Origin of Socio-Economic Differentials in Health in Uzbekistan
An international perspective

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Abstract

Background: The study investigates the magnitude of mortality differentials by wealth in Uzbekistan, a former soviet country of Central Asia, and compares it with similar indicators from sub-Saharan Africa.

Methods: Data were 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 and nutritional status were analyzed according to the same absolute measure of wealth (the wealth index) and to relative measures (mortality ratios).

Results: Wealth was distributed evenly in Uzbekistan, with a symmetric distribution around a mean of 5.5 modern goods owned. In Africa, on the contrary, the wealth index distribution had a lower mean (2.5) and was highly skewed towards the left, revealing a high proportion of very poor people. Adult and child mortality levels were lower in Uzbekistan. Despite these major differences, the relationship between mortality indicators and the wealth index bore much similarity in the two situations. The magnitude of 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, mortality levels remained lower in Uzbekistan than in Africa at the same level of wealth for both children and adults. A similar relationship was found between nutritional status and the wealth index in both cases. On the contrary, there were no differences by wealth in use of health services and level of education in Uzbekistan, whereas wealth gradients were steep in Africa for the same variables.

Conclusions: The study suggests that mortality differentials were primarily due to nutritional status, and not to access and 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 health policies that have produced this pattern.

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

Background

Health and wealth in socialist countries

Little is known about income and wealth differentials in mortality and other health outcomes in so-called socialist countries (former communist countries) of 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 differentials. 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 (the poorest areas) than in Tashkent, the capital 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 the possible effect of wealth on child growth.

Demographic and Health Surveys (DHS) conducted in Central Asia find mortality differentials similar to those observed in Africa. For instance, 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 education in Central Asia. However, the magnitude of differentials from primary to higher level of education ranged from 1 to 2.3, which are common values in Africa. Differentials by ethnicity ranged from 1 to 2 if Russians living in Central Asia were taken as the standard, again a value similar to those found in Africa. None of DHS survey conducted in Central Asia has so far directly addressed the issue of income and wealth differentials, though some use other indicators of poverty such as the qualitative question "making the ends meet".

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) 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 health indicators, and in particular with 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 required 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 recent DHS surveys now provide a Wealth Index, 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 African 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 direct comparisons over time in the same country as well as between countries, whereas the principal components are more abstract, and allow only differential analysis by quintiles, or other percentiles.

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 used for this analysis. Mortality differentials according to wealth appear as the product of two historical dynamics: economic growth and mortality decline, both of which being different in the various social strata. 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 statistical relationship between health and wealth. 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, as 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, a country located in West Africa which followed a liberal route, 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 liberal route and countries following a socialist route.

The main determinants of health and mortality trends 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 these four 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 clearly show that the main improvement in life expectancy (the core of the health transition) started around 1860, when major improvements in hygiene occurred, 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) showed 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 largely 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. This study hypothesizes that differentials in health 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 differences in nutrition could play a similar role. This will be central to the argument developed in this analysis.

Purpose of the study

The purpose of this study is to document the magnitude of wealth differentials in health outcomes, namely mortality and nutritional status, 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 contrasted social and historical 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 those in liberal regimes. To reinforce the main point, mortality differentials were also compared to those in 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 south-eastern mountains, part of the Himalaya system. The climate is warm most of the year, and favourable to many tropical parasitic diseases such as malaria, shistosomiasis, leishmaniasis and Guinea worm (*rishta*).

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 and general hygiene (*obshchaia gigiena*) which was to a large extent copied on the German system (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 Turkistan (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. 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 leishmaniasis control), 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'naya gigiena*) which focused on social approaches to diseases and a comprehensive population and health information system, again modelled on the German *Soziale Medizin* approach. Over the years, it was replaced by a more medical approach, though still keeping a strong social dimension, with emphasis on equity in access to health services (Gross Solomon, 1990 a,b; Rosen, 1949 and 1994; Semaško, 1922; Porter, 1999).

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 public health in the whole Turkistan. 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. District health services were organized, 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).

The communist 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, with a possible over-estimation, but much higher than in other Third World countries at that time, and closer to Western Europe levels (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). Mortality decline almost stopped in the recent period, with only minor improvements in the 1980's and 1990's: life expectancy was estimated at 69 years in 1998, with now a large gap with respect to Western European countries, but still much higher than in Africa. Part of the stagnation in the recent years seems to be due to the so called "residual principle", along which financial resource allocation to the health and social sector was defined by what remained after allocation to the production sector and to the military. This system was applied in Russia, and also in Central Asian countries, especially during the Brejnev era, and led to a lack of investment in the health sector, in particular for high technology equipment. However, it did not affect much the health personnel and basic resources (Hohmann, 2004).

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 controlled by 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. The effects of this policy on social indicators will be discussed later.

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). The divide between urban and rural areas was greater than elsewhere, and appeared closely related to income and wealth 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 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 export products. Farmers received an irregular income, depending on erratic production and fluctuations of 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, nutritional status, child survival 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 provided in Table 2. DHS questionnaires are well standardized and use basically the same type of information for wealth indicators, child survival and adult survival, and the same measures for nutritional status. 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 same 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 12, 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. Of course, there is a logic in the adding of heterogeneous goods: when households have some cash they will buy cheaper goods (a radio, a bicycle), and when they become wealthier they will acquire a modern house with all commodities, so that the index reflects well this progression. 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 potential 14 items ever recorded in DHS surveys were available (time to get water and type of toilet facility were missing). 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 difference had no importance for our analysis, and furthermore 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, the proportion of children who died for all women aged 15-49 was taken as the child mortality measure. This is therefore a close approximation of q(10), the probability of dying between birth and age 10 years. In multivariate analysis, age of mother was controlled for, although without any change in the differentials. Both sexes were lumped together since there was no difference of the mortality gradients between boys and girls.

Similarly, adult mortality was expressed simply as the proportion of parents (either mother or father) who had 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, mother and father survival were considered separately. However, since there was no difference in the magnitude of differentials according to wealth by sex, the composite indicator of both sexes combined was selected for the final analysis, adult mortality being defined as death of either or both parents. As for the study of child survival, age of the respondent was controlled for in multivariate analysis, although without any change in the differentials.

Absolute mortality differences 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 estimate slopes of mortality differentials, and to test differences in slopes. Other controls were also used (urban residence, sex of child or parent), also without any change in the magnitude of the differentials.

Some results are also presented according to 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, the two surveys were grouped together in order 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: child mortality was somewhat higher in the second survey (64 per 1000 versus 85 per 1000, adult mortality did not change significantly (30 per 1000 versus 31 per 1000), and the mean wealth index increased somewhat from 5.48 to 5.69.

For African countries, each of the 30 surveys (27 for adult mortality) was first analyzed separately, then they were merged 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.

In addition to mortality indicators, nutritional indicators were also considered. Most DHS surveys provide weight and height for children and for adult women. For children, weight for age was taken as an indicator of malnutrition, since it combines stunting (retarded growth, or low height for age) and wasting (low weight for height). The Z-score of weight for age was restricted to children above age 12 months (12-59 months or 12-71 months depending on survey). This bottom threshold of 12 months was selected because the prevalence of low weight for age is stable above age 12 months, whereas it fluctuates markedly in the first year. For adults, only stunting was considered, measured as 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 two distributions of wealth were remarkably different (Figure 1). African countries exhibited 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 (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 shapes of the distributions were radically different: a regular bell shaped distribution for Uzbekistan, but a highly skewed distribution towards extreme poverty for Africa. Uzbekistan appeared in a transitional situation, where households own about half of the modern goods in the list, whereas Africa appeared 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 (standard deviation / mean) 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 for year 2000: 3408 $ for Uzbekistan and 1143 $ for sub-Saharan

Africa, in constant 1995 USD (Maddison et al., 2003). In summary, Uzbekistan appeared as wealthier and with less inequalities than the average of sub-Saharan African countries.

2) Child mortality differentials

Child mortality differentials according to wealth exhibited 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 went from 241 per 1000 for the poorest households (wealth index = 0) to 48 per 1000 for the wealthiest (wealth index = 12). In Uzbekistan, the same Logit-Linear model estimated mortality at 125 per 1000 for no goods and at 38 per 1000 for the maximum number of goods. Therefore, at the same level of wealth, mortality appeared 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 appeared 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). Furthermore, the multivariate analysis allowed 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 for Uzbekistan, the difference being not significant (P= 0.757). This showed that in two different situations of socialist Central Asia and more 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 than in the latter.

<u>3) Adult mortality differentials</u>

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 for the poorest households (wealth index = 0) to 40 per 1000 for the wealthiest (wealth index = 12). In addition to random fluctuations, the pattern of adult mortality differentials was somewhat disturbed by HIV/AIDS, so that the pattern became smoother when countries with high HIV/AIDS seroprevalence were removed. In countries with high HIV/AIDS seroprevalence, relative risks of adult mortality exhibited two modes: one for the poorest, 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. Indeed, recent DHS surveys conducted in Tanzania (2003) and Cameroon (2004) found a positive correlation between wealth and HIV seroprevalence, which could explain the irregular patterns exhibited when mixing the various African countries. HIV/AIDS was not a demographic issue in Uzbekistan, and only a few AIDS deaths had occurred by 2002.

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, adult 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 was confirmed by the slopes of the Logit-Linear model: –0.074 for Africa and –0.067 in Uzbekistan, the difference being not significant (P= 0.918). In summary, in the 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 than in the latter. 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 gradient according to wealth would have remained basically the same, and similar to that in Uzbekistan.

Table 3 summarizes the main differences between the situations: despite major differences in income, in wealth distribution and in 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 may seem 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, the comparison was pursued with a pre-transitional society, where access and use of modern health services simply did not exist: 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 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 size to number of 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).

To put Villermé's findings into a modern framework, mortality indicators were computed, since he provided all the data to do so in his appendix: 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 corresponds to 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), crude rates were used for the estimations. Model life tables mortality functions indicate that relative risks for child and adult mortality would be almost identical to those of crude rates.

Neighbourhoods were ranked by wealth and grouped 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, a regression line was drawn 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 showed 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 in the wealthiest 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 nutritional status paralleled wealth differentials in mortality 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. This analysis showed 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 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 (Garenne and Gakusi, 2003; Hohmann and Garenne, 2005). Little is known on 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 different from that of sub-Saharan Africa. First, the average level of income is 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 health outcomes had been compared 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 similar, which means that despite its outstanding achievements the socialist health system had not resolved the main sources of health differentials. Our argument is to say that this seems likely to be due to differences in nutritional status. One could further argue that they are probably due to early age nutritional status, since most of the stunting develops prior to 36 months and since differences according to wealth were found in nutritional status among children as among adults. This means that if the poorest strata of the Uzbek population enjoy 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 is widespread, and in the 2002 DHS survey 28.7% of under-five children were below the -2 standard deviation threshold (against 2.5% expected in a well nourished population). 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 with those having 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 has been for a long time 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 the other republics (Mahkamov and Romančenko, 1976).

The focus in this analysis was on proximate determinants of mortality change (nutrition, preventive and curative medicine). However, one could argue for the role of genetic factors and the possible reverse causality: persons who have a worse health status for genetic reasons might also be those who are less likely to succeed economically. However, this is unlikely to be a strong counter argument to our findings. Indeed, this has never been formally proven, and furthermore improvements in mortality, nutritional status and income have affected the whole population in developed countries, showing that economic development and good health status is in the reach of the whole population. If malnutrition had disappeared in Uzbekistan as it did in Europe, it could not have been evoked as a source of mortality differentials.

Comparing Uzbekistan with European countries could be a next step in this analysis. However, this is likely to be more difficult for a variety of reasons. First, there are no DHS surveys with which to conduct the same comparisons. Second, mortality levels are much lower, and differentials are likely to reflect other problems, in particular behavioural factors [Kunst et al. 1998]. Third, malnutrition has virtually disappeared. Fourth, income and wealth are so much higher that regression lines would not have the same meaning.

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 [Garenne et al., 1997]. What is emphasized in this analysis is that, despite equity in access and use of health services, one could still find mortality differentials, which seem to be 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 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 on the average.

Demographic indicators showed no obvious difference in use of health services in Uzbekistan. 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 the highest standards tend to be for wealthiest people living in large cities, whereas lowest standards are found in remote rural areas.

To answer why the soviet system failed to eradicate all social and nutritional differentials would require further analysis. First, no political system so far succeeded in whipping out all mortality

differentials, although this might be the case in special populations of small size. 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 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 situation over the past few years.

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 larger) and a much wider geographical 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 they provided good public health services in colonial cities. 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 as a whole, though with major differences by country in the later. In Africa, mortality differences between the two areas of residence in the various countries seem to be primarily associated with differences in wealth [Garenne, 2005].

The precise origin of nutritional differences in Central Asia remains to be further explored. They are obviously linked to poverty, and low income is usually associated with less food diversity, poorer nutritional status, and often with smaller amount of food. 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 these interventions, 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 for targeting policies aiming at reducing differentials in health outcomes in theses situations.

Competing interest:

None declared

Author's contributions:

M.G. worked for several years in Africa, and was responsible for the analysis of sub-Saharan Africa and the re-visiting of Villermé's study. S.H. worked for several years in Uzbekistan and was responsible for the analysis of this country. Both authors share responsibility for the comparative analysis.

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Figure legends:

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

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 respondents (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

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 (WI) (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

Indicator	Uzbekistan			Africa		
	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		African countries, 1990's		Paris, France, 1817-1826	
	Child mortality	Adult mortality	Child mortality	Adult mortality	Neighbourhood classified by wealth	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 neighbourhoods ranked according to wealth; Column (6) refers to extrapolated mortality from proportions of poor people in each neighbourhood. See text for details.

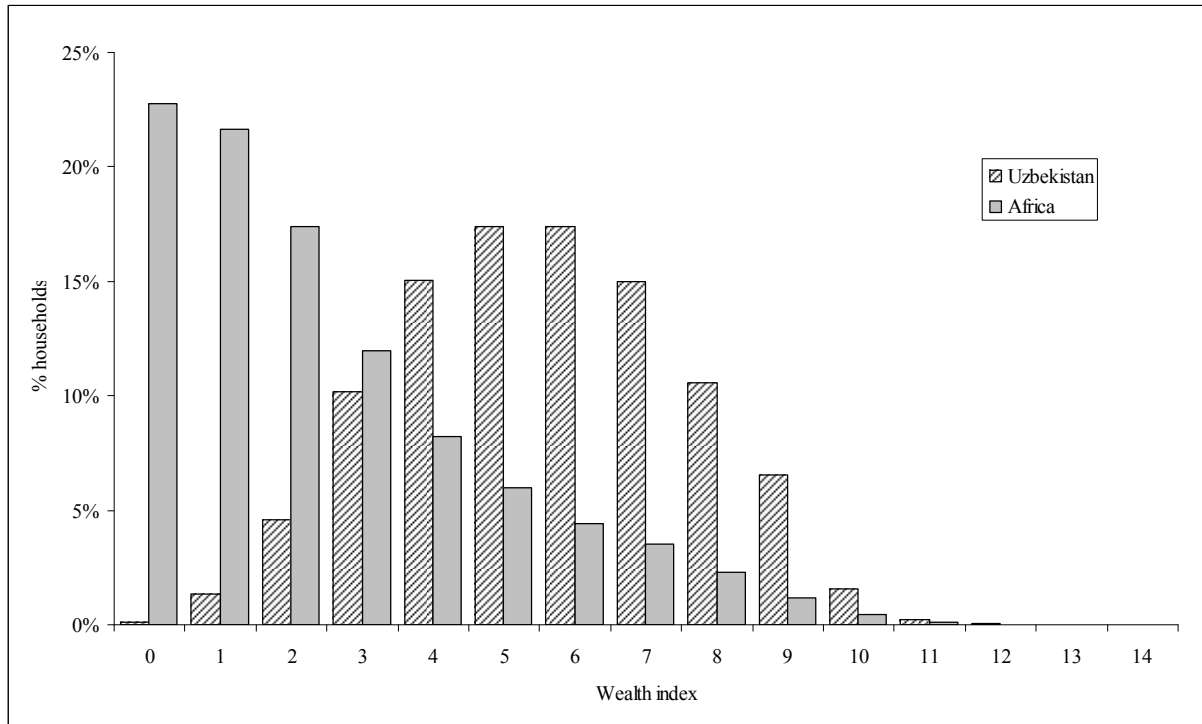Figure 1: Distribution of wealth in Uzbekistan and Africa

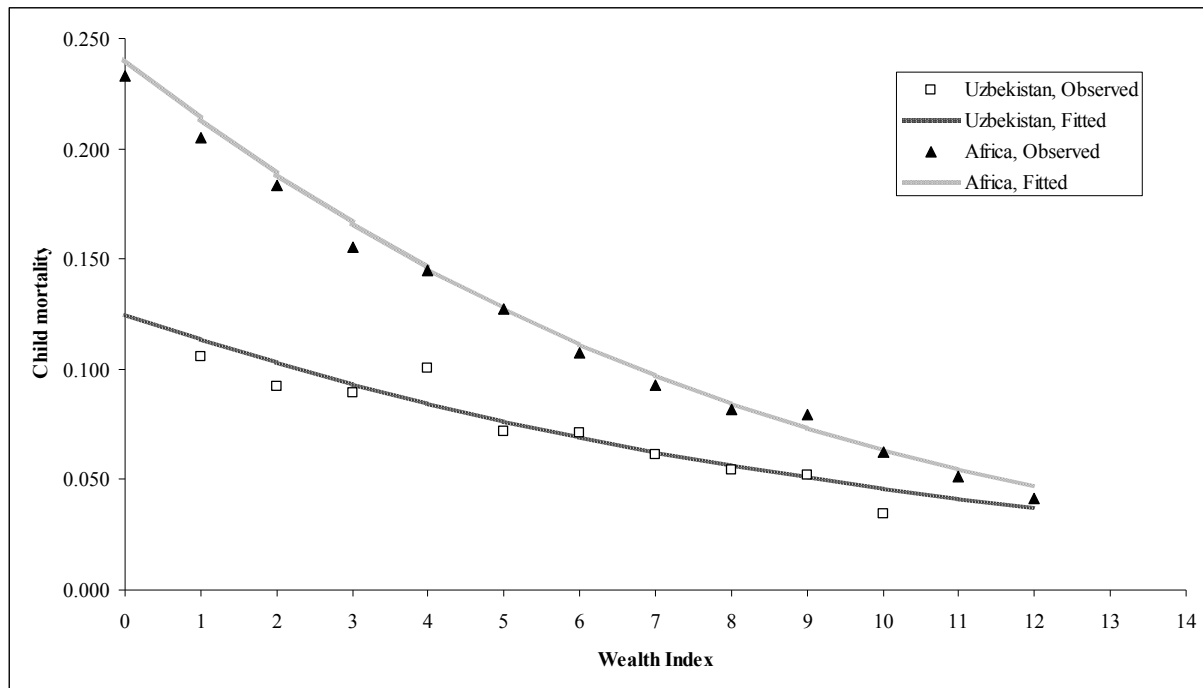Figure 2: Child mortality differentials in Uzbekistan and Africa

Figure 3: Adult mortality differentials in Uzbekistan and Africa