

**Grandmothers' Productivity and the HIV/AIDS Pandemic in
Sub-Saharan Africa**

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ABSTRACT

The HIV/AIDS pandemic has left large numbers of orphans in sub-Saharan Africa. Botswana has an HIV prevalence rate of approximately 40% in adults. Morbidity and mortality are high, and in a population of a 1.3 million there are nearly 50,000 children who have lost one or both parents to HIV/AIDS. The extended family, particularly grandparents, absorbs much of the childrearing responsibilities. This creates large amounts of additional work for grandmothers especially. The Embodied Capital Model and the Grandmother Hypothesis are both derived from life history theory within evolutionary ecology, and both predict that one important factor in the evolution of the human extended family structure is that post-reproductive individuals such as grandmothers provide substantial support to their grandchildren's survival. Data collected in the pre-pandemic context in a traditional multi-ethnic community in the Okavango Delta of Botswana are analyzed to calculate the amount of work effort provided to a household by women of different ages. Results show that the contributions of older and younger women to the household in term of both productivity and childrearing are qualitatively and quantitatively different. These results indicate that it is unrealistic to expect older women to be able to compensate for the loss of a younger women's contributions to the household, and that interventions be specifically designed to support older women based on the type of activities in which they engage that affect child survival, growth, and development.

KEY WORDS: HIV/AIDS, children, grandparenting, Africa, biodemography

INTRODUCTION

AIDS demography and orphans in sub-Saharan Africa

The vast majority of the world's cases of AIDS and instances of HIV infection are in sub-Saharan Africa (Shetty and Powell 2003). Botswana is now recognized as having the highest rate of HIV prevalence in the world, yet the epidemic is only in its early stages there (NACA 2004). Morbidity and mortality rates are highest in the ages between 20 and 45 for both men and women in sub-Saharan Africa (UNAIDS 2005). In communities affected by HIV/AIDS, whether in Africa or in minority communities in the United States, children pay an enormous cost in the loss of family members and the resultant loss of support and investment; too often the children are themselves HIV infected (Andrew et al. 2006). Many times, grandparents or other members of extended families take on the parenting responsibilities for children orphaned by AIDS or whose parents are too sick to parent them (Ntozi 1997, Williams and Tumwekwase 2001, Monasch and Boerma 2004).

Children losing one or both parents as a result of HIV/AIDS often face deficits in health care, food security, education, and caretaking that causes delays and/or disruptions to growth and developmental trajectories. In Zaire, children who lost their mothers faced early weaning, poor adult supervision, and a far lower rate of access to health care than children with two living parents (Andrew et al. 2006). These factors have direct and indirect effects that will dramatically slow the growth of affected children. Moreover, Andrew and colleagues (2006) assert that the stigma by association with HIV/AIDS has an additional significant negative consequence for access to health care. In rural Kenya losing a parent significantly impacts weight for height Z-scores (WHZ) for children under six years old (Lindblade et al. 2003). While these children may catch-up in weight over time, there is evidence that undernutrition in early childhood can have serious consequences for neurological and cognitive development even after apparent catch-up growth (Institute of Medicine 2000).

Often, the extended family is seen as vehicle for serving not only the physical and nutritional needs of children but also for providing education and inculcation in traditional culture, skills, and knowledge (Ankrah 1993, Freeman and Nkomo 2006). With the loss of a parent, economic and social roles are either provided by the extended family, especially grandmothers, or attempted by children who have not had the

necessary training or development to successfully substitute for lost parents (Freeman and Nkomo 2006). Community support in conjunction with extended family has often been highlighted as the most likely way to ensure the health and survival of orphans (Shetty and Powell 2003). This has led to programs that employ community workers to act as liaisons between HIV/AIDS impacted individuals and societal resources (Zachariah et al. 2006). Because many systems of assistance and reciprocity are culturally-specific, such a program developed in one community may not necessarily function well in another environment. This highlights the necessity to develop culturally-specific and appropriate intervention models.

The elderly often face enormous pressure in the context of the HIV/AIDS epidemic in sub-Saharan Africa. They may be caring for their ill adult children, making up productivity deficits due to AIDS related morbidity and/or mortality, and they may be acting as alloparents for large numbers of grandchildren (Knodel et al. 2003, Nyambedha et al. 2003, Zimmer and Dayton 2005). As sub-Saharan African populations age, it will also become more common for elderly people to be HIV seropositive themselves, and possibly face heightened morbidity and mortality as they struggle with these responsibilities.

Life History Theory and the productivity of older women

The Grandmother Hypothesis is an interpretation of human life history evolution proposed by Hawkes and colleagues (1998). This model emphasizes the contribution of grandmothers to their daughters' reproduction as a selective force on female reproductive senescence (menopause). The Embodied Capital Model (Kaplan and Bock 2001b) generates a similar hypothesis as part of its more comprehensive view of simultaneous selection on human life history traits. Because human offspring develop slowly compared to other primates, the period of dependence on mother is long. In hunting and gathering societies, the loss of a mother before substantial independence in foraging is likely to lead to the child's death as well (Hill and Hurtado 1996). This leads us to believe that in our evolutionary past this may have been the case owing to similarities between the lifestyles of contemporary hunter-gatherer peoples and Pleistocene people (Hill and Hurtado 1996). Since the effect of losing a mother was so profound, and because the period of dependence was so long, there was strong selection on women not to reproduce towards the latter parts of their lives but to divert those

resources to adult children to foster their own reproduction. According to the Grandmother Hypothesis the payoff in genetic fitness would on average be higher by diverting resources to grandchildren rather than using those resources for late life reproduction. The Embodied Capital Model does not predict that this alone would select for an extended female post-reproductive span, but rather is part of a suite of coevolved characteristics including extended juvenility, food sharing, male support of female reproduction, and long lifespan (Kaplan et al. 2000). Although these models differ in the many important respects, there is overlap in their recognition that grandmothers' provisioning of grandchildren has been an important element of the evolution of the human family. We expect that there will be a great deal of variability in the level and form of grandmothers' productivity based on features of the local subsistence ecology and family demography (Jamison et al. 2002, Lahdenpera et al. 2004, Leonetti et al. 2005). In the environment of endemic HIV/AIDS can older women compensate for the loss of labor from their adult daughters?

Amassing resources for reproduction is rarely the exclusive responsibility of a nuclear household, although it is the popular misconception. Sarah Hrdy (2005) suggests that one of the key characteristics that allowed early humans to migrate out across the globe was the flexibility of cooperative breeding. The terms alloparent, allomother, or allomaternal caretaker are used to describe individuals such as father, older siblings, grandparents, uncles, and aunts who provide care and resources to offspring. Earlier child bearing may be related to the availability of multiple family caretakers, an option unavailable to individuals living away from family (Hrdy 1999). In addition to providing resources, the presence of many allomaternal assistants may provide the appropriate social cues to potential mothers that they will receive the support required for reproduction (Hames and Draper 2004, Hrdy 2005, Kramer 2005). Hrdy (2005) suggests that mothers may also be able to lower investment per child and shorten birth spacing in response to allomaternal assistance without compromising child survival. It seems that different measures of child outcome may be more or less sensitive to care received across multiple individuals in a cooperative network. However, the presence of allomaternal caregivers should function to reduce the age at first reproduction. It is common in northern Botswana, as it is in much of Africa, for allocare to occur in the context of child fostering (Pennington 1990). In parts

of Africa, the cultural practice of child fostering is increasingly utilized as a response to heightened needs for allocare in the context of endemic HIV/AIDS, and this increased utilization can stress the relationships underlying the system (Madhavan 2004).

In environments where adult mortality is high there is increasing payoff to earlier reproduction since if an individual delays reproducing there is an increased chance of dying prior to reproducing. In addition, in a high child mortality context we would expect investment in offspring to be channeled into producing large numbers rather than high quality (Hill and Hurtado 1996). This means that, according to life history theory, the mortality profile associated with the HIV/AIDS epidemic would be expected to lead to an earlier age at first reproduction and investment in large numbers of offspring with limited investment in their skills and knowledge. If there has been strong selection for older women to channel their energy into their adult children's reproduction, we should see those resources used for earlier reproduction by an older woman's children and to increase the number of grandchildren without respect to their acquisition of skills and knowledge. A first step in examining these hypotheses is to establish baseline levels of contributions of older women in the household. By comparing the productivity profile of older women in the baseline context, we have an idea of the role of older women in the reproduction of their own children and in the provisioning and training of their grandchildren.

SUBJECTS AND METHODS

The study community

Data were collected in a multi-ethnic community of approximately 400 people in the Okavango Delta of northwestern Botswana (for detailed description of the study community see Bock 1995, 1998; Bock and Johnson 2002a). Several aspects of social and economic organization in this remote rural community made it particularly suited for a study of time allocation and the productivity of women. Historically there have been very low levels of market incorporation. As a result, until recently there was little cash economy within the community and almost all residents were deeply involved in traditional economic pursuits such as farming, foraging, fishing, and herding. Men who had migrated for labor purposes, however, were able to remit cash to family members residing in the study community. Today, the cash economy is confined to a relatively small number of residents who work for the schools or other government agencies,

receive drought relief, are street vendors, or have surplus crops to sell. This cash influx distinguishes recipients from those without access to cash through the ability to purchase food and other supplies and thus buffer themselves from cyclical perturbations due to variation in rainfall which heavily impact traditional economic activities such as foraging, farming, fishing, and herding. The low level of market incorporation and cash-based economic activities also made it possible to acquire accurate measures of household productivity.

Lastly, the community was extremely diverse with regard to traditional economic pursuits. Community members engaged in a wide variety of activities ranging from foraging and fishing to farming to herding, or some combination thereof. The economic diversity meant that adults' time allocation could be examined across a number of traditional economic pursuits. In this time and place where there was limited market incorporation and integration into external social, cultural, political, and economic institutions, traditional roles were strong and uninterrupted. Owing to the limited influence of formal education and other external forces on labor roles, productivity, and the structure of the household economy the relationship between the productive roles of different age classes can be viewed with clarity.

Five ethnic groups are represented: Hambukushu, Dceriku, Wayeyi, ||anikhoe, and Bugakhoe (see Bock and Johnson 2002a, 2002b for a complete ethnographic description). Hambukushu, Dceriku, and Wayeyi people are Bantus who inhabit the Okavango River drainage from Angola through the Caprivi Strip of Namibia into northern Botswana. Historically, they have participated in mixed economies of farming; fishing, hunting, and the collection of wild plant foods; and pastoralism. ||anikhoe and Bugakhoe people are San speakers who inhabit the Okavango drainage in Namibia and Botswana. ||anikhoe have historically had a riverine orientation in their foraging, while Bugakhoe have been savanna foragers. The ||anikhoe living in the study community practice a mixed economy, but farm at a much less intensive level than the Bantus. Moreover, among 50 ||anikhoe there are only four head of cattle, whereas a typical Bantu homestead of 20 people has an average of 12 head. Bugakhoe in this community are largely oriented towards fishing, hunting, and the collection of wild plant foods. None own cattle, and their agricultural fields are very small.

Mongongo nuts and grain are two foods that women produce, collect, and process are centrally important nutritionally and socially. Mongongo nuts are a highly nutritious (Lee 1979, Ohiokpehai 2003) nut that has been a major food source for San speaking peoples and others in southern Africa. Not only is the nut important for subsistence, the collection and processing of nuts is a key source of social interaction among women (Lee 1979, Draper and Cashdan 1988). The mongongo nut has a fruity pith covering an extremely hard shell. This shell, once cracked yields a smaller shell, which also must be cracked, revealing the nut meat. The outer fruit portion is usually removed by boiling or steaming it until soft, and then sucking on the nut. The outer shell must be cracked with care, since it is important that the inner shell remain intact. That way, the nut can be preserved for very long periods of time. If the inner shell is cracked the nut must be consumed quickly.

The staple grain crop in this community is a variety of dry farmed millet called *mahongo* in *Thimbukushu*, a *lingua franca* in the area. In wetter years sorghum is also grown in large quantities. The farming of this grain, its harvesting, and processing are central activities of girls and women in this community (see Bock and Johnson 2002 for a complete description). Households from all ethnic groups in the community rely on both farmed and foraged foods throughout the year. Mongongo nuts and grain were selected as indicators in this study owing to their wide distribution of reliance within the community across all ethnic groups. These commodities are also subject to wide-scale exchange and reciprocity through food sharing across households further increasing the near universal utilization across households.

People from all of the ethnic groups live in extended family homesteads based on patrilocal organization. Among the Bantus, polygyny is common with 45% of the men over 35 participating in polygynous relationships at any one time. Polygyny is rare among the San speakers. Marriage and reproductive unions, however, are fluid among all the ethnic groups. Multi-partnered sexuality is commonplace, and disputes over paternity and child support are common in the tribal court. For all the ethnic groups the norm is for men to marry and become fathers in their thirties.

Most men of all ethnic groups over the age of 35 had worked in migratory labor, usually in the mines of South Africa, for an average of five years. Many of the ||anikhoe and Bugakhoe men over the age of 25 had been soldiers in the South African Defence

Force during the bush wars of the 1970s and 1980s. Few women, however, had ventured beyond the next community 30 km away. At the time of data collection, there was no school, clinic, or borehole, with water drawn from a river source.

This community, as is the case in all of Botswana, has been in the grips of the HIV/AIDS pandemic since the 1990s. Due to the isolation of this community, the full force of the epidemic did not begin until the late part of that decade. Sentinel group monitoring in nearby areas of northern Botswana indicates that the prevalence of seropositivity among adults is over 30% (NACA 2004). Since most of those data are collected in more urban areas, it is not clear if the rate is the same in this community. However, the mobility of men would suggest that the rate is equally high (NACA 2004). Morbidity and mortality in the administrative district are concentrated among adults between the ages of 25 and 49 (NACA 2004). This morbidity and mortality profile is highly gendered with women being disproportionately affected (NACA 2004).

Data collection

Reproductive histories: All individuals over 15 years of age in the community were interviewed regarding their reproductive history. Respondents were asked to identify each of their children ever born, either living or deceased. Birth and death dates were asked, although for many people these dates are not known. If the date was not known, the date was estimated using relative age lists which have been compiled for this community (Bock 1995).

Household census data: Every extended family settlement was visited on a rotating basis. The head of the household, usually a senior male but sometimes a widow, was asked to identify everyone living in the household, relationship to him/her, as well as any changes (births, deaths, migration) since the last census was taken.

Economic resource assessment: On a monthly basis, each head of household was asked about non-monetary and monetary resource flow into the household. He or she was asked what resources including cattle were acquired, by whom, and from whom. These data, when combined with the acquisition data collected during the *instantaneous scan samples* (see below), give an accurate picture of resource flow.

Experimental return rate data:

For the *mongongo nut processing* return rate experiments, a sack of mongongo nuts was obtained from community members. A woman was compensated to perform

the first stage of processing, leaving the nuts with their outer shell exposed ready to process. For the processing rate experiment, an individual was given 500 g of whole nuts in the outer shell. These were also counted. The individual was instructed to process them as if he or she were at home, and the digital timer started. After 15 minutes the individual was told to stop and the number of nuts processed counted. The remaining nuts, as well as the product, was weighed. In addition, the number of intact inner-shelled nuts was counted, and it is this quantity that is used in the analysis. For these experiments data were collected from 6 women aged 25-49 and 7 women 50 and over and used in the following analyses.

For the *grain processing* experiments each person was given 500 g of millet, and asked to process it as if he or she were at home. In addition, 250 ml of water was also provided. The person was timed through the entire process and through each stage. At completion the flour and chaff from outer and inner hulls were weighed. These data were used to impute age-specific return curves for each sex for pounding, sifting, and total grain processing. Data from 7 women aged 25-49 and 7 women aged 50 and over were collected and used in the following analyses.

Time Allocation: Two types of time allocation data were collected. *Instantaneous scan samples* were collected for all study participants. Extended family homesteads were sampled on a rotating basis repeatedly over three four hour periods, 0600-1000, 1000-1400, and 1400-1800 which roughly correspond to the daylight hours. On an hourly time point, the activity, location, and interactants of all residents of the homestead was noted. For residents who were not present, other residents were asked for that person's activity and location and this information was verified with the focal subject either upon his or her return or later. *Focal follows of individuals* away from homesteads were conducted so that each of the major activities in which people of each age-sex class engage (as determined by the household samples) was represented adequately. These follows are designed to determine the amount of time people spend in activities when they were away from homesteads, intensity of activity, and return rates for activities. Focal follows were conducted twelve times a week. Homesteads were sampled on a rotating basis, as were individuals within homesteads. The follows lasted two hours and consist of point samples every ten minutes. At the point sample, the activity in which the individual is engaged, the location, and identity of co-participants were recorded. In

addition, the time of any resource acquisition was noted, as well as the type, amount of resource, and method of acquisition. Weights were obtained using Homs hanging spring balances.

RESULTS

Using data collected from 1992 to 1994 (Bock 2002a, 2002b; Bock and Johnson 2002b), we were able to construct time allocation profiles of women in the study community. We divided the sample into women 25-49 (n=22) and 50 and older (n=17) to represent mothers and grandmothers respectively. This division has a biological basis in that it is the average age of reproductive senescence across societies, but it does not take into account that women may continue to parent for some time after this age and often women are simultaneously acting as both mothers and grandmothers. For those reasons these results should be considered conservative. We found that the time allocated to most non-productive activities was not significantly different for younger versus older women with the exception of craft making (see Figure 1). Craft making, usually baskets and tools, requires large

INSERT FIGURE 1 ABOUT HERE

amounts of skills and knowledge and from ethnographic observation we know that this is one of the few activities in which didactic pedagogy is used to transmit knowledge. Grandparents are the primary source of training in craftwork for children. We also found significant differences in time allocated to productive activity between younger and older women in the sample. Older women spent proportionately more time in collecting wild plant foods, mostly mongongo nuts, and in processing those foods (again, mostly mongongo nuts). They spent significantly less time than younger women in grain processing.

Data collected in a naturalistic setting often have irregularly spaced and unbalanced measures. In response to concerns related to this data structure, lowess (locally weighted regression scatter plot smoothing) curves were constructed in order to graphically present age-specific return rates. Lowess is a preferred method for this analysis because it is not dependent on an underlying functional form and it is not sensitive to outlier values (Cleveland 1993). Piecewise OLS regression was performed to

evaluate the age differences in returns. This complementary analytical strategy between nonparametric lowess regression and piece-wise OLS regression has been employed extensively in studies of growth which face conceptually similar issues with regard to data analysis (Garber and Leigh 1997; Leigh 1994; Leigh and Shea 1995; Bock 2002a, Johnson 2003).

These differences in time allocation translate into major differences in productivity. Using average productivity for each age class derived from experimental return rates, we show that women 50 and over spend twice as much time processing mongongo nuts but produce roughly the same amount of useable

INSERT FIGURE 2 ABOUT HERE

calories. Piecewise regression analysis performed on these data show that there is a significant positive age effect from 11 to 35 years old ($n=10$, $p=.0044$, $r^2=.657$). There is a significant negative age effect in the age range from 35 to 75 ($n=11$, $p=.0269$, $r^2=.437$) (see Figure 2). Women 25-49 spend twice as much time in grain processing but produce on average three times as much useable grain per day. Piecewise regression analysis shows that returns rise significantly from 4 to 14 ($n=21$, $p<.0001$, $r^2=.672$) but do not increase significantly from age 15 to 75 (see Figure 3).

INSERT FIGURE 3 ABOUT HERE

We calculated the amount of energy from grain processing produced on average by women 25-49 and 50 and older by multiplying the average daily amount of time allocated to grain processing (measured as a proportion of a 720 minute active day) by the average return rate measured in kcal/min (energy data was obtained for dry-farmed millet from the WHO Food Tables (WHO 1966)). These data are the same as used to produce Figures 1 and 2. We repeated this calculation for mongongo nut processing again using the data that produced Figures 1 and 3 (energy data for mongongo nuts is from Lee 1979). The analysis shows that with the average time allocation profiles presented in Figure 1 there is no significant difference between women 25-49 and women 50 and over in the average daily energy produced through mongongo nut

processing (see Figure 4). Women in the 25-49 age class, however, produce over three times as much energy from grain processing on average relative to women in the 50 and over age class.

INSERT FIGURE 4 ABOUT HERE

In trying to model the effect of the loss of a younger woman's labor because of morbidity or mortality, it might be expected that older women should devote less time to mongongo nut processing and more time to grain processing. This is because while older women have significantly lower returns in mongongo nut processing, the two age classes show no significant difference in returns to grain processing. An older woman's labor should substitute for that of a younger woman on a one-to-one basis. The results presented in Figures 1 and 4, however, indicate that older women are specializing in mongongo nut processing regardless of the lower return rate. We hypothesize that a major constraint preventing older women from spending more time grain processing is the energetic expenditure required. We calculated the amount of energy expenditure required for grain processing and mongongo nut processing from published sources (Lawrence et al. 1985). Because we were unable to find measurements for energy expenditure for mongongo nut processing, we considered using measurements of energy expenditure for groundnut processing (1.41 kcal/min) and shellfish cracking (1.53 kcal/min) as proxies. Because groundnut shells are soft and easily broken with the fingers, we used the shellfish measurement since this activity is qualitatively similar to the method used in the study community to process mongongo nuts. We then use these data to calculate the net energy produced by grain processing and mongongo nut processing (see Table 1). The results show that when the energetic

INSERT TABLE 1 ABOUT HERE

cost of production is considered, women 25-49 produce about twice as much energy per minute from grain processing as women 50 and older. The results from mongongo nut processing are more profound, with women 25-49 producing about 4 times as much net energy per minute. Again, these results should be considered conservative since they are

averaged over each age class. The energy cost will in fact be increasing with age. In addition, both mongongo nuts and grain are seasonal resources in this community. These values reflect average time allocation over the course of a year; in reality, time allocated to these tasks is clumped around the seasonal availability and utilization of these resources. This again suggests that these results are conservative estimates of the relative differences between women in the different age classes.

DISCUSSION

The results shown in Table 1 beg the question of why older women spend any time processing mongongo nuts since their energetic returns are relatively low. If there is any principle of efficiency operating in the household economic system, we would expect older women to avoid mongongo nut processing and devote their productive time to grain processing, and we would expect the opposite patterning for younger women. One likely explanation for this seeming paradox is the energetic constraint faced by people as they age. Grain processing is an energetically demanding activity; the estimate of 3.27 kcal/min. that we use places this activity as energetically equivalent to moderate exertion for the younger women and high moderate exertion for the older women (Lawrence et al. 1985). Prior research in this community has shown that grain processing ability is largely based on strength and stamina while mongongo nut processing ability is largely based on experience (Bock 2005). A possible explanation for the pattern seen is that older women do not have the power and stamina to process grain for extended periods of time. Mongongo nut processing is less than half as energy intensive at 1.53 kcal/min. and may fall within the energetic output constraints faced by older women. The lower returns to mongongo nut processing, then, may be due to issues regarding dexterity and eyesight. In this case, older women are necessarily processing mongongo nuts at a slower pace that can be sustained for a long period of time. The difference between grain processing and mongongo nut processing may be energy intensity versus time intensity (Panter-Brick 2003).

The implication is that the roles of women 25-49 and over 50 are quite different as reflected in their time allocation profiles. Younger women are spending their time producing large amounts of calories to feed their families. Older women are spending more time at craftwork and at activities that take them out of the community such as collecting wild plant foods. It can be inferred from these data that grandmothers are

playing a strong role in assisting their grandchildren in acquiring skills in craft production and bush craft. The HIV/AIDS mortality profile for women in Botswana is highest for women between 25 and 50 (NACA 2004). The illness or death of these women will greatly affect the food production for a household in this community. These data show that grandmothers cannot simply make up these deficits by adopting the time allocation profile of a younger woman owing to the decreased age-specific productivity. This means that older women will have to spend more time than younger women at productive tasks to try and make up these deficits. Because time is finite there are trade-offs in time allocation; the time spent on one task is precluded for use in another task. Older women who increase their time allocation to productivity will be spending less time in craftwork and by implication, less time developing skills in their grandchildren. These data suggest that intervention strategies be focused on assisting older women in production of traditional foods and helping them to manage time allocation to the transmission of traditional skills and knowledge.

Intervention strategies are most effective when they meet the needs that the participants themselves recognize (Shaibu and Wallhagen 2004). In this case, simply providing financial assistance or food aid will not make up the deficits faced by a household in a number of dimensions given the loss of a woman 25-49. There are three main areas that should be supported: traditional subsistence and nutritional regimes, the time older individuals spend in craft production, and the transmission of traditional skills and knowledge from grandparents to grandchildren. In the study community, wild plant and animal foods such as mongongo nuts, a number of roots and leafy vegetables, and fish are staple dietary components. These foods provide high levels of micronutrients and phytochemicals that are often lacking in starchy grains, such as white rice, and other foods provided as economic and nutritional support (Johns et al. 2000, Cordain et al. 2005, Eaton et al. 1997). Unfortunately, policy makers often deride foraged foods as “starvation foods” that are a last resort and are undesirable, when in fact these foods usually impart the most robust nutritional contribution to diet. Rather than providing alternative lower quality foods, beneficial intervention would support families in continuing to incorporate these high quality wild foods in the diet even after loss of substantial household labor (Ohiokpehai 2003). Labor saving devices such as tools, mills, and other items to abet more efficient processing may be one of the most

effective means of providing support to families trying to maintain a high quality diet.

Our data show that older women spend substantial time in the production of traditional craft items such as baskets, fishing implements, and tools. These items are essential for the productivity of all members of the household. While some of these items can be replaced with consumer goods, the substitution is not optimal. First, most families in this setting do not have sufficient cash to purchase such items as buckets, plates, and tools. Second, the consumer items available are often of low quality and are not repairable. Therefore, if older individuals must switch time from craft production to other activities after the loss of a younger woman's labor, then the household is forced to make due with fewer, lower quality tools to accomplish the same amount of work. Culturally appropriate and -specific intervention would entail supporting craft production perhaps through establishment of coops and through the procurement and provisioning of raw materials.

The final area of concern is that of the transmission of traditional skills and knowledge. The farther an older woman is removed from traditional time allocation patterns, the less time she will have available to interact with her grandchildren in a setting where they will acquire traditional skills and knowledge. In the cultural context of the study community, most skill acquisition occurs through naturalistic observation and through children being embedded in the fabric of everyday household production (Bock 2002a, 2002b, 2005, Bock and Johnson 2002b; Lancy 1996, Weisner 1997). When grandmothers are placed in a new time allocation pattern that does not include the collection of wild foods, processing those foods, producing craft items, and other traditional activities performed by older people, then children will have no means to acquire skills and knowledge about these traditional activities.

In the context of the HIV/AIDS pandemic, households throughout sub-Saharan Africa have faced or will face the loss of women in the 25-49 year age class to devastating consequences. Clearly mongongo nuts and grain are not the only food resources available in households in the study community, nor are two women the only individuals providing these resources (Bock 2002b). The example used here is an attempt to clarify the trade-offs faced by older women given the loss of a younger woman's labor because HIV/AIDS related morbidity or mortality. This example, however, is also pertinent given the emphasis on the ability of the extended family to

compensate for such losses. The assumption that the extended family, especially grandparents, can make up the loss of productivity does not seem to be supported in the study community. In particular, there is no doubt that grandmothers have important roles in the lives of grandchildren. Grandmothers in the study community, however, are not able to substitute their labor for that of a lost younger woman, meaning that it is unrealistic to think that household productivity is elastic when younger women are too sick to work or are deceased. Moreover, to ask older women to assume this role may have detrimental effects on their own health (Ainsworth and Dayton 2001) with concomitant additional negative impact on grandchildren. Intervention can help to compensate for the loss of labor, but it should take specific forms that support grandparents, and in particular grandmothers, in pursuing their traditional roles and activities.

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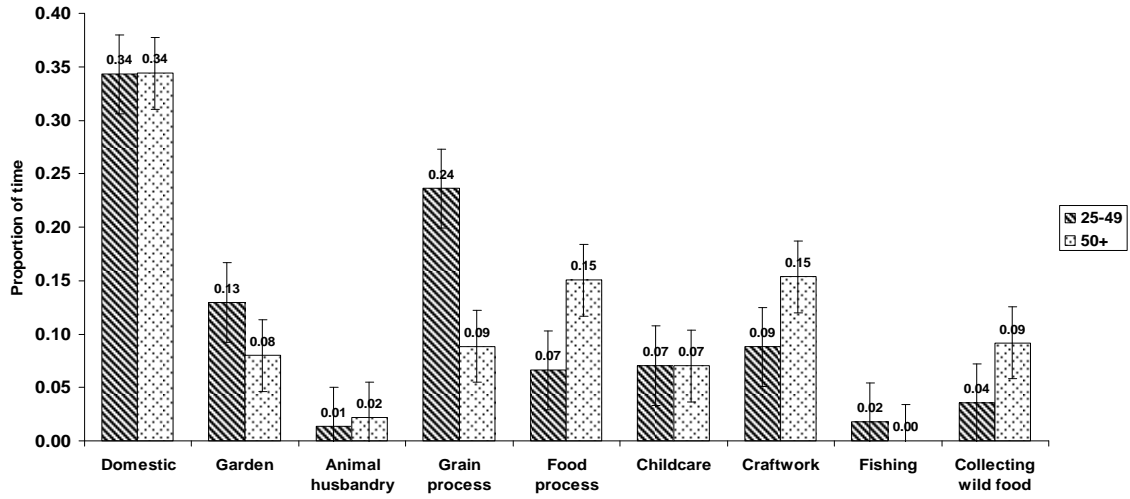
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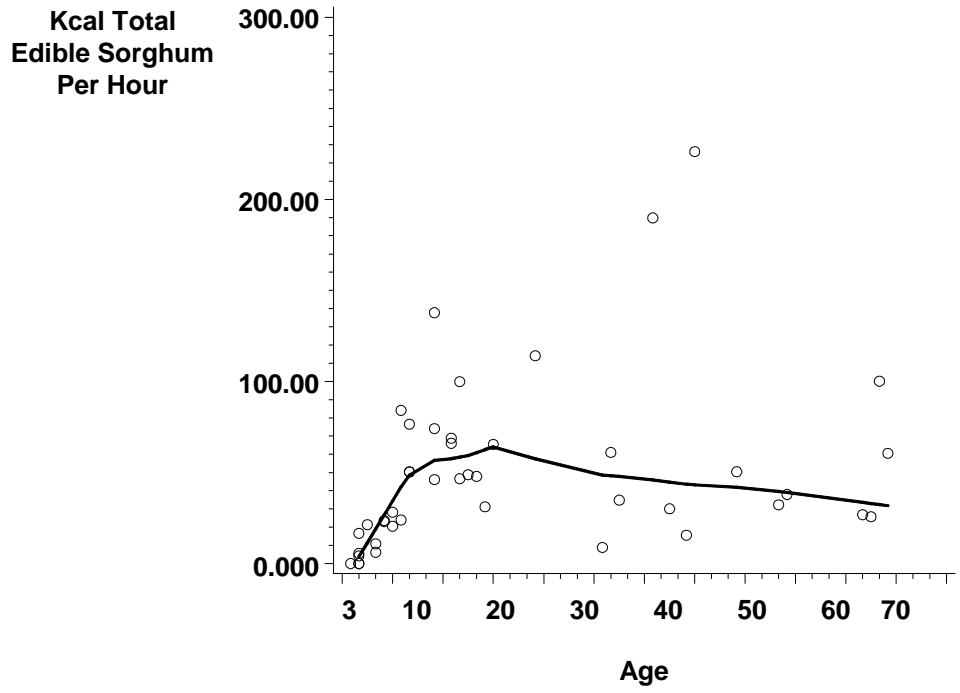
Activity and age class	Average time spent per day (min)	Energy cost (kcal/min)	Total energetic expenditure per day (kcal)	Energy produced (kcal/min)	Total energy produced per day (kcal)	Net energy produced (kcal/min)	Net energy produced per day (kcal)
Grain processing (25-49)	173	3.27	561	4.88	845	1.65	284
Grain processing (50+)	65	3.27	212	4.14	269	0.88	57
Mongongo nut processing (25-49)	50	1.53	77	13.36	668	11.83	591
Mongongo nut processing (50+)	108	1.53	165	5.49	593	3.96	428

Table 1. Energy cost and production by age for grain processing and mongongo nut processing. (Total and net values rounded to nearest whole number.)

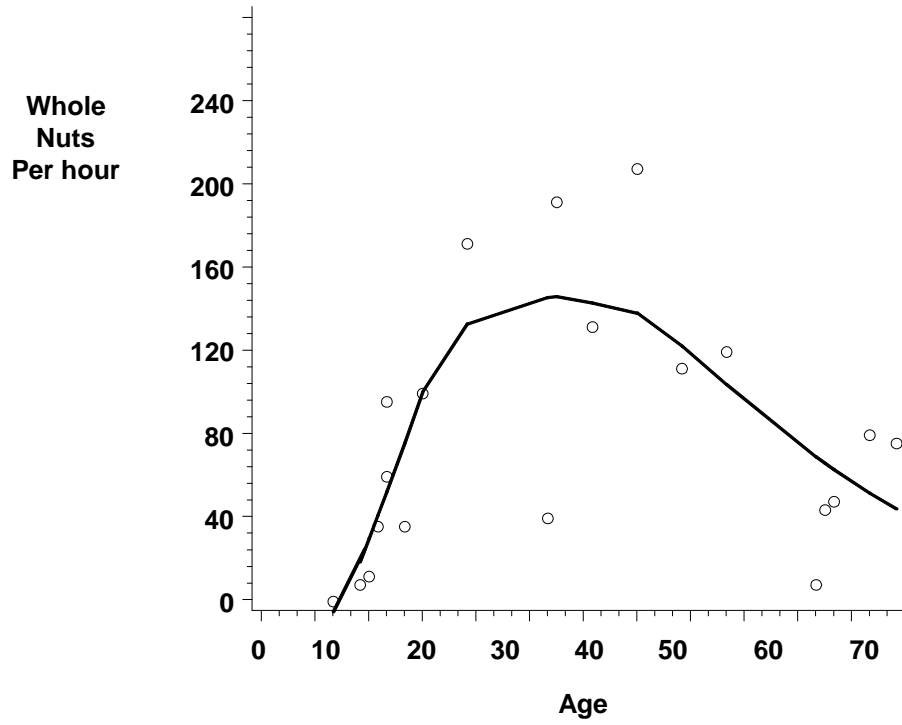
Time allocation to tasks



**Age-Specific Total Grain Processing Returns
Females of all ages
LOWESS Curve**



Age-Specific Mongongo Nut Cracking
Females of all ages
LOWESS Curve



Caloric production per day compared between older and younger women

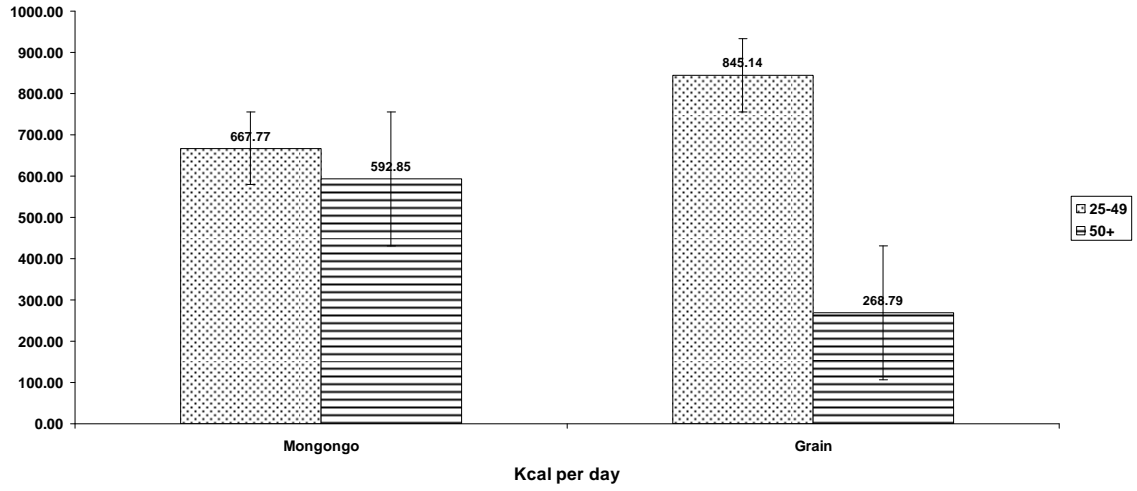


FIGURE LEGENDS

Figure 1. Time allocation to productive tasks by women 25-49 and 50+. There are significant differences in grain processing, wild food processing, craftwork, and collecting wild food.

Figure 2. Age-specific grain processing returns for females 3 to 75. Each point represents one individual.

Figure 3. Age-specific mongongo nut processing returns for females 3 to 75. Each point represents one individual.

Figure 4. Caloric production per day. Older women produce far less calories per unit time spent in productive activities.