

**Is the AIDS epidemic having an impact on the coping
behaviour and health status of the elderly?
Evidence from Northwestern Tanzania**

Martha Ainsworth

Development Research Group, the World Bank

and

Julia Dayton

Department of Epidemiology and Public Health, Yale University

December 2000

This paper is based on a research project entitled, “The economic impact of fatal adult illness due to AIDS and other causes in sub-Saharan Africa”, sponsored by the World Bank, USAID and Danida. We are grateful to UNAIDS—particularly Anita Alban—for the financial support for this paper, to Paurvi Bhatt, Deon Filmer, Robert Hecht, John Knodel, Sukhontha Kongsin and John Stover, for comments on an earlier draft, and to Anna Marie Marañon for expert assistance in producing the paper with all of the figures intact. Our use of the term ‘elderly’ in this paper to describe adults over the age of 50 is purely for convenience; we wish to affirm that none of our friends, colleagues or co-investigators over 50 could in any way be described as elderly. The findings, interpretations and conclusions expressed in this paper are those of the authors and do not necessarily represent the views of the World Bank or its members.

Foreword

With HIV/AIDS leading to growing numbers of adult deaths, the extended family is likely to play an increasingly important role in caring for the sick and orphaned. It has been hypothesized that this burden falls most heavily on the elderly, which could have an adverse effect on their welfare. Yet very little research has been carried out in this area. Data collected by the Kagera Health and Development Survey, carried out in 1991-94 by the World Bank in Kagera Region, Tanzania, are well suited to analyse the impact of AIDS mortality at the family level and on the welfare of the elderly

As background for the ADF 2000, UNAIDS supported further analysis of these data to explore (among other things) the impact of HIV/AIDS on the elderly, and the coping mechanisms employed by that age group. This paper presents the findings of that analysis, which show that the impact on the physical well-being of the elderly is less in Kagera than may have been expected in such a high-prevalence area. The policy implications are that household wealth and community infrastructure—such as the access to health services and improved roads—may play a more important role in the welfare of the elderly than does the death of an adult. This has far-reaching consequences for the planning of services in the AIDS era and suggests the need for a cross-sectoral approach to ensure adequate access to public services.

UNAIDS, October 2000

I. Introduction

High HIV infection rates in sub-Saharan Africa are producing dramatic increases in the mortality of prime-aged adults. As of the end of 1999, an estimated 24.5 million Africans were living with HIV/AIDS, accounting for more than 70% of all global infections (UNAIDS 2000). In Tanzania, where the first AIDS case was detected in 1983, an estimated 1.3 million people out of a total population of nearly 33 million were believed to be infected with HIV, and 140,000 had already died of AIDS. The estimated infection rate among prime-aged adults (aged 15-49) was 8.1%, or about one in every 12 adults. In neighbouring Uganda, a study of Masaka District found that when HIV prevalence reached this level, two-thirds of all adult mortality was due to AIDS (Nunn et al. 1997). In Masaka, a 15-year-old's probability of death before the age of 60 had already reached 61%, whereas, in the absence of HIV/AIDS, it would have been only 24% (Boerma et al. 1998).

The AIDS epidemic poses a huge challenge to countries with limited resources and implementation capacity (Ainsworth and Teokul 2000, World Bank 1999). Tanzania's GNP per capita is one of the lowest in the world—only US\$220. Of the total population of 33 million, 19.9 million people live on less than one dollar a day (World Bank 2000a). In Tanzania, as in other low-income countries, the government faces extremely tight resource availability from public revenues and a huge development agenda to finance, of which the prevention of HIV/AIDS is one of several critical items. The public sector 'safety net' to help households through times of crisis is extremely thin. Most assistance for needy families is financed through the extended household, community or nongovernmental organizations. Yet the AIDS epidemic is taking a widespread toll on households, and there is concern that the traditional private safety net may be unraveling. A number of international donors have recently pledged greatly increased amounts of assistance for sub-Saharan Africa to strengthen its response to AIDS. Policy-makers and donors urgently need better information about the distribution and depth of the epidemic's impact on welfare outcomes of different types of survivors, how existing antipoverty programmes may affect them, and what new programmes or policies might be effective.

The elderly often have been invoked as one of the key groups of survivors adversely affected by the death of prime-aged adults (Barnett and Blaikie 1992, Hunter and Williamson 1998, National Research Council 1996, World Bank 2000b). The elderly play a potentially important role in helping the household cope with adult morbidity and mortality from AIDS. They do so by acting as:

- guardians of orphaned grandchildren
- health caregivers for adult children stricken with AIDS

- substitute workers in the market and on the farm during the illness and after the death of a prime-age adult.

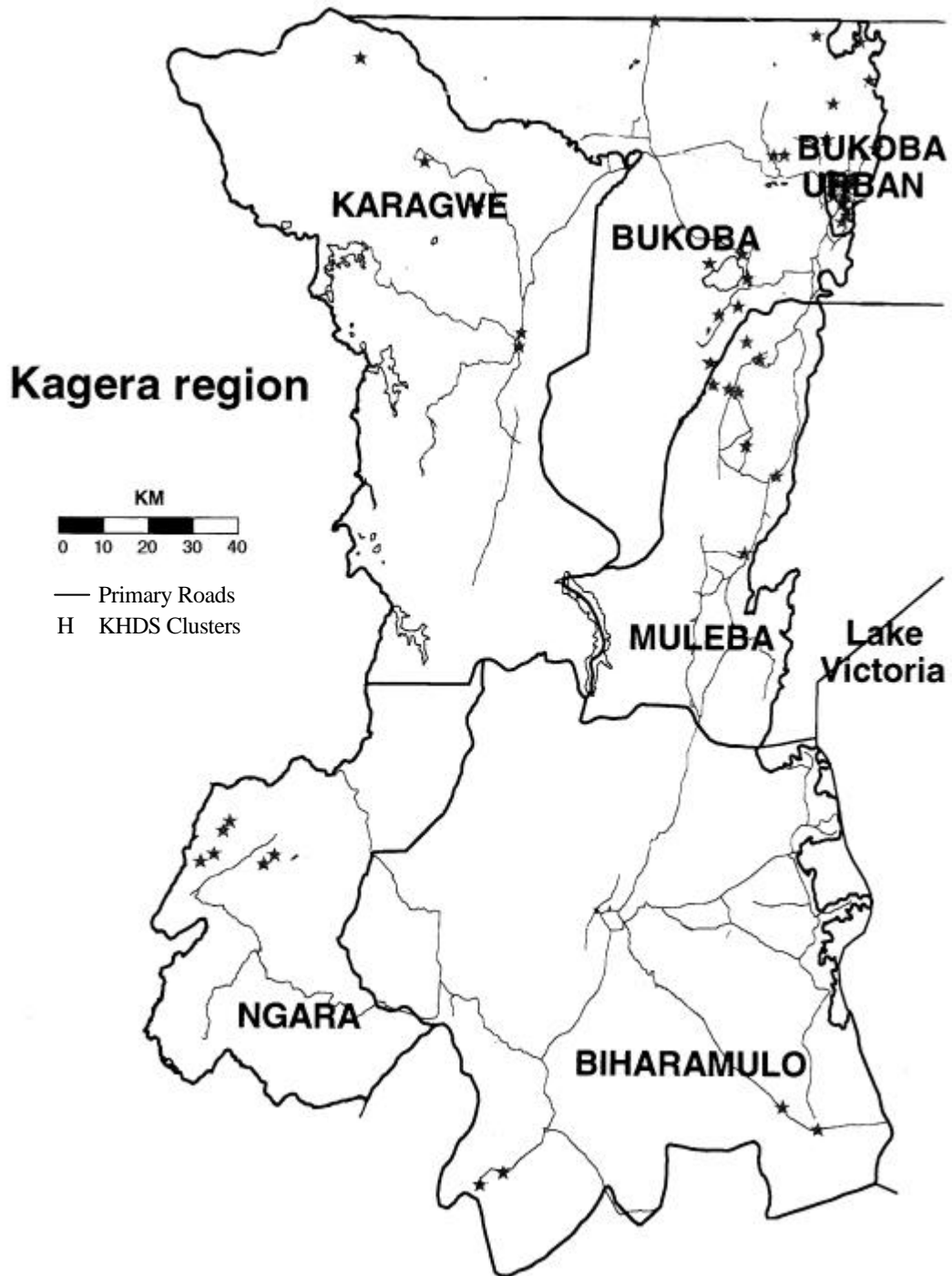
In assuming these roles, the elderly in households with an adult death may reallocate their time. To the extent that household income also declines or that the elderly are permanently robbed of the old-age security often provided by adult children, their physical well-being may decline. Yet, up to now, most of what is known about the impact of AIDS on surviving household members—including the elderly—is anecdotal, based on small, in-depth studies or case studies of specific individuals and without comparison to a control group. It is very difficult to know whether these impacts are typical or among the most severe, how to identify those who are most seriously affected, and the types of policy instruments that are likely to be most cost-effective in helping them. For example, it has often been suggested that caring for one's grandchildren following an AIDS death is a burden for the elderly and disadvantageous for the children. However, in African societies, grandparents traditionally play an important role in raising their grandchildren; children with living parents are often 'fostered' to their grandparents to be raised, particularly in West Africa (Ainsworth 1996, Isiugo-Abanihe 1985, Page 1986). African parents have many children, not only to compensate for high child mortality, but also because children are economic assets and play a key role in supporting their parents in old age.

This paper uses data from the Kagera Region of Tanzania from 1991 to 1994 to examine the reallocation of time of the elderly in response to adult deaths and the ultimate impact of prime-aged adult mortality on their physical well-being. The next section of the paper describes the setting and dataset. The third section is devoted to a review of the hypotheses and evidence in the literature on the coping behaviour of the elderly, followed by a closer examination of the coping of the elderly in Kagera. The fourth section reviews the literature and hypotheses on the determinants of physical well-being of the elderly, the channels through which an adult death in the household can affect the physical well-being of the elderly, and a summary of the results of multivariate analysis of the determinants of physical well-being in Kagera. The final section summarizes the results and conclusions for policy.

II. The setting and the data

The Kagera region of Tanzania is located to the west of Lake Victoria, adjacent to Uganda, Rwanda, and Burundi, in an area of high HIV prevalence and high adult mortality (see Map). The 1988 census reported more than 1.3 million people living in the region, with more than 80% residing in rural areas. Most of the population is engaged in agriculture—tree crops in the north and annual crops and livestock in the south.

Household consumption expenditure in 1991 was US \$217 per capita, based on data used from this study, ran



Kagera is at the epicentre of the African AIDS epidemic. The first case of AIDS in the region was diagnosed in 1983, although HIV was probably present at least a decade earlier. A population-based seroprevalence survey conducted in 1987 found that about one in four adults in the regional capital (Bukoba) were infected with HIV, but that one in 10 adults in rural areas surrounding Bukoba was also infected (Killewo et al 1990). In the rural south and southwest of Kagera, in contrast, fewer than 1% of adults were infected; to the west the adult infection rate was 5%. These levels of infection are not unlike those projected nationally at present—about 8% of prime-aged adults. A follow-up study in 1993 found that HIV prevalence had declined from 24% to 18% in Bukoba town among those 15-54 years of age, and in the rural area surrounding Bukoba, from 10% to 6.8% (Kwesigabo et al. 1998). However, in the latter case, the only population group that registered a significant decline was rural women aged 15-24¹.

Source of data

We use the Kagera Health and Development Survey (KHDS)—a longitudinal living standards survey of over 800 households, with four waves of data collected at six-to-seven-month intervals from 1991 to 1994². The objective of the data collection and research effort was to measure the impact of prime-aged adult deaths on the welfare of surviving household members. Even with the high HIV infection and mortality rates in Kagera, the sample of households had to be heavily stratified in order to observe a sufficient number of households likely to suffer an adult death during the short time frame of the panel (three years). A total of 51 primary sampling units (PSU) were chosen from both high- and low-mortality communities in each of four geographical zones of the region. An exhaustive listing was made of all households in these 51 PSUs—more than 29,000 households in total—each of which was asked about the recent mortality of prime-aged adults (in the 12 preceding months), the cause of death (illness, accident, childbirth, etc.) and whether there were any adults too sick to work. In each PSU, a sample of 16 households was subsequently chosen at random from one of two groups: 14 households were randomly selected from among households reporting either an adult death from illness, an adult too sick to work, or both; and two households were randomly selected from among those reporting neither event. A total of 816 households were selected for the original sample and 757 completed all four interviews³. The questionnaire and sampling are described in greater detail in Ainsworth et al. (1992). The KHDS is one of

¹ Since HIV infection is lifelong, the only way that the percent of the population infected can decline over time in a cohort is for the mortality rate to exceed the new infection rate (incidence) or for HIV-positive people to migrate out of the study population.

² The KHDS was part of the research project entitled, 'The economic impact of fatal adult illness due to AIDS and other causes in sub-Saharan Africa' supported by the World Bank, USAID, and Danida. The project was conducted in collaboration with the World Bank (Mead Over, principal investigator, Martha Ainsworth, co-investigator) and with the University of Dar es Salaam (Phare Mujinja, Innocent Semali and Godlike Koda, co-investigators). See Over and Ainsworth (1989).

³ Since households that left the sample were replaced, a total of 915 households were interviewed at least once.

the few population-based surveys capable of examining over time the impact of adult deaths on the rest of the household.

The household questionnaires collected detailed information from each household member on demographic characteristics, education, health status (acute and chronic), health expenditure, labour force participation and time use, income, migration, remittances sent and received, savings and height and weight. In addition, household consumption expenditure, the value of home production consumed, household income, and the value of economic assets were obtained for each household, as was information on every household member and every non-resident relative who died before and during the survey. Previous analyses of these data have studied the impact of adult deaths on household composition (Ainsworth and Semali 1995), children's health and nutritional status (Ainsworth and Semali 2000, Dayton 1999), labour force participation of surviving household members (Beegle 1998), child schooling (Ainsworth, Beegle and Koda 2000), fertility (Ainsworth, Filmer and Semali 1998), household transfers (Lundberg, Over and Mujinja 2000) and household consumption expenditure (World Bank 1999).

In this paper, we will focus on the impact of the recent death (within the past six-to-seven months) of a prime-aged adult in the household on the time allocation and physical well-being of adults over 50⁴. In economic studies of child welfare in developing countries, the most common measures of physical well-being are anthropometric indices of wasting (low weight for height) and stunting (low height for age). Likewise, in this paper we use an anthropometric index called body mass index (BMI) as our objective measure of the well-being of the elderly. BMI, defined as the respondent's weight in kilograms divided by height in metres squared, is considered a strong measure of overall health status for adults because extreme high and low values have been associated with higher mortality (Waalder 1984). Essentially, low values are indicative of acute under-nutrition and comparable to wasting in young children. BMI is likely to vary in the shorter run and responds to changes in energy inputs and outputs (Strauss 1986). There has been limited research on the association between extreme BMI values and mortality in the elderly in developing countries, but the highest risks of mortality in developing country populations are associated with extremely *low* values of BMI, rather than high ones, which is more typical in industrialized countries (WHO Expert Committee 1995). For men and women, the cut-off of BMI for under-nutrition or thinness for ages 60-69 is 18.5, and for overweight is 30 (WHO Expert Committee 1995)⁵. We use this lower

⁴ In future work, we will examine the impact of the recent death of an adult child, either in the household or elsewhere; the recent death of a spouse; and the impact of the surviving number of living children.

⁵ The health risk of overweight for elders over the age of 69 is uncertain (WHO Expert Committee 1995).

threshold in this study, although we recognize that the precise definition of extreme values remains under debate (Strauss and Thomas 1998; Garcia and Kennedy 1994; Immick, Flores and Diaz 1992).

Demographic characteristics of the sample

Over the course of the longitudinal survey, the KHDS interviewed a total of 730 persons over 50 at least once and as many as four times⁶. For the purpose of describing the sample and the changes that occurred over time, we will initially restrict ourselves to the sample of those over 50 who resided in the 757 households that completed all four interviews in the panel. During the first interview, or ‘wave one’, which occurred from October 1991 to March 1992, there were 566 persons over 50 (53% of whom were female) who were members of these households. The highest percentage (41%) were in their fifties; about a third were in their sixties (34%) and more than a quarter (26%) were 70 or older. Of these elderly seen in wave one, 50 (9%) lived in a household that had a death during the longitudinal survey⁷.

There were very marked differences between women and men in their education, marital status, and relation to the head of the household. Only about a quarter of elderly women had any education, whereas 80% of elderly men had some schooling and more than a third had completed five years or more of schooling (Figure 1). More than half of the elderly women (53%) were widows and only a third (33%) were currently married, whereas 80% of elderly men were currently married and only 14% were widowers (Figure 2). These differences in marital status among elderly men and women are typical and reflect the facts that 1) male life expectancy is lower; 2) elderly women outnumber elderly men; and 3) men typically marry younger women. Among married men and women in the sample, more than 90% were co-resident with their spouse. Virtually all of the elderly men (97%) were the head of their household, while roughly a third of the elderly women were household heads (34%) or the spouse of the head (32%) (Figure 3). In addition, one in five of the elderly women (21%) was the mother of the head of household.

⁶ In the survey, 493 persons (67.5%) were interviewed four times, 83 (11.4%) three times, 78 (10.7%) twice, and 76 (10.4%) once. The most important reasons why some people were not interviewed all four times were the following: they turned 51 during the survey; their household moved out of the sample during the survey; and their household moved into the sample (replacing a household that dropped out) during the survey. As we shall see later, among the households interviewed four times, there was remarkable stability in the population of household members over 50.

⁷ In the multivariate analysis, we include persons from all households (regardless of the number of times seen) and include adult deaths six months prior to the first wave.

Figure 1: Distribution of women and men over 50 by years of completed schooling

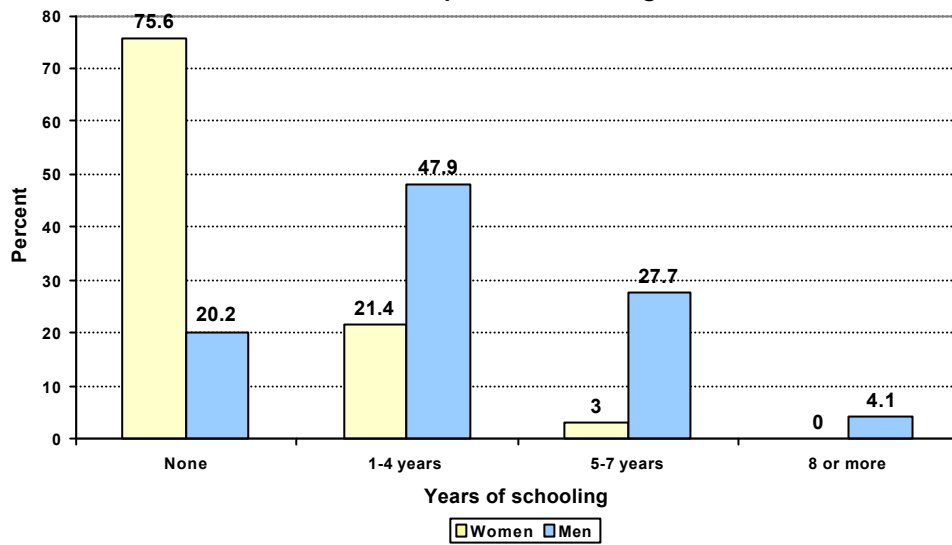


Figure 2: Distribution of adults over 50 by marital status

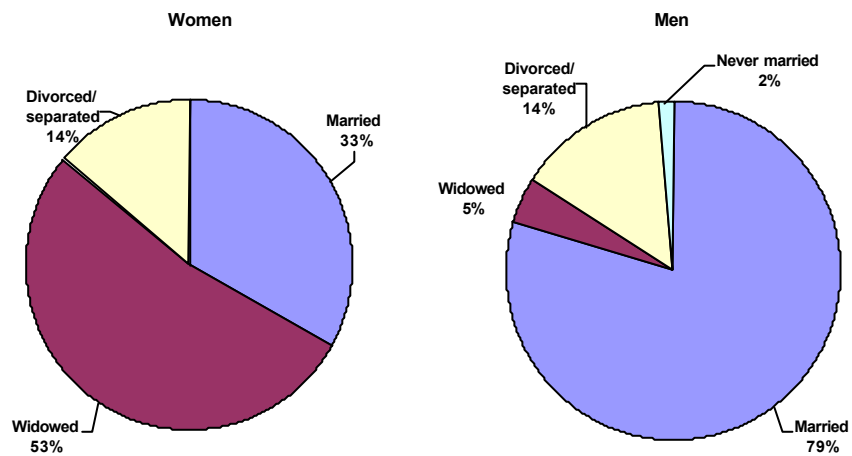
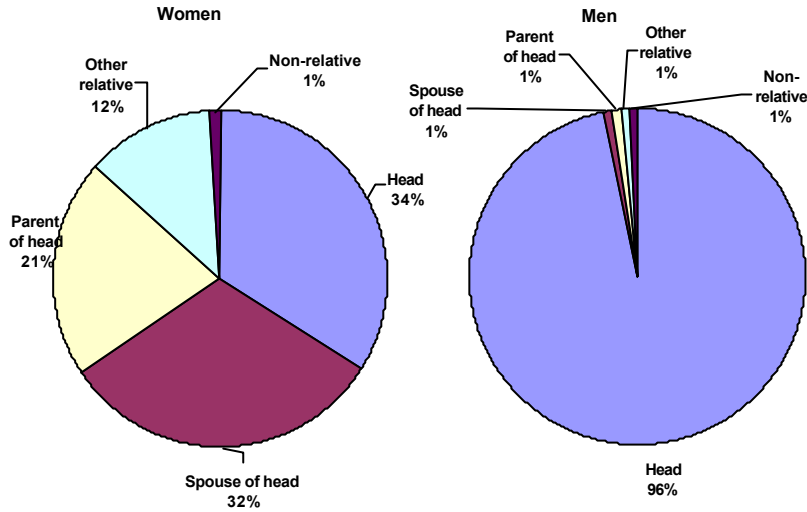
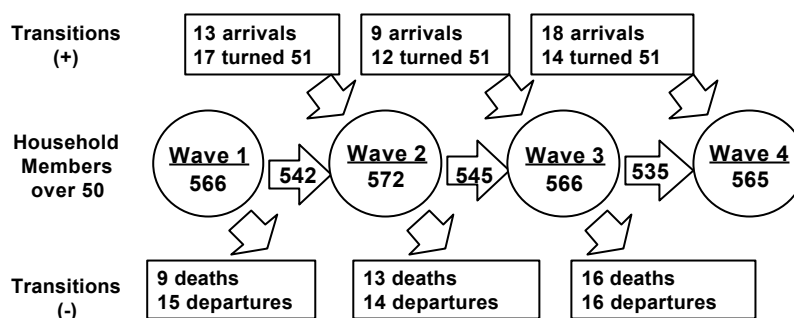


Figure 3: Relation of those over 50 to the head of the household



There was very little movement of the elderly into and out of households over the course of the longitudinal survey (see Figure 4). Of the 566 people over 50 seen in the first wave, 498 (88%) were still household members in wave four. A total of 38 of the elderly (7%) died over that period and 45 (8%) moved out of the households. However, the numbers of elderly were boosted by arrivals and aging. Forty-three adult household members turned 51 and 40 moved in. Thus, the number of elderly at the end of the survey (565) in these households interviewed four times was very similar to the number at the beginning (566). Household members over 50 were the least likely of any demographic group to join or leave the Kagera households during the survey (Ainsworth and Semali 1995).

Figure 4: Transitions of the elderly in Kagera households interviewed four times, 1991-94



Overall, the elderly in the KHDS sample have lower average BMI values than do the elderly living in other developing countries (Table 1)⁸. Adults over 50 in our sample are also more likely to have a low BMI (24%) compared with Indonesians aged 18 and older (14%) and Ivoirians aged 20-60 (4%) (Frankenberg, Thomas and Beegle 1999; Thomas, Lavy, and Strauss 1996).

Table 1: Mean and Standard deviation of Body Mass Index (BMI) by age group and geographic location
(Standard deviations in parentheses)

Location	Age group (years)		
	60-69	70-79	>=80
Men			
<i>Kagera, Tanzania (1991-93)</i>	<i>20.3 (3.0)</i>	<i>19.3 (2.6)</i>	<i>18.1 (2.0)</i>
Brazil (1989)	23.7 (5.4)	22.9 (5.0)	22.4 (4.1)
China	20.8 (3.0)	21.7 (3.9)	20.9 (2.6)
Guatemala (rural)	21.3 (2.6)	20.2 (2.2)	19.6 (2.3)
United States	26.4 (4.0)	25.6 (3.7)	24.6 (3.8)
Women			
<i>Kagera, Tanzania (1991-93)</i>	<i>21.3 (4.3)</i>	<i>19.7 (3.3)</i>	<i>19.7 (3.9)</i>
Brazil (1989)	25.8 (6.7)	25.0 (7.4)	23.9 (4.9)
China	21.7 (3.9)	20.7 (3.6)	19.6 (3.1)
Guatemala (rural)	22.4 (3.3)	21.4 (4.4)	20.7 (4.1)
United States	26.5 (5.3)	25.7 (4.9)	24.5 (5.0)

Source: KHDS: authors' calculations. Other countries: WHO Expert Committee (1995).

⁸ We were unable to find any references for BMI of the elderly in other sub-Saharan countries.

III. Coping behaviour of the elderly in response to an adult death

In response to an adverse event, such as the illness and death of an adult from AIDS, household members will often reallocate their time or resources to minimize the impact on their well-being. Depending on the success of this coping mechanism, the welfare of survivors, such as the elderly, may be affected. In this section, we review the descriptive statistics for our sample of adults over 50 with respect to their living arrangements, time use and well-being, as measured by BMI. We will also refer to evidence found in other studies of the same phenomena. We only know of only one other study, in Thailand, that provides quantitative evidence of the effect of adult AIDS morbidity and death on a relatively large sample of the elderly (Knodel et al 2000)⁹.

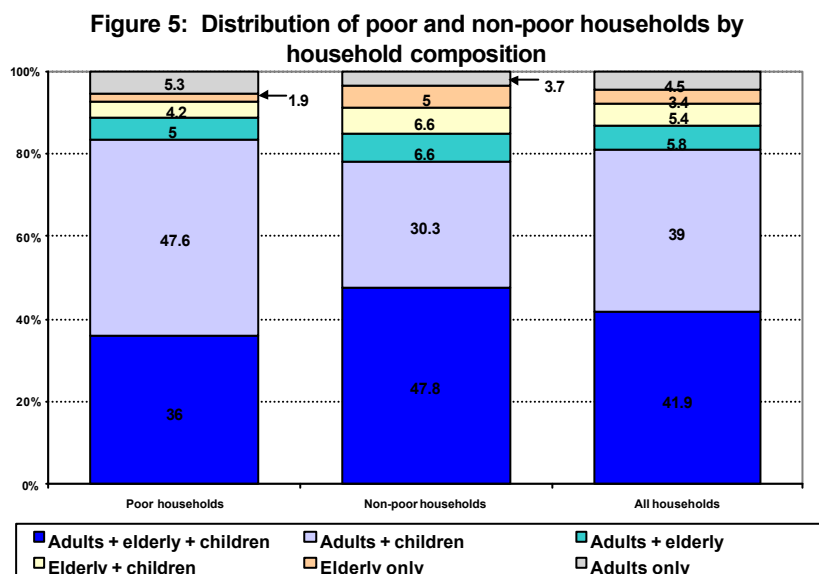
Living arrangements of the elderly

Because most of those who die from AIDS are prime-aged adults, it has been suggested that the epidemic will increase the share of households comprised solely of elderly and children (Barnett and Blaikie 1992, Hunter and Williamson 1998). Households with no prime-aged adult are believed to be less economically viable and more demanding of the time and energy of the elderly in terms of caring for children and generating income. Reinforcing the tendency towards an imbalance in households with only young and old is the common practice for grandparents to take responsibility for raising AIDS orphans. Knodel et al. (2000) report from their study in Thailand that, in roughly half of all AIDS deaths in which one spouse dies, the couple's children are cared for by the surviving parent. However, when there was no surviving parent, 74% of the orphans were cared for by grandparents. While these arrangements potentially could increase the dependency ratio, there is also substantial potential for movement of individuals between households, which could help to re-balance household composition and minimize such impacts. Using the KHDS, Ainsworth and Semali (1995) found that there was much more turnover in household membership (adults joining and leaving the household) among households with a prime-aged adult death than in households without a death; in fact, two-thirds of the households with an adult death between waves one and four had adults both join and leave the household in that interval. This means that, on average, the number of adults did not decline by one in households with a prime-aged adult death. In households with

⁹ Using data from 1999, Knodel et al. (2000) examined the extent to which prime-aged adults with AIDS received care from parents (usually aged 50 years or older), and assessed the economic effects of the care-giving and subsequent death from AIDS on parents. They used local informants (usually staff of the community health station) to obtain basic information about adults in their catchment area with AIDS or who had died from AIDS. For a subset of sick and deceased whom the informant knew well, a more detailed set of questions was also asked of the informant. Data were collected at 85 sites in 8 provinces and in Bangkok, with a focus on provinces with high rates of AIDS, and covered a total of 1069 individuals who were sick or who had died of AIDS, with detailed data on 286 of them. The unit of analysis was the person with AIDS but, in some cases, it was the parent of the AIDS patient. However, there was no control group and the sample, while covering many provinces, is not representative in a statistical sense of the elderly in Thailand or of households with AIDS patients.

an adult death, the dependency ratio (in this case, the number of children and persons over 50, relative to the number of adults 15-50) worsens after the death (from 1.24 to 1.41) but in fact is still lower than the dependency ratio in households without an adult death (1.52 in wave four).

Figure 5 shows the distribution of the 757 KHDS households seen during all four waves by their demographic composition in wave one, and then splits the sample into two almost equal groups: households with less than the median value of household assets per capita in wave one ('poor'); and households with higher than the median value of assets per capita in wave one ('non-poor'). Households consisting only of the elderly and children and of elderly only were rare: only 5.4% of households consisted solely of people over 50 and children under 15, and 3.4% of households had only elderly members¹⁰. There were no households during wave one or any of the subsequent waves that were composed entirely of children under 15. Nearly 42% of households have three generations—children, prime-aged adults and the elderly. An almost equivalent number have no elderly members (39%), only prime-aged adults and children¹¹.



¹⁰ The descriptive statistics in this section pertain to the whole sample and have not been weighted to be representative of the Kagera population.

¹¹ Given the high mortality of prime adults in our sample, it is interesting to compare household composition in the KHDS sample (unweighted) with household composition nationwide from the 1991-92 Demographic and Health Survey. The same share of KHDS households as Tanzanian households have at least one prime-aged adult (91%), but KHDS has fewer households with only prime-aged adults (4.5% vs. 11% for DHS), fewer with elderly only (3.4% vs. 5.8%), and fewer with prime-aged adults and children only (39% vs. 46.6%). However, KHDS has more

When we examine the distribution of household types by household assets per capita, poor households are less likely to have an elderly person (47%, vs. 66% in non-poor households) and a smaller share have all three generations (36% vs. 48% in non-poor households). This could be for any number of reasons, including higher mortality among the elderly poor. However, it implies that *the presence of a person over 50 in the household is not a good indicator of the household's low economic status*. A second observation is that households made up of only the elderly and children are almost as common in poor and as they are in non-poor households. Thus, *household composition is not necessarily a good indicator of the welfare level of the household either*.

Overall, the number of households with only elderly and children rises slightly between waves one and four, from 5.4% to 6.5%, and with only elderly from 3.4% to 5.4%. Figure 6 shows the changes in household composition between waves one and four among households that had a prime-aged (15-50) adult death between waves one and four (n=82), and those that did not (n=675). For households that had an adult death between the first and last interview of the longitudinal survey, the observation for wave one (first pass) represents a time before the death and for wave four (last pass) after the death. Observations on households that did not have a death during the panel, interviewed at the same time, are shown as controls. The share of households with elderly and children and those with only elderly rose in households that had a prime-aged adult death; however, this was also true of households that did not have an adult death (a numerically larger group), and the overall numbers remain small. Thus, *households with only elderly and children and those with elderly alone are not exclusively those with recent adult deaths and they represent a small share of all households, even in this sample in which households likely to have a death were over-sampled*.

households with three generations (41.9% vs. 27.7%). Thus, the percentage of households with at least one person over 50 in the KHDS is substantially higher (56.6%) than in the DHS (42.4%).

Figure 6: Distribution of household composition in households with and without a death, first and last passes

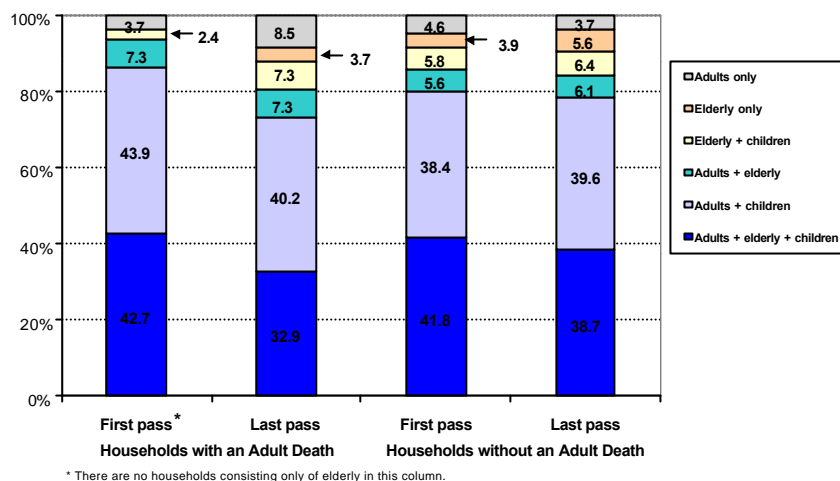


Table 2 shows the distribution of the elderly across different household types. Nearly three-quarters of adults over 50 (73%) live in households with all three generations and 10% live in households with prime-aged adults only. Another 10% of the elderly live in households with children only, while 7% live only with other elderly. Elderly in households with a prime-aged adult death are redistributed somewhat from households with prime-aged adults and children to those with children only or elderly only. However, again there is a tendency for this to happen over time, even in households without a prime-aged adult death.

Table 2. Distribution of the elderly in Kagera households interviewed four times, by household composition and adult deaths during the panel

Household composition	All households				Households with an adult death				Households w/o an adult death			
	Wave 1		Wave 4		Wave 1		Wave 4		Wave 1		Wave 4	
	Percent	n	Percent	n	Percent	n	Percent	n	Percent	n	Percent	n
Prime adults, elderly, children	73.0	(413)	67.3	(380)	82.0	(41)	67.3	(37)	72.1	(372)	67.3	(343)
Prime adults & elderly	10.3	(58)	9.7	(55)	12.0	(6)	12.7	(7)	10.1	(52)	9.4	(48)
Elderly & children	10.1	(57)	12.0	(68)	6.0	(3)	12.7	(7)	10.5	(54)	12.0	(61)
Elderly only	6.7	(38)	11.0	(62)	0.0	(0)	7.3	(4)	7.4	(38)	11.4	(58)
Total	100.0	(566)	100.0	(565)	100.0	(50)	100.0	(55)	100.0	(516)	100.0	(510)

Note: 'n' is the number of persons >50 in each cell.

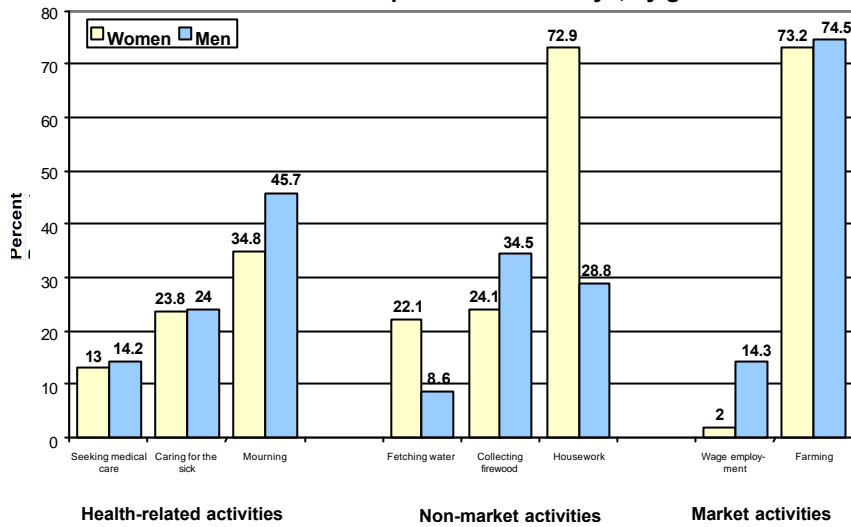
Time use of the elderly

Adult morbidity and mortality due to AIDS may affect the time use of the elderly in market and non-market activities. During the illness, they may spend time caring for the sick adult and/or engaging in activities to substitute for the lost labour of the patient to the household. Knodel et al. (2000) found in Thailand that two-thirds of adults with AIDS co-reside with, or live next to, their parents and that a parent or older generation relative cared for 70% of adults who died from AIDS. The vast majority of these parents were aged 50 or older and most were over 60 years. Based on information provided by key informants, about a quarter of parents living with a person who died of AIDS had to reduce or stop working as a result of the adult illness. In contrast, according to a national study of the United States using data from 1990, only 13% of AIDS caregivers were over the age of 50 and only 6% were at least 60 (Turner, Catania and Gagnon 1994). In a study of household coping in six districts of Uganda, parents were most commonly cited as the principal caretakers for AIDS patients (Ntozi and Nakayiwa 1999).

Following the death, time will be diverted to mourning activities and the elderly adult may have to increase his/her participation in economic activities in order to replace the lost productivity of the deceased household member (Barnett and Blaikie 1992). However, this entire burden need not be borne by the elderly, since other household members may adjust their time. Further, it is important to note that while the production of the household may decline following a death, so does the consumption. Therefore, it may not be necessary for the remaining household members to fully compensate for the lost labour of the deceased. The net effect on the time of the elderly is uncertain and can only be known through empirical observation.

Figure 7 reports the participation rates in health-related activities, non-market activities, and market activities in the seven days prior to the first interview for men and women over 50. There are few differences in health-related activities by gender. Men and women were roughly equally likely to be seeking medical care for themselves (13-14%) or to be caring for sick household members (24%). However, elderly women spent on average about twice as much time (2.2 hours) compared to elderly men (1.2 hours) caring for the sick (not shown). Beegle (1998) found in this same dataset that men and women aged 50-65 were the second most likely to be caring for sick household members, after women aged 15-50 (27%). Elderly men were significantly more likely to have engaged in mourning activities (46%) compared to elderly women (35%), spending an average of 3.6 hours mourning in the previous seven days, compared to 2.5 hours for elderly women.

Figure 7: Participation rates in economic and coping activities in the previous seven days, by gender



With respect to the other market and non-market activities in Figure 7, for all activities except farming there are statistically significant and sometimes quite large differences in labour force participation rates, by gender, in the previous seven days. Elderly women are far more likely than elderly men to engage in fetching water and performing household chores. Elderly women spent, on average, 10.7 hours in the previous seven days on housework, compared to 2.2 hours for men. On the other hand, elderly men were much more likely to collect firewood and work in wage employment. With respect to farming, nearly three-quarters of elderly men and women were active in the seven days before the survey and they performed roughly equal numbers of hours of farm work—16.2 hours for women and 17.3 hours for men.

Figures 8-11 show selected results for changes in the participation rate of the elderly between the first and last waves of the survey in households with and without a prime-aged adult death during the survey. The share of elderly caring for the sick declined in both groups, but significantly only in households without an adult death (Figure 8). The participation rate in housework in the previous seven days remained constant in households without an adult death, at slightly more than half, but rose from 48% to 56% of households with a death (Figure 9). While the increase in participation in housework in Figure 9 is not statistically significant, regressions for hours spent in household activities (including household chores and caring for ill members) found that the death of a prime-aged adult in the past year was associated with an increase in hours spent on household work—on average just under four hours—for adults aged 51-65 (Beegle 1998). There was no change in the participation rate in farming over time in households with or without an adult death, although the elderly in households with an adult death were less likely in

all periods to engage in farming, compared to the elderly in households that did not have an adult death (Figure 10).

Figure 8: Percent of adults over 50 who cared for the sick in the past 7 days during the first and last pass, in households with and without an adult death

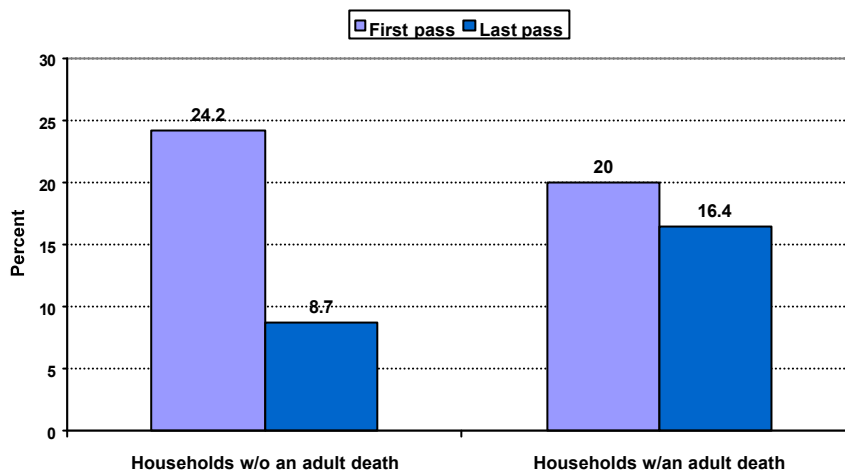
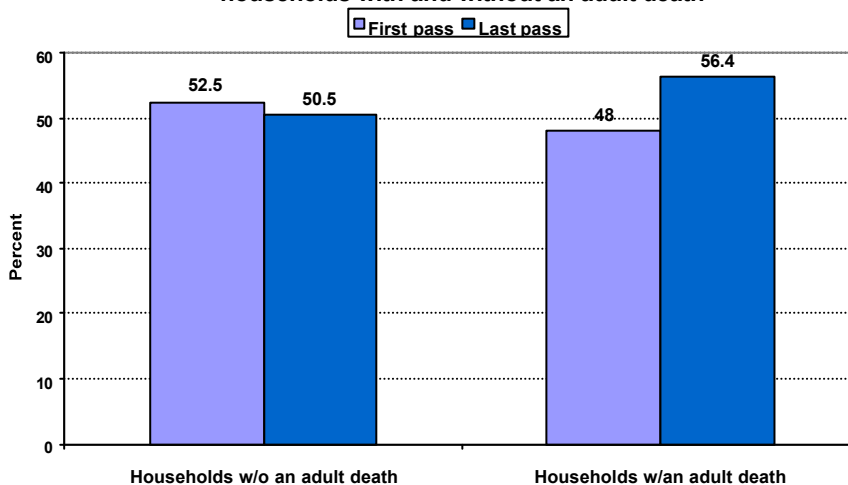


Figure 9: Participation rate in housework in the past 7 days among adults over 50 during the first and last pass, in households with and without an adult death



Regression analysis by Beegle (1998) found no evidence that the elderly worked more hours per week on the farm as a consequence of an adult death in the previous year. The percentage of the elderly engaged in wage employment declined in both types of households, but more so in households with an adult death (from 16% to 11%) (Figure 11). However, this change is not statistically significant. More notable is that both before and after an adult death, the elderly in households that had an adult death were more than twice as likely to work in wage employment than those in households that did not have an adult death.

Figure 10: Percent of adults over 50 who farmed in the past 7 days during the first and last pass, in households with and without an adult death

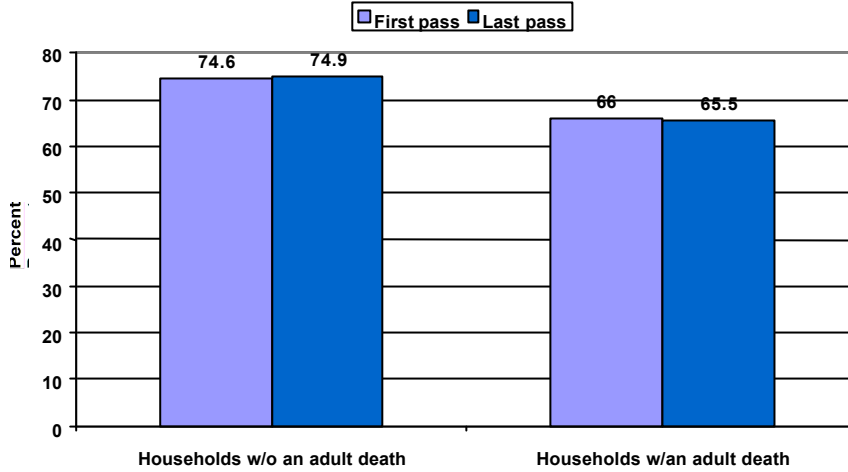
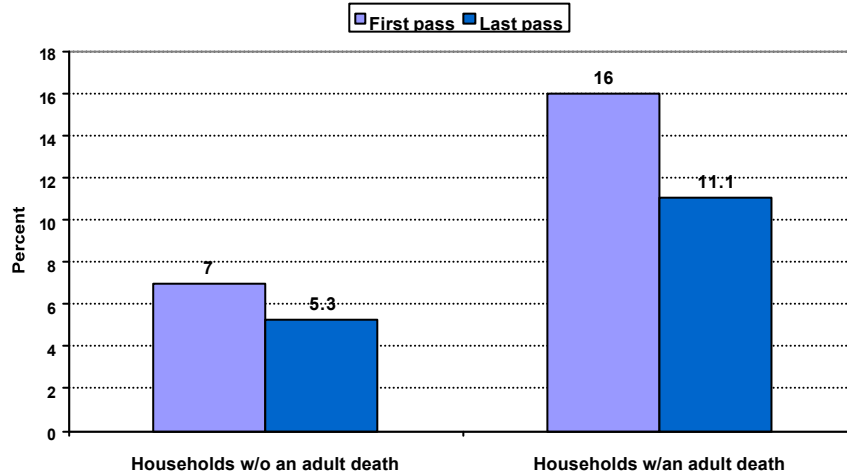


Figure 11: Percent of adults over 50 who had wage employment in the past 7 days during the first and last pass, in households with and without an adult death



IV. The impact of adult deaths on the physical well-being of the elderly

Economic theory suggests that individuals seek to maximize their health status, subject to the constraints imposed by their budget, their time and their genetic endowment. To achieve the best health, an individual makes use of several kinds of inputs, such as food for nutrition, medical care for prevention and treatment of illness and clean water to prevent disease. People decide how much of these inputs to consume, based on their own preferences, their income, and the price, quality and availability of these inputs—for example, the availability and price of food and medical care or the proximity of potable water

and good roads. In this section, we first review the literature from developing countries on the determinants of BMI and mortality in adults and, where available, the elderly. This body of literature is small, as most research on the determinants of health status in developing countries has focused on children, and relatively little is understood about the patterns and factors that affect the health status of adults or the elderly.

The determinants of adult BMI and elderly mortality

Studies have found that BMI declines with age in Indonesia (Frankenberg, Thomas and Beegle 1999) and that adult women in Côte d'Ivoire had higher BMI values than men, controlling for other factors (Thomas, Lavy and Strauss 1996). Household wealth and income should be associated with better health, as those with more resources can afford more and better-quality health services. In Côte d'Ivoire and Ghana, higher per capita household expenditures were associated with higher BMI in adults 20-60 and adult women 20 and older, respectively (Thomas, Lavy and Strauss 1996, Alderman 1992). In Indonesia, an increase in per capita income between 1997 and 1998 was associated with an increase in BMI for women, but not for men (Frankenberg, Thomas and Beegle 1999). In Bangladesh, greater household assets (number of rooms in the dwelling, and ownership of a cow) were associated with a reduced mortality risk among elderly women (Rahman, Foster and Menken 1992). In the other study of mortality among the elderly in Bangladesh, having at least one household asset (cow, boat, watch or quilt) at the beginning of the survey was associated with lower mortality among both men and women, as compared with those having none of these assets (Rahman 1999).

Education is expected to improve health outcomes and BMI because it is associated with higher wages and higher incomes, better access to knowledge about the use of health inputs, and a better ability to transform those health inputs into good outcomes. The few studies that have looked at the impact of education, while controlling for wealth, have mixed results: in Ghana, additional education was associated with higher BMI among women over 20, while in Côte d'Ivoire, among men and women 20-60, it did not (Alderman 1992, Thomas, Lavy and Strauss 1996).

The relationship between the elderly person and the head of the household is also potentially important if we believe that the head of the household has greater access to household resources and is the most important decision-maker. The study by Rahman (1999), using longitudinal data from Matlab, Bangladesh, found that the head of the household or the spouse of the head had lower mortality, even after controlling for disability status, the presence of spouses and sons and household resources. The effect of being the household head declined with age and became insignificant after age 75. The presence

of one or more adult sons in the household was associated with reduced mortality for elderly women but not for elderly men (Rahman 1999). Elderly Bangladeshi widows in rural households that they do not head are at increased risk of mortality, compared with married women and widows who are heads of household (Rahman, Foster and Menken 1992). However, household size had no relationship to BMI for men or women in the Indonesian sample of adults aged 20-69 (Frankenberg, Thomas and Beegle 1999).

Community and policy variables have also been shown to affect adult BMI, although there is no evidence from samples of the elderly. We expect higher food prices to reduce food intake or the quality of food purchased and higher price of medical care to reduce its use, both reducing BMI. Higher food prices were associated with a lower BMI of adults aged 20-60 in Côte d'Ivoire, and these effects were greatest for those living in rural areas (Thomas, Lavy and Strauss 1996). However, the availability and quality of health services in the community had no effect (individually or jointly) on the BMI of adults. There appear to be additional regional differences, even after controlling for community characteristics. In the sample of men and women in Cote d'Ivoire, and of women in Ghana, those living in urban areas were found to have significantly higher BMI than those living in rural areas (Alderman 1992). In Indonesia, decreases in BMI were particularly likely for women (but not for men) living in Central Java (Frankenberg, Thomas and Beegle 1999).

The impact of a recent prime-aged adult death on BMI

The illness and death of a prime-aged adult can affect the health status or physical well-being of the elderly by causing a reduction in household income, the direct and indirect health effects of coping behaviours, and by raising the exposure of the elderly to disease vectors in the household. The burden of additional work (market work, housework or caregiving) could contribute to a decline in health status. In the face of tight financial constraints caused by an adult illness, the elderly may also consume less medical care or food so that more can be spent on the patient. In Thailand, Knodel et al. (2000) found that elderly parents were the main source of finance for medical care for 60% of the AIDS patients who lived with their parents while ill, for 40% of the AIDS patients who lived adjacent to their parents and for about 25% of the AIDS patients whose parents lived elsewhere. The loss of remittance income from adult children who die could result in lower health status.

Analysis of the impact of prime-aged adult deaths on BMI among the elderly is complicated by the fact that households of different economic status are not equally likely to experience AIDS-related deaths. A review of the literature of the socioeconomic correlates of HIV infection in eastern and central Africa from the late 1980s and early 1990s reveals a consistent pattern: adults with greater wealth and schooling

in more skilled jobs are more likely to be infected with HIV (Ainsworth and Semali 1998, World Bank 1999). The same has been found in the Kagera data with respect to AIDS mortality: those most likely to die of AIDS had more schooling and non-farm occupations (Ainsworth and Semali 1998). This positive correlation between HIV infection and economic status is, in fact, a reversal of the normal relationship between income and health—the wealthy and more educated generally have better health and higher life expectancy than the poor and less-educated (World Bank 1993). As a result, on average, initial health conditions in households that eventually suffer a prime-aged adult death may be better than in households not experiencing these deaths. For example, in the Kagera data, young children in households that eventually had a prime-aged adult death were less likely to be nutritionally stunted before the death occurred than were children in households that did not experience a prime-aged death (Ainsworth and Semali 2000). The descriptive statistics on the coping abilities of the elderly in Kagera are already suggestive of this pattern: the elderly in households that had a death during the panel were less likely to be farmers, less likely to engage in housework, and more likely to participate in wage-employment than elderly in households that did not have a death during the survey.

Thus, it is not surprising that, in our sample, the elderly living in households that experienced a prime-aged death during the panel initially had a higher BMI (20.92) than those living in households that did not have a death (20.27), although this difference is not statistically significant (see Figure 12). While BMI improves over the survey period for both groups, the increase is greater for the elderly in households with an adult death. The difference in mean BMI between adults in the two groups in wave four is statistically significant ($p=.01$). This suggests that the BMI of the elderly in households with a sick adult (which are initially better off) might be worsened during the illness and recover after a death.

This is demonstrated more clearly in Figure 13, which shows the share of the elderly in households with and without a death who had a low BMI (lower than 18.5). Among those in households that had a death during the panel, 28.3% had a low BMI before the death (compared with 30.2% of the elderly in households without a death) and this share decreases to 18.2% after the death (compared with 28.9% of the elderly in household without a death). Since better health status is associated with greater economic status, these patterns are further evidence that households with a prime-aged death had a higher economic status than households without one.

Figure 12: Mean BMI among adults over 50 during the first and last pass, households with and without an adult death during the panel

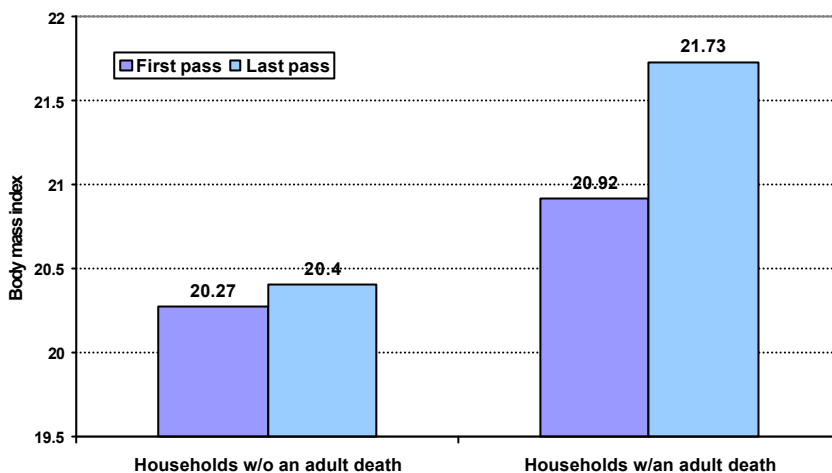
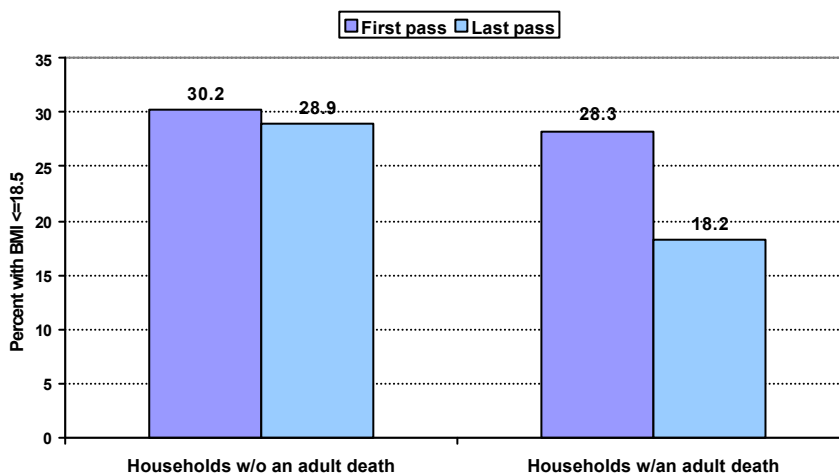


Figure 13: Percent of adults over 50 with low BMI during the first and last pass, in households with and without an adult death during the panel



These summary statistics suggest that, in order to measure the impact of a prime-aged death on a welfare outcome such as BMI, it will be very important to disentangle the impact of the death from the other economic factors that can affect BMI, using multivariate techniques. Unless these economic factors are taken into consideration, a researcher might erroneously conclude that a prime-aged death improves the

physical well-being of the elderly, when it may, in fact, be worsening the well-being of the elderly in households with more resources¹².

Multivariate analysis of the determinants of BMI among the elderly

Policy-makers interested in improving the welfare of the elderly need to understand the characteristics of the elderly at greatest risk of low BMI and the extent to which these outcomes are affected by heightened morbidity and mortality of prime-aged adults due to the AIDS epidemic. To examine this issue, we ran multiple regressions of the determinants of the BMI of all persons over 50 ever observed in the KHDS dataset over four survey waves, including individuals in households observed less than four times¹³. The explanatory variables included:

- individual demographic characteristics (sex, age, whether widowed, relation to the head of the household);
- years of completed schooling;
- household wealth (quality of housing, value of durable goods, amount of land owned);
- household composition (the number of children and teenagers, co-residence of a prime-aged adult);
- dummy variable for whether the household experienced the death of an adult aged 15-50 in the past six-to-seven months, alone and interacted with household assets;
- community health factors (adult mortality rate, recent epidemic);
- community infrastructure (whether the road is passable all year, proximity of a health facility, availability of antibiotics and number of doctors at the nearest health facility);
- urban and regional dummy variables and controls for the month of the year.

The results of the regression analysis find that the most important determinant of higher BMI among the elderly is the household's economic status. Controlling for these economic factors, neither a recent adult death (in the six months before the interview) or a future prime-aged adult death in the household (in the six months following the interview) were significantly associated with a decline in BMI among those over 50 years of age. However, in some specifications, the regression results indicated that the elderly living in

¹² The availability of longitudinal data is particularly helpful in disentangling these relationships, as it is possible to observe measurements on the same individual before and after the death.

¹³ Results are from reduced-form random and fixed-effects regressions of individual demographic characteristics, household assets, household composition, community characteristics, recent and future deaths, and interactions between deaths and assets,

better-off households (those with relatively more assets) suffered a decline in BMI following the death of an adult, while in poorer households (in which the BMI of the elderly is already lower) BMI was unaffected. The BMI of the elderly was not affected by the 1991 adult mortality rate in the community, but it was consistently lower (-.13 points) in communities that reported an epidemic in the last six months and this result was statistically significant. The elderly living in urban areas had a higher BMI by about one index point, compared to the elderly in Bukoba rural district, and the elderly living in rural Ngara had the lowest BMI of any of the six districts of Kagera.

A number of variables which have been hypothesized in the literature to affect the well-being of the elderly had no significant relation with BMI. Contrary to expectations, respondents in households with more young children (0-6), more teenagers (7-14) or who were themselves widowed did not have significantly lower BMI. Respondents who were heads of household or the parent of the head did not have significantly higher BMI. Female respondents generally had higher BMI than male respondents, but this difference was not always statistically significant. The only age group for which BMI was consistently and sometimes significantly lower were adults aged 75 and older. The respondent's schooling did not have a significant relation with BMI, although it must be noted that the level of schooling in the sample was quite low and the respondents were schooled many decades earlier. These results were not affected by dropping the controls for household wealth.

The regressions also revealed important results on the impact or *lack of impact* of public infrastructure on the health of the elderly. To the extent that illness reduces BMI, one would have expected that the proximity of health care might reduce morbidity spells and thus raise BMI. Contrary to expectations, there was no significant relation between the BMI of the elderly and the proximity of a health facility. Nor was BMI affected by the measures of health care quality—the availability of antibiotics on the day of the interview and the number of doctors. The reasons why better quality care is not benefiting the elderly deserve closer investigation.

However, the BMI of the elderly was found to be *highly* sensitive to the quality of the road infrastructure in all specifications and econometric models. Controlling for all of the other variables in the regressions, BMI of the elderly is lower by about one index point in communities where the road is completely impassable during certain times of the year. The impact of poor road infrastructure on elderly women is substantially greater (about 1.3 index points lower) than on elderly men (about 0.8 index points lower),

on the elderly respondent's BMI. Our sample for the regressions is 2246 observations of 697 persons over 50 years of age

compared to communities where the road is passable all year long. This suggests that the elderly benefit from the mobility that provides better access to goods and services that contribute to health, such as medical care and food. These results might partly explain the lack of impact of proximity to a health facility: in communities where the road is impassable, the distance to a health facility and its quality are irrelevant¹⁴. At the time of the KHDS fieldwork in 1991-94, the quality of the road infrastructure in Kagera was extremely poor and was a constant challenge to the survey teams¹⁵.

These results on BMI of the elderly are highly consistent with results of previous work on low weight for height (wasting) of children under five in the KHDS data (Ainsworth and Semali 2000): there was no significant relation between orphan status or recent adult deaths and children's weight for height, but children in non-poor households weighed significantly more (were less wasted) and those in communities with an impassable road for part of the year weighed significantly less (were more wasted), controlling for individual, household, and community characteristics. Both adult BMI and children's weight for height are measures of acute malnutrition. Previous research on this dataset also revealed that households with an adult death, on average, cut back on their non-food expenditure to finance a higher share of expenditure on health care and funerals, while preserving the share of household consumption expenditure on food (World Bank 1999). Among poor households, however, food consumption per adult equivalent declines, whereas among non-poor households per-adult food consumption rises after an adult death.

V. Summary and policy implications

Policy-makers are concerned that the elderly are particularly affected by the high mortality of prime-aged adults brought on by the AIDS epidemic and, to date, there are few quantitative studies that look at these effects. The impacts and mechanisms thought to be important are: an increased share of households composed only of the elderly and children and an increased burden of care of young children among the elderly; increased time spent caring for sick household members; a greater burden of housework and farm work among the elderly to compensate for the lost labour of the AIDS patient; and reduced resources for food for household members other than the patient. To the extent that these coping mechanisms are unsuccessful in completely mitigating the impact of prime-aged adult AIDS cases in the household or that

followed for at least one and as many as four waves.

¹⁴ Better infrastructure facilitates mobility and, in doing so, improves economic opportunities but puts people at greater risk of HIV. Yet this result on the impact of passable roads on the BMI of the elderly is an important reminder that, for many, and especially the poor, the lack of basic road infrastructure is a major impediment to improved health outcomes.

¹⁵ Personal observation (Ainsworth). The 100 km road between Bukoba town and the Ugandan border, for example, could take five hours or more to travel during the rainy season and then was sometimes completely cut off.

they constitute an excess burden for the elderly, the physical well-being of the elderly could be expected to decline.

In this paper, we examine these hypotheses with longitudinal data from 1991 to 1994 in the Kagera region of Tanzania. At that time, HIV infection rates were roughly 25% among adults in the main town, Bukoba, 10% in the surrounding rural areas, and ranged from 5% to less than 1% in the rest of the region. The adult mortality rate had already dramatically increased, since AIDS was first detected in the region in the early 1980s. The household survey we used collected detailed socioeconomic data on individuals and households and, in addition, measured the height and weight of every respondent. Households thought to be at high risk of AIDS deaths were over-sampled. This allowed us to analyse the impact of adult deaths occurring from six months before the first interview until the end of the fourth wave of data collection on the body mass index (BMI)—a measure of the physical well-being—of household members over the age of 50. These data provide some important advantages in addressing this issue: a relatively large sample size of the elderly; the ability to analyse well-being both before and after a prime-aged adult death in the household; and, perhaps most important, a control group of elderly in households that did not have a prime-aged adult death.

Many of our findings challenge the conventional view about the average impact of AIDS on the coping abilities and physical well-being of the elderly. The share of households composed only of elderly and children was relatively small—about 5%—even in this sample that over-sampled hard-hit households, and the share of this household type among poor households (4.2%) is actually less than that for non-poor households (6.6%), though not statistically significant. The participation rate of the elderly in farm work and in caring for sick household members remained relatively constant before and after adult deaths, although their participation in household chores increased. The participation rate in wage employment, which was higher among the elderly in households with prime-aged adult deaths, declined after the death. Prime-aged adult deaths had no impact on the BMI of the elderly in those households, compared to households without a prime-aged death. The elderly in households with larger numbers of children did not have lower BMI than other elderly, nor did the elderly who were widowed. In light of evidence that the elderly in households suffering an adult death were, on average, somewhat better-off before the death than the elderly in households without an adult death, the analysis has emphasized the importance of controlling for household wealth prior to a prime-aged adult death, in analysing the impact of AIDS mortality on surviving household members.

The most vulnerable elderly in terms of low BMI are those in the poorest households and, in particular, those in communities cut off from health and other important services by the poor road network. The BMI of the elderly in communities where the road was impassable during part of the year was one point lower than that in communities with year-round access. A similar result was found for the wasting (low weight for height) of children under five in the same households (Ainsworth and Semali 2000). Improving the quality of the roads would improve the access of the elderly with the lowest BMI to better health services and their households to more economic opportunity, both of which should raise BMI. It would help the elderly in greatest need, including those whose households have an adult death and live in these communities.

These results reaffirm the enduring ability of the extended family network, supported by high fertility, to cope with numerous adverse shocks, both at the household and community level, in societies in which mortality has traditionally been high for all age groups, even before the AIDS epidemic. Our results, which show no reduction in BMI for the 'average' elderly person in households with adult deaths, do not necessarily contradict the findings of in-depth studies of the impact of AIDS mortality on smaller samples of the surviving elderly. These impacts have been documented and are severe for some. Such studies are important in generating information on the nature of the impacts and the constraints that affected households face. However, it is difficult to establish how typical and pervasive the impacts are, and the correct policy response without a control group of households without a death or a more representative sample. This is particularly important to establish in low-income countries, like Tanzania, where the AIDS epidemic is superimposed on a population with a high level of poverty, most of it *not* related to the AIDS epidemic. In such settings, policy-makers need to be concerned with policies to raise the welfare of those with the lowest levels of well-being and to prevent the spread of HIV/AIDS.

Our findings highlight the fact that, sometimes, to improve health-related outcomes we must turn to solutions outside the health sector. The findings also suggest the need for caution against seeking 'packaged' solutions for mitigating the impact of AIDS in hard-hit African countries. Not all countries or regions of countries are subject to the same poor quality of the road infrastructure as was the case in Kagera in the early 1990s. The policy implications for improving the well-being of the elderly in countries hard-hit by the AIDS epidemic will depend very critically on the existing infrastructure and levels of welfare in the population. However, in many cases, the policy likely to have the greatest impact on welfare outcomes will be one that is not necessarily focused on households or communities with AIDS mortality, but rather on the poorest segments of the population.

References

- Ainsworth M et al 1992. "Measuring the impact of fatal adult illness in sub-Saharan Africa: an annotated household questionnaire." *LSMS Working Paper* no. 90. Washington, DC, World Bank.
- Ainsworth M and Semali I. 1995. "The impact of adult deaths on household composition." World Bank and Muhimbili University College of Health Sciences. Draft.
- Ainsworth M. 1996. "Economic aspects of child fostering in Côte d'Ivoire." *Research in Population Economics* 8:56-62.
- Ainsworth M and Semali I. 1998. "Who is most likely to die of AIDS? Socioeconomic correlates of adult deaths in Kagera Region, Tanzania", in M. Ainsworth, L. Fransen and M. Over, *Confronting AIDS: Evidence from the developing world*. Brussels: European Commission.
- Ainsworth M, Filmer D and Semali I. 1998. "The impact of AIDS mortality on individual fertility: evidence from Tanzania", in M. Montgomery and B. Cohen, eds. *From Death to Birth: Mortality Decline and Reproductive Change*. Washington, DC: National Research Council.
- Ainsworth M and Semali I. 2000. "The impact of adult deaths on children's health in Northwestern Tanzania." *Policy Research Working Paper* no. 2266. Development Research Group, World Bank, Washington, DC.
- Ainsworth M and Teokul W. 2000. "Breaking the silence: Setting realistic priorities for AIDS control in less-developed countries." *Lancet* 356:55-60.
- Ainsworth M, Beegle K and Koda G. 2000. "The impact of adult mortality on primary school enrolment in Northwestern Tanzania." Background paper for the African Development Forum 2000. Draft, September 30.
- Alderman H. 1990 "Nutritional Status in Ghana and its determinants." *Social Dimensions of Adjustment Working Paper*, 3. Washington, DC: The World Bank.
- Barnett T and Blaikie P. 1992. *AIDS in Africa: its present and future impact*. London: Belhaven Press.
- Beegle Kathleen. 1998. "The impact of adult mortality on households: evidence from rural Tanzania." Santa Monica, CA: RAND Corporation. Draft manuscript.
- Boerma J, Andrew T, Nunn J and Whitworth JAG. 1998. "Mortality impact of the AIDS epidemic: evidence from community studies in less-developed countries." *AIDS* 12(suppl 1): S3-S14.
- Dayton Julia. 1999. "Does parental morbidity affect child health status? Evidence from Kagera, Tanzania." Unpublished PhD dissertation. School of Public Health, Yale University, New Haven, USA.
- Frankenberg E, Thomas D and Beegle K. 1999. "The real costs of Indonesia's economic crisis: Preliminary findings from the Indonesia Family Life Surveys." Santa Monica, CA, RAND Corporation.
- Garcia M and Kennedy E. 1994. "Assessing the linkages between low body mass index and morbidity in adults: evidence from four developing countries." *European Journal of Clinical Nutrition* 48(Suppl 3): S90-6.

- Higgins P and Alderman H. 1992. "Labor and women's nutrition: a study of energy expenditure, fertility, and nutritional status in Ghana." Washington, DC, World Bank.
- Hunter S and Williamson J. 1998. *Children on the brink: strategies to support a generation isolated by HIV/AIDS*. Washington, DC: US Agency for International Development.
- Immink MD, Flores R et al. 1992. "Body mass index, body composition and the chronic energy deficiency classification of rural adult populations in Guatemala." *European Journal of Clinical Nutrition* 46(6): 419-27.
- Isiugo-Abanihe UC. 1985. "Child fosterage in West Africa." *Population and Development Review* 11(1): 53-73.
- James WPT, Ferro-Luzzi A and Waterlow JC. 1988, "Definition of chronic energy deficiency in adults: report of a working party of the International Dietary Energy Consultative Group." *European Journal of Clinical Nutrition* 42:969-981.
- Killewo J, Nyamuryekunge K et al. 1990. "Prevalence of HIV-1 infection in the Kagera region of Tanzania: a population-based study." *AIDS* 4(11): 1081-5.
- Killewo JZ, Sandstrom A et al. 1993. "Incidence of HIV-1 infection among adults in the Kagera region of Tanzania." *International Journal of Epidemiology* 22(3): 528-536.
- Killewo J, Dahlgren L and Sandstrom A. 1994. "Socio-geographical patterns of HIV-1 transmission in Kagera Region, Tanzania." *Social Science and Medicine* 38(1): 129-34.
- Knodel JC, Saengtienchai C, Im-em W and Van Landingham M. 2000. "The impact of Thailand's AIDS epidemic on older persons: quantitative evidence from a survey of key informants." Research Report No. 00-448 Population Studies Center, Institute for Social Research, University of Michigan.
- Kwesigabo G, Killewo JZ et al. 1998. "Decline in the prevalence of HIV-1 infection in young women in the Kagera region of Tanzania." *Journal of Acquired Immune Deficiency Syndrome and Human Retrovirology* 17(3): 262-8.
- Kwesigabo G, Killewo JZ et al. 1999. "Prevalence of HIV infection among hospital patients in north west Tanzania." *AIDS Care* 11(1): 87-93.
- Kwesigabo G, Killewo JZ et al. 2000. "Monitoring of HIV-1 infection prevalence and trends in the general population using pregnant women as a sentinel population: 9 years experience from the Kagera region of Tanzania." *Journal of Acquired Immune Deficiency Syndrome* 23(5): 410-7.
- Lundberg M, Over M and Mujinja P. 2000. "Sources of financial assistance for households suffering an adult death in Kagera, Tanzania." Background paper for the 2000 African Development Forum. Draft, September.
- Merrill SS, Seeman TE et al. 1997. "Gender differences in the comparison of self-reported disability and performance measures." *Journal of Gerontology. Series A, Biological Sciences & Medical Sciences* 52(1): M19-26.
- National Research Council. 1996. *Preventing and mitigating AIDS in sub-Saharan Africa: research and data priorities for the social and behavioral sciences*. Washington, DC: National Academy Press.

Nunn AJ et al. 1997. "Mortality associated with HIV-1 infection over 5 years in a rural Ugandan population: cohort study." *British Medical Journal* 315: 767-771.

Ntozi JPM and Nakayama. 1999. "AIDS in Uganda: How has the household coped with the epidemic?" In IO Orubuloye, JC Caldwell, JPN Ntozi, eds., *The Continuing HIV/AIDS Epidemic in Africa: Responses and Coping Strategies*. Canberra: Health Transition Centre, National Centre for Epidemiology and Population Health, Australian National University,

Over M and Ainsworth M. 1989. "The economic impact of adult deaths due to AIDS and other causes in sub-Saharan Africa." Research proposal. Development Research Department and Africa Technical Department, World Bank, Washington, DC. Mimeo.

Page H. 1986. "Child-bearing versus child-rearing: Co-residence of mothers and children in sub-Saharan Africa." Interuniversity Programme in Demography, IPD Working Paper, no.1986-2. Paper presented at the Annual Meeting of the Population Association of America, April.

Rahman MO. 1999. "Age and gender variation in the impact of household structure on elderly mortality." *International Journal of Epidemiology* 28(3): 485-91.

Rahman O, Foster A and Menken J. 1992. "Older widow mortality in rural Bangladesh." *Social Science & Medicine* 34(1): 89-96.

Rahman O, Strauss J et al. 1994. "Gender differences in adult health: an international comparison." *Gerontologist* 34(4): 463-9.

Strauss J. 1986. Does better nutrition raise farm productivity? *Journal of Political Economy* 94(2):297-320.

Strauss J, Gertler P et al. 1993. "Gender and life-style differentials in the patterns and determinants of adult health." *Journal of Human Resources* 28(4): 791-837.

Strauss J and Thomas D. 1998. "Health, nutrition and economic development." *Journal of economic literature* 36: 766-817

Thomas D, Lavy V and Strauss J. 1996. "Public policy and anthropometric outcomes in the Côte d'Ivoire." *Journal of Public Economics* 61:155-192

Turner HA, Catania JA and Gagnon J. 1994. "The prevalence of informal caregiving to persons with AIDS in the United States: caregiving characteristics and their implications." *Social Science and Medicine* 38(11):1543-52.

UNAIDS. 2000. *Report on the global HIV/AIDS epidemic*. Geneva. June.

Waalder H. 1984. "Height, weight and mortality: the Norwegian experience." *Acta Medica Scandinavica*, supplement no. 679.

World Bank. 1993. *World Development Report 1993: Investing in Health*. New York: Oxford University Press.

World Bank. 1999. *Confronting AIDS: Public priorities in a global epidemic*. Revised edition. New York: Oxford University Press.

World Bank. 2000a. *World Development Indicators 2000*. Washington, DC.

World Bank. 2000b. *Intensifying action against HIV/AIDS in Africa*. Africa Region. Washington, DC.

World Health Organization Expert Committee. 1995. "Physical status: the use and interpretation of anthropometry." *WHO Technical Report Series*, no. 854. Geneva.