance of health services in mortality decline. No country in the world has enjoyed significant mortality decline without efficient modern health services, and when health services are destroyed, as in Central Mozambique during the civil war, mortality goes back to pre-transitional levels. What we wanted to emphasize in this analysis is that despite equity in access and use of health services one could still find mortality differentials, probably due to corresponding differentials in nutritional status. In any case, mortality levels in Uzbekistan do correspond to a much more elaborate and equitable system of public health, and we have seen that at a given level of wealth mortality was lower and nutritional status better than in Africa. This is most likely due to better health services and to higher food consumption.

Demographic indicators show no obvious difference in use of health services. This is a quantitative indicator which could hide some qualitative differences. The soviet system itself distinguished between six levels of care, called subsystems, linked to the official social ranking (*tchin*): elites (primarily the communist *Nomenklatura*), Ministerial (high ranking civil servants), large cities, other cities, industrial districts and rural districts (Davis, 1998). These might be linked to wealth, and it may be that part of the correlation observed between health and wealth was in fact a reflection of this social stratification. However, this does not contradict the main argument that in Africa access and use of health services is highly contrasted by wealth, which is not the case in Uzbekistan. There is no doubt that quality of care also varies in Africa with geographical areas, and that people with the highest standards tend to be wealthiest people living in large cities, whereas lowest standards are found in remote rural areas.

Our statistical analysis showed no difference in slopes in the Logit-Linear model linking wealth and mortality. This indicated that mortality differentials remained in Uzbekistan, and were of comparable magnitude to those found in Africa. However, at least for children, the slope might in reality be somewhat smaller. The fact that the test showed no significant difference might be due in part to the relatively small sample size: if we had a much larger sample, of the same size as that from Africa and with the same pattern, the difference could have become significant. This suggests that further research based on much larger samples could reveal some minor difference in the effect of wealth on health between the two situations. However, this is unlikely to change the leading conclusion, that is that differentials according to wealth remained despite equity in use of health services, and paralleled those in nutritional status.

To answer why the soviet system failed to eradicate all social and nutritional differentials would require further analysis. First, we are not aware of any system which succeeded in whipping out mortality differentials, although this might be the case in special populations of small size. In general it seems that some inequalities are not reducible. Second, any dynamic system will create some inequalities, and the soviet system was certainly very dynamic for several decades. If one compares the situation of Uzbekistan with nearby Afghanistan, even prior to the soviet invasion, one could only

be impressed by the major achievements in Central Asia. Since progress cannot be both instantaneous (occurring at the same time) and universal (reaching the whole population at once), some inequalities are always expected when there are changes. However, progresses were small over the past 30 years in Uzbekistan, after major changes between 1930 and 1970, and one could have expected lower differentials. The current situation witnessed around year 2000 is unlikely to be explained by very dynamic changes in the past generation.

Our comparison between colonisations in Central Asia and in Africa could be considered unfair. In particular, the sizes of the problems were different: the size of the population of main European colonizers (British, French, Portuguese), was similar to that of Russians, but they were facing in Africa a much larger population (about 10 times bigger) and a much larger area. Even if the terrain was probably not more difficult, the size of the health problems was much larger. However, if this could explain in part the better achievements in Central Asia, it does not change the issue of inequalities.

All public health policies have an ultimate target to provide health for all, with equitable access at least for the basic services which are the key for the health transition. In this respect, the model followed by Europeans and Russians had similar aims. However, Soviet Russia was able through a highly centralized and public system to provide these basic services to the whole population of Central Asia. In Africa on the contrary, European colonizers relied primarily on Missions for the rural areas (which accounted from 80% to 90% of the population at that time), even though if they provided public health services in cities, and some in rural areas. The situation improved after independence, though dichotomies needed time to resolve. Interestingly, the magnitude of urban / rural differences in mortality remained similar in Central Asia and Africa, though with major differences by country in the later. This seems to be closely associated with differences in wealth and nutrition between the two areas of residence.

The precise origin of nutritional differences in Central Asia remains to be explored. They are obviously linked to poverty, and low income (or assets) is usually associated with less food diversity and poorer nutritional status, when not with total amount of food (quote xx). Basic data on food consumption indicate that the issue is likely to be multidimensional. Many strategies are available to improve nutritional status among the poorer strata. However, in order to focus them, one would need to know whether nutritional deficiencies are primarily due to deficits in protein and energy or in micronutrients. Further research is therefore needed if one wants to reduce differentials in health outcomes in theses situations.

References

Abdullaev I. K. (1991). Histoire de la création (des bases) de la protection maternelle et infantile en Ouzbékistan. [Iz istorii sozdaniâ osnov ohrany materintsva i detstva v Uzbekistane], *Sovetskoe zdravoohranenie*, n° 11, pp. 64-65.

Abdiev FT, Shamgunova GSh. (2001). Control of parasitic diseases in Uzbekistan. *Med Parazitol (Mosk)*; (**3**):60-61.

Agzamhodjaev S. A., Gafurbaev M. K., Bromanskaâ M. I. (1965). La situation/état des lieux de la santé publique en Ouzbékistan rural. [Sostoânie sel'skogo zdravoohraneniâ respubliki], *Medicinskij žurnal Uzbekistana,* n° 8, pp. 3-16.

Anonym (1882). « Situation sanitaire du Kraj de Turkestan en 1880 » [Sanitarnoe sostoânie Turkestanskogo kraâ v 1880 godu], *Turkestanskie vedomosti*, n°26, p. 103.

Arimond M, Ruel MT. (2004). Dietary diversity is associates with child nutritional status : evidence from 11 demographic and health surveys. *J Nutr*; 134(10): 2579-85.

Arnold D. (ed.). (1988). *Imperial medicine and indigenous societies*, Manchester University Press, 231 p.

Becker C, Urzhumova DS, Seitenova AS. (2003). Mortality recovery and stabilization in Kazakhstan. *IBS working paper* No 6. Boulder, Colorado (USA) [available on the web]

Bourdelais P. (ed.). (2001). *Les hygiénistes : enjeux, modèles et pratiques*, Paris, Belin, 540 p.

Buttino M. (1990). "Study of the economic crisis and depopulation in Turkestan 1917-1920", *Central Asian Survey*, 9, n° 4, pp. 64-69.

Buttino, M. (1993). Politics and Social Conflict during a Famine : Turkestan immediately after the Revolution. in Buttino, *In a Collapsing Empire : Underdevelopment, Ethnic Conflicts and Nationalisms in the Soviet Union*, Milan, pp. 257-277.

Buttino, M. (2003). La rivoluzione capovolta. L'Asia centrale tra il crollo dell'impero zarista e la formazione dell'URSS. Napoli, Italy, L'Ancora del Mediterraneo. 492 p.

Carrère d'Encausse H. (1981). *Réforme et révolution chez les musulmans de l'empire russe*, Paris, Presses de la FNSP, 312 p.

Cavanaugh C. M. (2001). "Backwardness and biology : medicine and power in Russian and Soviet Central Asia, 1868-1934", Ph.D. Dissertation, Columbia University.

Čičenin P. I. (1974). 50 ans de service sanitaire et épidémiologique. [Sanitarno-èpidemiologičeskaâ služba Uzbekistana za 50 let], *Medicinskij žurnal Uzbekistana,* n°10, pp. 6-11.

Davis C. (1998). Morbidité, mortalité et réformes du système de santé dans les Etats en transition de l'ex-URSS et de l'Europe de l'Est. *RECEO*, vol. 29, n°3, pp. 133-185.

Duffy J., (1992). *The Sanitarians. A History of American Public Health*, Illini Books edition, 330 p.

Džalalova K. M. (1972). Histoire de la mise en place du système de santé publique en Ouzbékistan au cours des premières années de pouvoir soviétique » [Iz istorii stanovleniâ zdravoohraneniâ v Uzbekistane v pervye gody sovetskoj vlasti], *Medicinskij žurnal Uzbekistana,* n°11, pp. 75-77.

Egrétaud M., (1959). *L'Orient soviétique*, Paris, Editions sociales, 274 p.

Field M. G., (1967). *Soviet socialized medicine*, New York, The Fress Press, 231 p.

Filmer D, Pritchett LH. (2001).Estimating wealth effects without expenditure data-or ears: an application to educational enrolments in states of India. *Demography*; **38**:115-32.

Fourniau V. (1994). *Histoire de l'Asie centrale*, Paris, PUF, Que sais-je?, 128 p.

Garenne M, Gakusi E. (2003). Mortality trends in sub-Saharan Africa. [Available on web site: www.cerdi.fr]

Garenne M, Hohmann S. (2003). A wealth index to screen high risk families: application to Morocco. *Journal of Health, Population and Nutrition*; **21**(3):235-242.

Gross-Solomon S. (1990a). Social hygiene in soviet medical education, 1922-1930 », *Journal of the History of Medicine and Allied Sciences*, 45, pp. 607-643.

Gross-Solomon S. (1990b). The limits of government patronage of science: social hygiene and the Soviet state, 1920-1930 », *Social History of Medicine,* 3 (3), pp. 405-435.

Hohmann S, Garenne M. (2005).

Ismail S, Mickelwright J. (1997). Living standards and public policy in Central Asia: what can be learned from child anthropometry. *Innocenti Occasional Papers*, Economic and Social Policy Series, No 62. (UNICEF, Italy). 26 p.

Kadyrov A.A., (1976). "La mise en place et le développement de la santé publique soviétique en Ouzbékistan" [S*tanovlenie i razvitie sovetskogo zdravoohraneniâ v Uzbekistane]*, Tachkent, Medicina, 131 p.

Kadyrov A. A., (1984). "N.A. Semashko en Ouzbékistan" [N. A. Semaško v Uzbekistane], *Sovetskoe zdravoohranenie*, (1), pp. 49-50.

Kadyrov A. A. (1994). History of medicine in Uzbekistan [*Istoriâ mediciny Uzbekistana]*, Tachkent, Izd-vo Imeni Ibn Siny, 234 p.

Kamilov A. I., Ahmedova D. I., Âdgarova K. T., (2003). Protection maternelle et infantile dans la république d'Ouzbékistan : état des lieux et perspectives. [Ohrana materinstva i detstva v respublike Uzbekistan : sostoânie i perspektivy], *O'zbekiston tibbiyot jurnali*, n°6, pp. 85-89.

Karasaev A. I., Reznitskii Û. Û. (1965). Le développement de la santé publique en Ouzbékistan rural au cours des dix premières années de pouvoir soviétique » [Razvitie sel'skogo zdravoohraneniâ Uzbekistana v pervoe 10-letie sovetskoj vlasti], *Sovetskoe zdravoohranenie*, 24 (11), pp. 47-49.

Kitagawa E, Hauser P. (1973). *Differential Mortality in the United States*. Harvard University Press.

Lapeyssonie L. (1988). *La médecine coloniale. Mythes et réalités*, Paris, Seghers, 310 p.

Mahkamov G. M., Romančenko N. L. (1976). Les problèmes de nutrition rationnelle en Ouzbékistan. [Problemy racional'nogo pitaniâ v Uzbekistane], *Medicinskij žurnal Uzbekistana,* n°4, pp. 3-7.

Mezenceva E., Rimaševskaâ N. (1990). The Soviet country : health of the USSR population in the 70s-80s – an approach to a comprehensive analysis. *Social Science and Medicine*, 31 (8), pp. 867-877.

Musabaev I. K, Nevskij M. V. (1967). Les principaux bilans de lutte contre les infections graves en Ouzbékistan soviétique sur 50 ans. [Osnovnye itogi borb'y s važnejšimi infekciâmi v uzbekskoj SSR za 50 let sovetskoj vlasti], *Žurnal Mikrobiologii Èpidemiologii Immunobiologii*, 44 (11), pp. 11-14.

Peyrouse S. (2003). *Des chrétiens entre athéisme et islam. Regards sur la question religieuse en Asie centrale soviétique et post-soviétique*. Paris, Maisonneuve & Larose/IFEAC, 406 p.

Peyrouse S. (2004). Les missions orthodoxes entre pouvoir tsariste et allogènes. Un exemple des ambiguïtés de la politique coloniale russe dans les steppes kazakhes. *Les Cahiers du Monde Russe*, Paris, EHESS, n° 1-2, vol. 45, pp. 109-135.

Petrov B. D. (1977). N. A. Semashko – Fondateur du système de santé publique soviétique. [N. A. Semaško-Osnovopoložnik sovetskogo zdravoohraneniâ], *Sovetskoe zdravoohranenie*, (10), pp. 63-66.

Population Reference Bureau. (2004). The wealth gap in health. [available on web site: www.prb.]

Porter D. (1999). *Health, Civilization and the State*, London, Routledge, 376 p.

Poujol C. (2001). *Dictionnaire de l'Asie centrale*, Paris, Ellipses, 352 p.

Preston S.H., van De Walle E. (1978). Urban French Mortality in Nineteenth century, *Population Studies*, **32** (2), pp. 275-297.

Rosen G. (1949). Approaches to a concept of social medicine. A historical survey", In *Backgrounds of social medicine*, Milbank Memorial Fund, New York, pp. 11-23.

Rosen G. (1993). *A History of Public Health.* Baltimore, Johns Hopkins University Press, 535 p.

Semaško N. A. (1922). L'hygiène sociale : essence, méthode et connaissance" [Social'naâ gigiena, eë suščnost', metod i značenie], *Social'naâ gigiena*, 1, p. 8.

Šamsiev S. S. (1972). Naissance et développement de la santé publique pour les enfants en Ouzbékistan » [Zaroždenie i rasvitie detskogo zdravoohraneniâ v Uzbekistane], *Pediatriâ*, 51 (12), pp. 25-8.

Ûldašev Š. G., Muhtarov S. S. (1981). Situation et perspectives du développement de la santé publique dans l'oblast de Boukhara" [Sostoânie i perspektivy razvitiâ zdravoohraneniâ buharskoj oblasti], *Medicinskij žurnal Uzbekistana*, n°6, pp. 26-28.

Uzbekskaâ SSR, 1981, Tachkent. (Statistical Yearbook)

Vichnevski A. (1995). L'Asie centrale post-soviétique : entre le colonialisme et la modernité. Paris, *RECEO*, 4, pp. 101.123.

Villermé, L.R. (1830). De la mortalité dans les divers quartiers de la ville de Paris. Paris, : 294-334.

Uzbekistan – Archives Centrales de médecine, sciences et techniques. [Central'nij gosudarstvennij arhiv naučno-tekničeskih i medicinskih dokumentov Respubliki Uzbekistan] (CGANTMD), f. 1, op. 6. (1965 to 1981).

Uzbekistan – Institute of History and Archeology (1968). History of the SSR of Uzbekistan [*Istoriâ Uzbekskoj SSR]*, Tom 2, Institut Istorii i Arheologii, Akademiâ Nauk Uzbekskoj SSR, Tachkent, Izd-vo « Fan », 1968, 662p.

Uzbekistan – Statistical Yearbook. Various issues.

Zimmer Z, Kwong J. (2004). Socioeconomic status and health among older adults in rural and urban China. *Journal of Aging and Health*; **16**(1):44-70

Table 1

List of variables from DHS surveys used for building the wealth index

Variable code			Availability in Uzbekistan DHS surveys	Nb of African DHS surveys in which available
HR file	IR file	Variable		
HV201	V113	Source of drinking water	Y	30
HV204	V115	Time to get to water source	NA	26
HV205	V116	Type of toilet facility	NA	29
HV206	V119	Has electricity	Y	29
HV207	V120	Has radio	Y	30
HV208	V121	Has television	Y	28
HV209	V122	Has refrigerator	Y	29
HV210	V123	Has bicycle	Y	29
HV211	V124	Has motorcycle	Y	29
HV212	V125	Has car/truck	Y	29
HV213	V127	Floor material	Y	29
HV214	V128	Wall material	Y	8
HV215	V129	Roof material	Y	10
HV221	V153	Has telephone	Y	22
		Number of items	12	11.9

Note: For African DHS surveys, the mean number of items available was computed.

Table 2

List of DHS surveys selected for the analysis, with sample size

Country	Year of DHS survey	Nb households (wealth index)	Nb births (child mortality)	Nb under 15 (adult mortality)
Central Asia				
Uzbekistan	1996	3703	9650	7103
	2002	4168	11604	8300
African countries				
Benin	2001	5769	19246	14598
Botswana	1988		11271	
Burkina Faso	1999	5143	22987	16915
Burundi	1987		11998	
Cameroon	1998	4697	16018	11623
Central Afri Rep	1994	5551	17012	12902
Chad	1996	6840	26126	18410
Comoro Islands	1996	2252	7913	6112
Cote d'Ivoire	1999	5935	8421	17707
Ethiopia	2000	14072	47500	31366
Gabon	2000	6203	15763	12702
Ghana	1999	6003	12758	9359
Guinea	1999	5090	23121	16065
Kenya	1998	8380	22813	16166
Liberia	1986		16342	
Madagascar	1997	7171	22696	16026
Malawi	2000	14213	41404	29396
Mali	2001	12331	49285	32433
Mozambique	1997	9282	26871	19361
Namibia	2000	6392	14508	13518
Niger	1997	5928	29784	17396
Nigeria	1999	7647	23374	16093
Rwanda	1992	6252	20107	15080
Senegal	1997	3528	26366	14774
South Africa	1998	12247	22756	18924
Tanzania	1999	3615	11786	8472
Togo	1998	7517	25119	19275
Uganda	2001	7885	24921	19873
Zambia	2001	7126	23211	17959
Zimbabwe	1999	6369	13628	11205
Benin	2001	5769	19246	14598

Table 3:

Summary indexes for the comparison of Uzbekistan with Africa

Variable	Uzbekistan	Sub-Saharan Africa
Population (2000) (millions)	24.3 M	653.5 M
GDP-PPP (USD) in 2000 (constant 1995 $)	3408 $	1144 $
Mean Wealth index (nb of modern goods)	5.59	2.41
% Very poor (WI < 1)	1.5%	44.4%
% with at least 4 modern goods (WI > 4)	83.7%	26.2%
Mean child mortality (per 1000)	75	181
Mean adult mortality (per 1000)	30	92
Slope of child mortality with wealth index (std. error)	-0.122 (0.014)	-0.159 (0.002)
Slope of adult mortality with wealth index with (std. error)	-0.067 (0.024)	-0.074 (0.003)

Sources: Population: United Nations, 2002; GDP-PPP: Maddison, 2003;
Note: Slopes were calculated using a Logit linear model after controlling for age of respondent.

Table 4: Comparison of differentials in use of health services and modern education, according to wealth, Uzbekistan and African countries

	Uzbekistan			Africa		
Indicator	Poorest fifth	Middle fifth	Richest fifth	Poorest fifth	Middle fifth	Richest fifth
Use of health services						
% Modern contraception	46	56	52	10	15	32
% Antenatal care	82	79	84	49	58	77
% Delivery care	92	99	100	25	38	74
% Vaccination coverage	81	79	78	33	43	60
Modern education						
% Education	99	99	100	26	37	68

Source: Population Reference Bureau, 2004
- Modern contraception: percentage of married women using modern methods
- Antenatal care: percentage of pregnant women with three or more antenatal care visits
- Delivery care: percentage of births attended by medically trained personnel
- Vaccination coverage: percentage of children fully vaccinated
- Education: percentage of women who have completed fifth grade

Table 5: Order of magnitude of relative mortality differentials according to wealth in Uzbekistan and other studies.

Wealth class	Uzbekistan, 1990's (Socialist health system) Child mortality	Uzbekistan, 1990's (Socialist health system) Adult mortality	African countries, 1990's (Mixed health system) Child mortality	African countries, 1990's (Mixed health system) Adult mortality	Paris, 1817-1826 (Pre-transitional France) Neighbourhood classified by wealth	Paris, 1817-1826 (Pre-transitional France) Equivalent to wealth index
	(1)	(2)	(3)	(4)	(5)	(6)
Very low	2.43	1.68	2.43	1.43	1.50	3.26
Low	1.96	1.48	2.16	1.36	1.35	2.70
Medium	1.57	1.30	1.85	1.27	1.16	2.13
High	1.26	1.14	1.37	1.13	1.07	1.57
Very high	1.00	1.00	1.00	1.00	1.00	1.00

Source: (1-4) Author's calculations from DHS surveys. Classes are based on mean value of wealth index plus or minus one or two standard deviations; (5-6) Author's calculations from Villermé (1840). Column (5) refers to Paris neighborhoods ranked according to wealth; Column (6) refers to extrapolated mortality from proportions of poor people in each neighborhood. See text for details.

Figure 1: Distribution of wealth in Uzbekistan and Africa

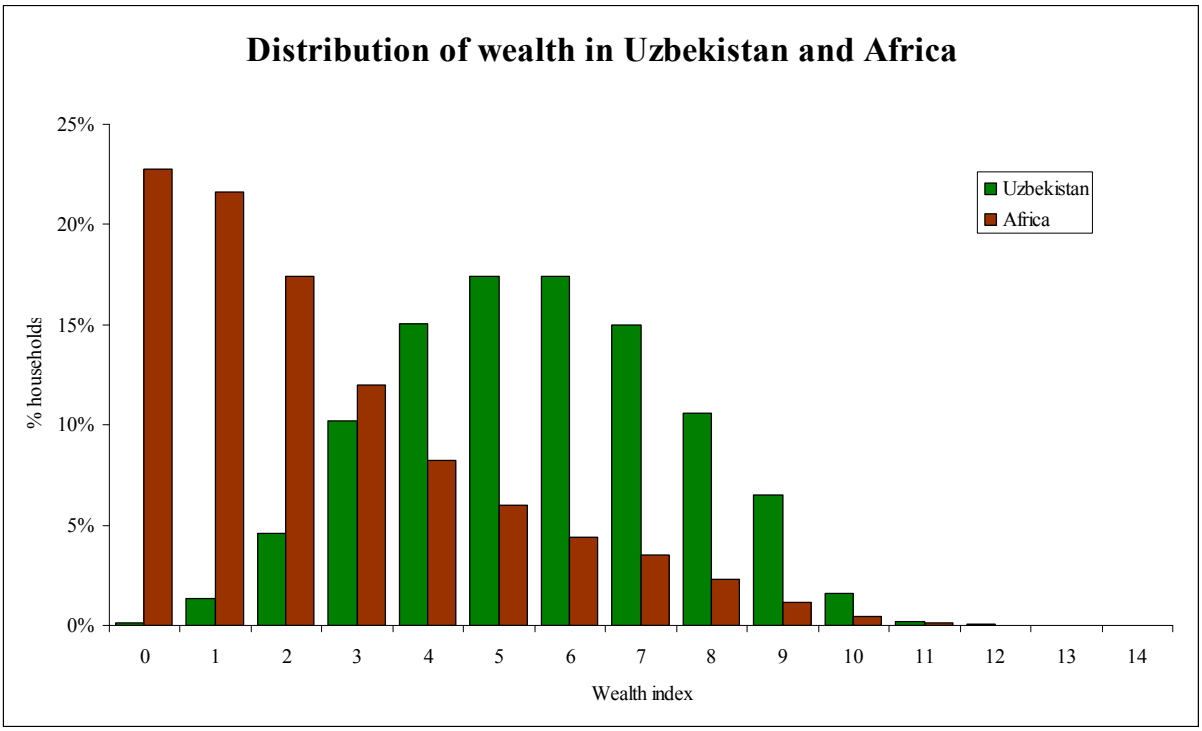

Figure 2: Child mortality differentials in Uzbekistan and Africa

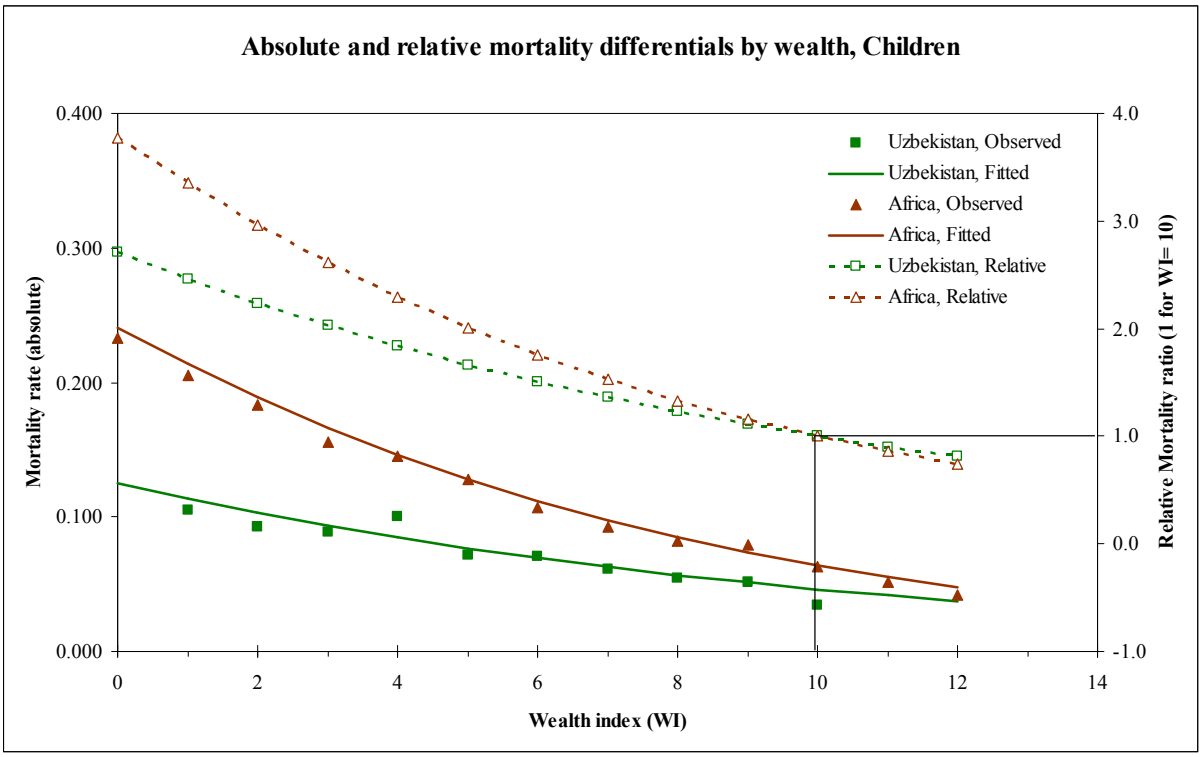

Figure 3: Adult mortality differentials in Uzbekistan and Africa

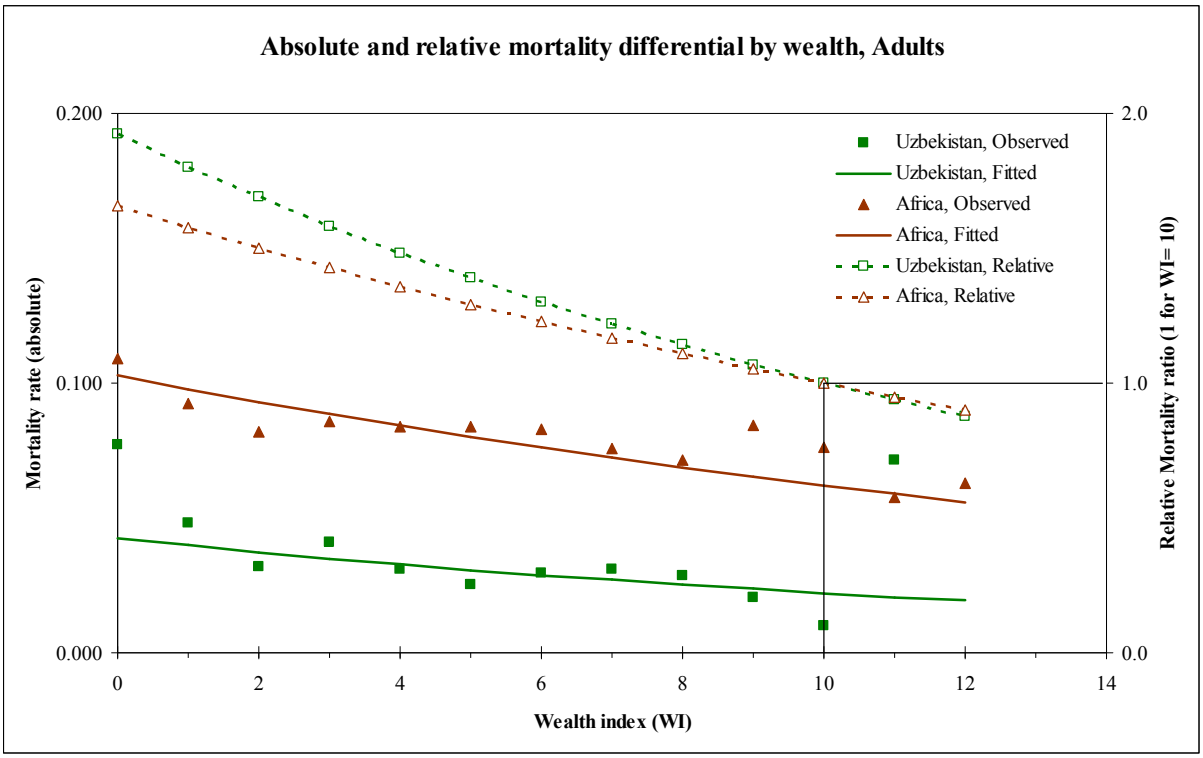

Figure 4: Differentials in child nutritional status in Uzbekistan and Africa

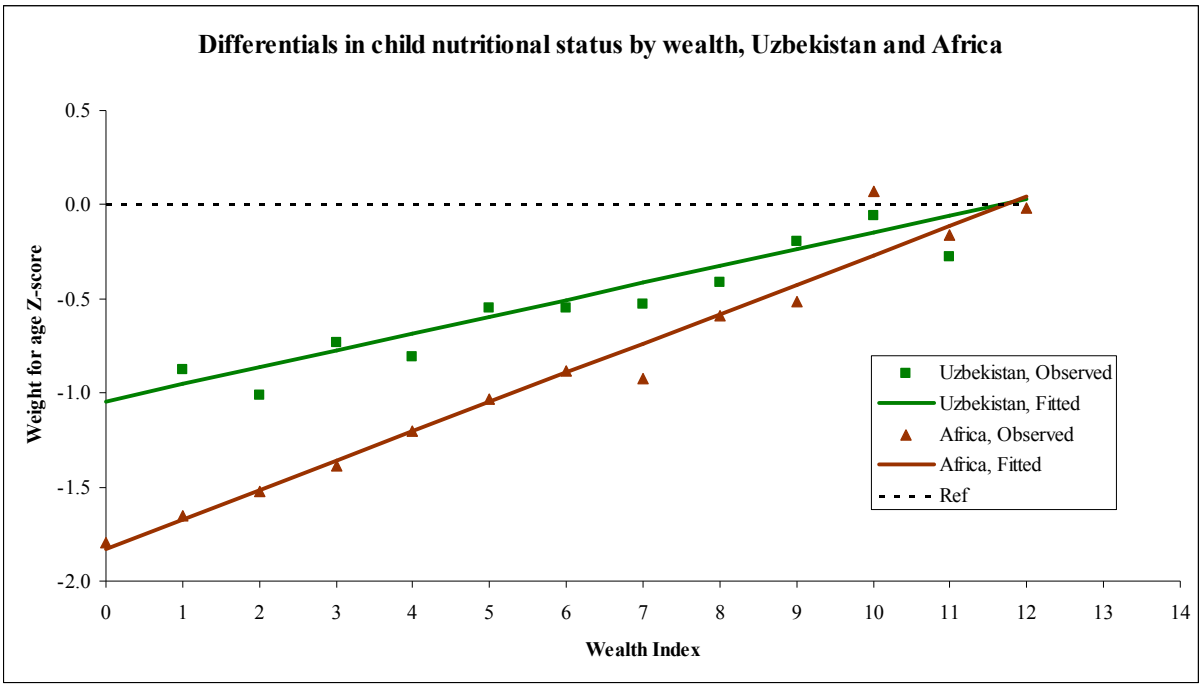

Figure 5: Differentials in adult nutritional status in Uzbekistan and Africa