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Poverty, Wealth Inequality and Health among Older Adults in Rural Cambodia

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Abstract

Little research exists on health determinants among adults living in economically deprived regions despite the fact that these areas comprise a good part of the world. This paper examines the distribution of wealth then tests associations between wealth inequality and a variety of health outcomes, among older adults, in one of the world's poorest regions – rural Cambodia. Data from the 2004 Survey of the Elderly in Cambodia are employed. Using a disablement framework to conceptualize health, associations between four health components and a wealth inequality measure are tested. The wealth inequality measure is based on an index that operationalizes wealth as ownership of household assets and household structural components. Results confirm difficult economic conditions in rural Cambodia. The lowest wealth quintile lives in households that own nothing, while the next quintiles are only slightly better off. Nevertheless, logistic regressions that adjust for other covariates indicate heterogeneity in health across quintiles that appear qualitatively similar, with the bottom quintiles reporting the most health problems. An exception is disability, which presents a U-shaped association. It is difficult to determine mechanisms behind the relationship using cross-sectional data, but the paper speculates on possible causal directions, both from wealth to health and vice-versa. The analysis suggests the ability to generalize the relationship between wealth inequality and health to extremely poor populations as a very small difference in wealth makes a relatively large difference with respect to health associations among those in meager surroundings.

Keywords

Cambodia; Aging; Developing countries; Health inequalities; Social class; Asia

INTRODUCTION

Evidence confirming that economic inequality has implications for health dates back decades if not centuries, and corroboration of an association between measures of economic well-being and health has been found in Europe, the U.S., and elsewhere in the developed world (e.g. Antonovsky, 1967; Fox, 1989; Huisman, Kunst & Mackenbach, 2003; Kitagawa & Hauser, 1973; Mackenbach, Kunst, Cavelaars, Groenhof, Geurts & the EU Working Group on Socioeconomic Inequalities in Health, 1997; von dem Knesebeck, Luschen, Cockerham & Johannes, 2003). Earned income has been receiving close scrutiny in recent research. An advantage for higher earners has been a persistent finding (Ecob & Smith, 1999; Gornick, Eggers, Reilly, Mentnech, Fitterman, Kucken et al., 1996; McDonough, Duncan, Williams &

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House, 1997; Smith, 1999; Sorlie, Backlund & Keller, 1995; Wilkinson 1986; Zimmer & House, 2003). Moreover, measures that indicate longer-term economic well-being, such as life-long economic hardship, accumulated liquid assets, bank savings and home ownership, have occasionally been shown to be as valuable for predicting health outcomes as current income (Lynch, Kaplan & Shema, 1997; von dem Knesebeck et al., 2003).

Researchers are increasingly asking whether basic associations that have implications for health can be generalized to older populations. The question has international significance given global population aging and the subsequent increases in the proportion of health care costs consumed by older aged populations worldwide. In developed countries, research has indicated implications of income inequality extend to older people (Berkman & Gurland, 1998; Grundy & Sloggett, 2002; Huisman et al., 2003 Matthews, Jagger & Hancock, 2006), although some attenuation of the association has been found at very old ages (House, Lepkowski, Kinney, Mero, Kessler and Herzog 1994). A lesser number of studies have been conducted in countries described as rapidly developing or middle income (e.g., Beydoun & Popkin, 2005). The general subject of poverty and health has been broached to a limited extent in the developed world (Haan, Kaplan & Camacho, 1987; Menchik, 1983), and demographic and epidemiological literature has examined poverty and infant, child and maternal mortality in developing countries (Hobcraft, McDonald & Rutstein, 1984; Houweling, Kunst, Looman & Mackenbach, 2005). There has, however, never been a test of the association between economic inequality and health among older adults within a society that can itself be characterized as poverty stricken, despite the fact that many of the world's older people live in such environments. Affirming associations between economic inequality and health within extreme poverty settings, where there may be less variation in economic well-being than is typical elsewhere, and where valid indicators may differ from those traditionally considered, would go a long way toward establishing the existence of a persistent, robust and global generalization.

The current study takes place in just such a setting: rural Cambodia. The modern history of Cambodia is replete with periods of war, violence and genocide, which peaked between 1975 and 1979 during the rule of Pol Pot and the Khmer Rouge (Heuveline, 1998). Although Cambodia was poor prior to this, the disorder that occurred during and immediately after the Khmer Rouge ensured many inhabitants remained in extremely poor conditions. Today, Cambodia is classified as one of the world's least developed countries according to the UN, and it ranks low on the Human Development Index with over three-fourths of the population living on less than two dollars a day (Ministry of Planning, 2003). It has low literacy (74%), high mortality (life expectancy 56) and high infant mortality (95 deaths per 1,000) (Population Reference Bureau, 2005). Poverty is particularly pervasive in rural areas (Knodel, Kim, Zimmer & Puch, 2005).

If the link between economic inequality and health is universal, as is sometimes suggested (National Research Council, 2001), one would expect health differentials to appear even in countries at the very bottom of a global wealth continuum. Therefore, a starting hypothesis may be that economic gradients in health exist among older adults living in rural Cambodia. Nonetheless, there are reasonable bases for suspecting the contrary. Research has shown that the health status of older Cambodians is generally poor, even in comparison to those living in neighboring countries, and hence there may be little variation in health (Zimmer, 2006). The rural environment is economically depressed and health care resources are underdeveloped and under-funded (Ministry of Planning 2003). Although economic resources may allow for the purchase of health care in more prosperous surroundings, availability and utilization is minimal for almost all rural Cambodians, regardless of individual resources, which may equalize access to services. Furthermore, research on the topic in middle-income and rapidly developing countries has been mixed. Conflicting results have, for instance, been found across

Asian settings wherein the association between economic status and health has occasionally been tested (Beyodoun & Popkin, 2005; Chiu, Hsieh, Mau & Lee, 2005; Zimmer & Amornsirisomboon, 2001; Zimmer, Chayovan, Lin & Natividad, 2004). Hence, the issue of whether associations between economic inequality and health hold among older people living in extremely poor environments is an open question, which is addressed in the current study. This analysis, using data from a survey of older Cambodians living in rural areas takes place in two stages. The first looks at the structure of poverty among older rural Cambodians. The second examines the relationship between poverty and wealth inequality on one hand and health outcomes on the other.

Household wealth has advantages as an indicator of poverty for older adults and as a means of examining inequalities, particularly within this population. First, it is a more permanent indicator than income or consumption (Rutstein & Johnson, 2004). This is particularly the case with people who are often retired who do not currently earn income. Second, in Cambodia, as in other developing countries, older people tend to be reliant on the family for their material survival. Therefore, the economic status of the household is a more pertinent indicator of material well-being than individual income. Third, it is easily measured in surveys through questions about assets. Poverty and wealth inequality in the current study are assessed using a household level index that utilizes information about the ownership of a series of assets.

In order to organize multiple components of health, the study adopts a ‘disablement’ framework conceptualized by Verbrugge & Jette (1994), which itself is founded on earlier conceptualizations by Nagi (1979) and the World Health Organization (1980). Using this framework, health is divided into four components: *pathology*, *impairment*, *functional limitation* and *disability*, which represent the pathway leading from a medically diagnosed health condition to a disability. Specifically, pathology refers to physiological abnormalities that can be medically diagnosed and labeled as diseases. Pathological disorders can lead to impairments, which refer to general body dysfunctions, such as difficulties seeing or hearing. Impairments can lead to functional limitations, which are difficulties conducting basic physical movements, such as lifting things or walking. Finally, functional limitations can lead to disabilities, which refer to the inability to perform tasks necessary for daily living, such as bathing or getting up from bed. It is particularly important to separate disabilities from other dimensions when examining the impact of poverty on health since, much more than for the other health components, disabilities can be influenced by social and physical environments (Freedman & Martin 1998; Pope and Tarlov 1991; Verbrugge & Jette, 1994). Performing a task like bathing, for example, will depend not only upon abilities to conduct physical movements but on factors that may be much more directly tied to economic and social circumstances, like the type of bathing facility available and the availability of physical assistance. The current study examines associations between wealth and each of the four separate components of this conceptualization of health.

METHODS

Data

Data is from the 2004 Survey of the Elderly in Cambodia (SEC), the first probability sample survey geared to older adults completed in Cambodia. The survey involved interviews with 1,273 individuals 60+ in 2004. Respondents came from Cambodia's six most populous provinces, which together contain more than half of the country's population: Battambang, Kampong Cham, Kandal, Phnom Penh, Prey Veng, and Takeo. A multi-stage sampling design involved a proportionate to size systematic selection of villages, then a random selection of households containing at least one older adult, and a selection of one older adult within each household. In total, 48 villages were selected, with about 25 interviews completed within each village. Villages within Phnom Penh province, which includes both urban and rural areas, were

over-sampled. Thirty-nine villages are classified as being rural and the others, all located within Phnom Penh province, are classified as urban. The current study is limited to 1,011 respondents from rural villages. Urban residents were eliminated since indicators of economic status and the conceptualization of poverty for rural and urban Cambodia do not compare.

Because of the over-sampling, and because only one individual per household was selected to be interviewed, it is necessary to employ a weighting to make results representative. Weights were established by taking the inverse of the probability that an individual was selected to be part of the sample. This probability was determined by considering two factors. The first was the probability that a specific individual was chosen out of the total number eligible within the household. The second was the probability that a specific household was sampled, which was estimated by using data from the last Cambodian census. Analysis performed and reported elsewhere affirmed that the weighted sample it is representative based on comparisons with other data sources such as the 2004 Inter-censal survey (Knodel et al. 2005). Results to follow refer to the weighted sample. Very detailed information on survey methodology, including matters such as interviewing techniques, sampling strategy, sampling intervals, number of cases by village, weighting, refusals, use of proxy respondents, and other related topics, plus a copy of the questionnaire, is available in Knodel et al. (2005). Additional information is also available in several earlier publications and reports that utilize the SEC data (Knodel and Zimmer 2006; Knodel, Zimmer, Kim and Puch 2006; Zimmer 2006; Zimmer, Knodel, Kim and Puch 2006).

Measuring health

As noted above, four separate components of health derived from the disablement framework conceptualized by Verbrugge and Jette (1994) are used as outcome measures. The first is *health symptoms*. When constructing the SEC instrument, it was presumed that asking questions about diagnosable diseases would be unproductive given that doctor visits are rare for this population and diseases often go undiagnosed. Instead, respondents were read a list of easily recognizable symptoms thought to relate to specific diseases and were asked whether the symptom was experienced during the past month. From most frequently reported to least, (with the percent that report the symptom in parentheses), these included: joint pain (89%), dizziness (75%), headaches (73%), fever (59%), chest pain (58%), coughing (50%), breathing problems (39%), trembling hands (39%), stomach aches (38%), diarrhea (27%), skin problems (21%) and vomiting (15%). The second considers *impairments*. Respondents were asked specifically about two sensory impairments - eyesight and hearing capacity. Sixty-five percent reported difficulty seeing without wearing glasses and 30% difficulty hearing without wearing a hearing aid. The third is *functional limitations*. Respondents were read a list of these and asked whether, on their own, they have difficulty conducting the activity, and if so, the degree of difficulty (a little, a lot or cannot do). In order from most to least frequently reported, (with the percent reporting they have *a lot of difficulty* or they *cannot do* in parentheses), these are: lifting 5 kilograms (39%), walking 200-300 meters (33%), climbing stairs (27%), crouching (23%) and grasping with fingers (14%). The final component is *disabilities.* The SEC included four disability items commonly referred to as Activities of Daily Living, which are tasks necessary for daily self-maintenance (Katz, Ford, Moskowitz, Jackson & Jaffe, 1963). Respondents were asked whether they had a difficulty, and if so, the degree. In order from the most to least frequently reported, (with the percent reporting they have *at least little difficulty*), these are: getting up from bed (19%), bathing (8%) eating (8%) and dressing (6%).

For each health component, a dichotomous summary measure was constructed. For symptoms, only 1% reported none, while the mean and median number reported was 6. Therefore, a measure was constructed indicating whether an individual reported less than 6 or 6+ symptoms. For the other three components, the summary measure indicates whether one or more problem

was reported. A sensory impairment means reporting either seeing or hearing problems or both. A functional limitation means reporting a lot of difficulty with, or being unable to perform, one or more task. A disability means reporting any difficulty with at least one ADL task.

Measuring wealth

The study adopts a household wealth index widely used in recent analyses that consider poor countries, particularly analyses using Demographic and Health Survey (DHS) data (e.g., Bicego, Rutstein & Johnson 2003; Boyle, Racine, Georgiades, Snelling, Hong, Omariba et al. 2006; Evans & Miguel 2007; Moser, Leon & Gwatkin 2005; Pande & Yazbeck 2003; Rutstein & Johnson 2004; Victora, Wagstaff, Armstrong Schellenberg, Gwatkin, Claeson & Habicht 2003; Wagstaff 2003; Wang 2003). Conceptually, the index is built on the notion that wealth is an underlying unobservable measure relating to relative economic position within a social hierarchy. As such, even within very poor environments, the location of a particular household within a hierarchy can be assessed through variables that provide information on whether or not a household owns or contains basic assets and structural components (Rutstein & Johnson 2004). The current study considers whether or not the house or household in which an older person lives contains the following assets: radio, television, jewelry, motorcycle, fan, telephone, car, or refrigerator. In addition, it considers two structural components. The first is a modern toilet, which is defined as an indoor toilet that can be flushed. The second is a modern floor, which is defined as a floor that is constructed using modern materials, specifically, finished wood, vinyl, asphalt, ceramic, marble or cement, as opposed to a floor constructed of dirt, clay, unfinished wood, or similar types of primitive materials.

Construction of the index follows Filmer and Prichette (2001). Each variable is dichotomized as 1 if present and 0 if not. Weights are determined by factor scores derived from the first principal component (PC) in a PC analysis. The first component is used since it is the one that captures the largest amount of information common to all the items. For the current study, the first component has an eigenvalue of 4.1 capturing fully 41% of the variance. The index is derived by multiplying a normalized score for each asset by its weight as determined by the PC analysis. Thus, the index is a linear combination of the assets weighted by component-scores that account for the principal part of their co-variation. Individuals are then ranked from top to bottom according to the index and, as suggested by Rutstein and Johnson (2004) divided into quintiles. Given a sample size of about 1,000, this means about 200 respondents within each quintile, but numbers are not exactly 200 due to a fair degree of heaping around ownership of certain combinations of items.

The PC approach to constructing a wealth index has several advantages. First, applying factor scores for weights circumvents the enforcement of an arbitrary and subjective numeric value being given to items, including one that would treat each as being equal despite obvious differences in the importance of each asset and its contribution to the underlying concept. Second, because asset variables are coded as 0 and 1, weights are easily interpreted. That is, the ownership of an asset increases the index score by a factor of the weight divided by the standard deviation of the variable (Filmer & Prichette 2001). Third, a number of validations of the index have been conducted, each of which suggest that it is in agreement with measures of household consumption and proxies well for other indicators of economic well-being (Bollen, Glanville & Stecklov 2002; Filmer & Prichette 2001; Houweling, Kunst and Mackenbach 2003). Hence, the procedure is a reasonable response to a data constraint, that is, the absence of data that assesses household wealth directly.

Analysis plan

After a description of the sample, the structure of wealth and poverty is analyzed. This is accomplished by a descriptive examination of a series of findings that depict attributes of the

population across the wealth quintiles formed using the PC procedure described above. The attributes include the mean, standard deviation, median and range for number of assets owned, the specific types of assets owned, and selected demographic characteristics, all presented across wealth quintiles.

Next, the association between wealth quintile and health is examined with a series of logistic regression equations. The first four equations (labeled as Model 1) establish a bivariate association by showing results that are unadjusted. Wealth quintiles are treated categorically, and dummy dichotomous indicators are constructed that contrast the impact of being in the second through highest quintile with those in the lowest wealth quintile. Results presented are in the form of odds ratios and show the odds of reporting poor health. Robust standard errors that account for sample design are used to determine statistical significance and specific p-values are reported. The next four equations (labeled as Model 2) regress each of the summary health measures on wealth quintile, age (measured categorically) and sex. The last four equations (labeled as Model 3) attempt to examine possible mechanisms driving any association by adjusting for additional characteristics. The first is a measure for having worked in agriculture for most of one's life (measured dichotomously), which is considered since the physical labor involved in agricultural work may accrue some benefit to health (Zeng, Vaupel, Zhenyu, Chunyuan & Yuzhi, 2001). The second is household size. It is possible older adults that develop health problems, particularly ones that limit ability to carry out daily functions, have a need for obtaining care and are therefore likely to live with offspring or others who provide physical assistance. Indeed, this is a common expectation in much of the developing world where social security and other means of formal support is not readily available (Bongaarts & Zimmer, 2002; Hermalin, Ofstedal & Shi, 2003). The third is whether the individual has worked in the past year (measured dichotomously), which is considered since healthier individuals are able to remain working longer. The final two are marital status (measured as married versus other) and formal schooling (measured as any versus none). The net significance of wealth in all equations is estimated by calculating the difference in the −2 X the log-likelihood statistic ($\Delta -2\ X\ LL$) between equations that do and do not contain the four wealth dichotomous indicators (the latter not shown).

A final procedure, which is conducted to obtain a more intuitive look at the association, employs coefficients from the logistic regression equations (specifically, Model 3) to calculate the predicted probability of reporting health problems across wealth quintiles. These predicted probabilities are presented in graph form. To determine the probabilities, the value of all variables for the final set of equations, except for wealth quintile, are held constant, and the mean sample probability for each summary health measure is calculated (Roncek 1991). As such, the result can be interpreted as the probability that an otherwise average respondent would report any of the four health problems (6+ symptoms, 1+ impairment, 1+ functional limitation and/or 1+ disability).

FINDINGS

Sample description

Table 1 provides descriptive information about the sample by sex. About half the sample is married, although there is wide variation by sex, in part a consequence of the earlier war and in part a consequence of higher male mortality. A majority have no schooling and only a fraction have more than primary, although again, there is substantial variation by sex. About 38% report not having worked in the last year, and about 78% report that their main occupation most of life was agriculture. More than three-quarters report living with an offspring. Very few older Cambodians live alone and most live in households of three or more people.

Table 2 shows the percent reporting summary health problems by age and sex. Fifty-seven percent report six or more symptoms, about 70% a sensory impairment, about 54% a functional limitation and about 24% a disability. The percent reporting health problems increases by age across all health components. Women are more likely to report 6+ health symptoms, a functional limitation and a disability, but there is little difference in reporting a sensory impairment by sex.

Structure of wealth and poverty

Table 3 presents information about wealth and poverty in three panels. Panel A shows the mean, standard deviation, median, and range of number of assets across wealth quintiles, with the range being represented by the 10^{th} and 90^{th} percentiles. The overall mean is 2.4, the median is 2, and the range is between 0 and 5. There is a clear relationship between number of assets owned and wealth quintile with individuals low on the index being those that live in households that own none or few assets. Indeed, the PC procedure results in a relatively clear-cut division. The lowest quintile is made up of 160 older adults living in households that own none of the assets. Although in a relative sense those in the second quintile have more wealth, the qualitative increase is trivial. It is made up of 226 individuals living in households that own one asset. Again, the qualitative change to the middle quintile is slight. The mean number of assets owned is 1.9, but the range indicates nearly all of these individuals live in households with two assets. There is more variation in number of assets owned for those in the fourth quintile where the mean is 3.1 and the standard deviation is 0.6. Finally, those in the highest quintile own between 4 and 8 assets, with a mean of 5.6.

Panel B examines the specific assets owned across quintiles. As noted, those in the lowest own nothing. The one asset owned by those in the second quintile tends to be a radio, although it is sometimes a television or jewelry. Those in the third quintile typically live in households that own both a radio and television. Those in the fourth quintile typically own a radio and television and they may also have one or two of: modern toilet, jewelry, motorcycle, modern floor. An appreciable step up in wealth is only evident for the highest quintile. These older adults live in households that own a fair mix of assets. Very few rural Cambodian households containing an older adult possess a telephone, a fan, a car or a refrigerator, but nearly all of these exist in the highest wealth quintile. Thus, with the exception of those in the highest quintile, older adults in rural Cambodia live with a very low economic standard. This should not be surprising given a number of past descriptions of the level of poverty that is experienced in rural Cambodia (Hayes, 2000; Ministry of Planning, 2003). A large proportion of older adults live in very primitive housing conditions, subsist only on what they grow and own only a few essential items.

Panel C presents demographic characteristics of older adults across wealth quintiles. The lowest quintile is made up primarily of women and of unmarried individuals. However, the percent female and not married does not necessarily decrease consistently when moving to higher quintiles. In fact, the second highest percent of women are found in the highest quintile. Expectedly, the proportion with schooling generally increases with increasing household wealth. For instance, only about one-quarter of those in the lowest quintile have schooling compared to about half of those in the highest two quintiles. Those in the highest quintile are more likely to have worked in the past year than those in the other quintiles. Very notable are associations with agricultural labor and household composition. More than 85% of those in the lowest three quintiles worked in agriculture most of their lives compared to about 59% of those in the highest quintile. The percent living with a child increases steadily from about 60% to 90% moving from the lowest to the highest wealth quintile, and the mean household size increases steadily from 4.2 to 6.4. Clearly, more people in the household allows for an accumulation of assets, which is reflected in the wealth index. In sum, those in the highest

quintile appear more likely to be educated, non-agricultural workers living in large households. Those in the lowest quintile appear more likely to be unmarried women without schooling, working in agriculture and living in small households.

Association between wealth and health

Table 4 shows results of logistic regression equations that predict the odds of reporting poor health using the four summary health measures. Equations labeled as Model 1 shows relationships that are completely unadjusted and thus establish the bivariate association. Equations labeled Model 2 add adjustments for age and sex. Results for the age and sex adjusted equations mirror very closely those for the unadjusted results across all indicators of health. In both cases, despite qualitatively minor difference in wealth, those in the second quintile are less likely to report all health problems in comparison to those in the lowest, and those in third are less likely to report health problems in comparison to those in the second. Differences between the first and second quintile are not statistically significant at standard p-values, although the decline in the odds of reporting health problems across all four components of health is a strong indication that the association is nonetheless robust. Take, for instance, the probability of reporting symptoms when adjusting for age and sex (Model 2). Odds ratios in the probability compared to the lowest quintile decline progressively from the second to the highest quintile, meaning that each gradient increase in wealth relates to a lower probability of reporting symptoms. A similar inverse association exists with sensory impairments. The lack of significance between the lowest and second quintile is partly a function of sample size. In an earlier version of this analysis, quartiles rather than quintile differences were tested, and the odds of reporting health problems between the lowest and second quartile was significantly different across all four health components to at least $p<.05$. Moreover, the decline in odds in Table 4 is statistically significant to at least $p<.05$ comparing the lowest and the third quintile for all health indicators. For functional limitations, the decline in the probability of reporting difficulties flattens across the highest quintiles. Disability presents an anomaly. The association is U-shaped and although there is an initial decline in odds ratios, there is virtually no difference in the probability of disability between those in the lowest and highest quintiles.

The effects of age and sex are as expected. Higher age relates to higher odds of reporting health problems and, except for sensory impairment, women are more likely to have health problems.

Model 3 further adjusts for agricultural occupation, household size, work status, marital status and schooling. These additional controls may provide some possible explanations for the association between wealth and health. For instance, one reason associations between wealth on one hand and functional limitation and disability on another are not totally linear is that those in the highest quintile are the least likely to have worked most of their lives in agriculture, and the physical labor involved in agricultural work may accrue some benefit to functioning. Therefore, after adjusting for agricultural occupation a more linear association could result. Since older adults with disabilities may require help from others, it may be these individuals that tend to move in with family members, forming large sized household. In turn, as was seen in an earlier table, wealthier quintiles are made up of larger households. Therefore, household size may explain some of the anomalous association with disability. (Living with offspring is another possible consideration; however it is highly correlated with, and provides similar results, as household size.) Healthier individuals are able to remain working longer. This may particularly explain why those in the second or third quintiles are healthier than those in the lowest - all three contain mostly people working in agriculture, but the very lowest quintile may contain individuals who, by virtue of being unhealthy, no longer work. The continued income brought in by those still working allows them to assist their household in the purchase of assets like a radio or a television. Marital status and having formal schooling may also help

explain the association since these two factors relate to wealth and are thought to also associate with health.

Results from Model 3 indicate that relationships are generally unaffected by additional controls. For all health outcomes, those in the second and third quintiles are substantially less likely to report health problems than those in the lowest. The $\Delta -2$ X LL value is statistically significant for symptoms, impairments and functional limitations, suggesting that overall wealth quintile helps to explain the variation in these three health components. The association with disability remains U-shaped and the $\Delta -2$ X LL statistic for this measure is not significant to the standard $p<.05$. Therefore, the association with disability remains anomalous.

Contrary to the reasoning presented above, those in agriculture are not healthier than others. Indeed, they are more likely to report symptoms and functional limitations. In addition, those living in larger households are not more likely to report health problems, with the exception of symptoms. In contrast, those working are much less likely to report sensory impairments and functional limitations. Marital status is unrelated to health. Also in contrast to expectations, schooling is generally unrelated except for its influence on functional limitation, which is in an unexpected direction.

Additional equations controlling for each variable separately (including living with offspring) were examined (results not shown). Results were very similar to those shown in Model 3 of Table 4. Furthermore, additional analyses, not presented here, tested the association for each individual health problem that makes up the summary measures. The association with wealth was linear or nearly linear for most symptoms, with some variation. For instance, the association between wealth and breathing problems or joint pain was strongly inverse and linear, while the association with diarrhea was less so. The associations between wealth and all other individual health problems generally mirrored those of their summary measures. The relationship with both hearing and seeing was strongly linear. Those in the second and third quintiles were less likely than those in the lowest to report each functional limitation, but the association flattened for the highest quintiles. The association with each specific disability was U-shaped. The consistency of results implies that the summary measures represent general patterns very well. Additional analyses, also not shown, indicated that creating summary measures using different cut points results in generally similar results.

Predicted probabilities obtained from Model 3 from Table 4 are plotted in Figure 1. The figure emphasizes that those in the lowest quintile have a consistently higher probability of reporting health problems than do those in the second quintile, regardless of the health measure. The decline in the probability of reporting a sensory impairment, health symptoms or functional limitation is generally linear across quintiles, while the probability of reporting a disability U-shaped.

Given that some previous research has suggested a weakening of the association between income and health at very old ages (House et al. 1994), further analysis (not shown) also tested for wealth by age interactions. No significant interactions were found when considering interactions with age for three of the four health components. Given the environment of rural Cambodia and the general poverty that exists, it is possible that those that survive to old age represent a robust group regardless of where they exist within the wealth hierarchy. Therefore, it may not be surprising to find age having little influence on the nature of the wealth – health association. However, there was some differentiation in the association between wealth and functional limitation across age groups. Similar to findings referenced above, the association was most robust and most noticeably linear (in a negative direction) for those in the youngest age bracket (60 to 64). At older ages (particularly among those 75 and older), the association was weaker and U-shaped. This probably explains the leveling off of the impact of wealth on

functional limitation as seen in Figure 1, that is, the effect is not consistently linear across all wealth quintiles for all age groups.

CONCLUSION

An abundance of evidence from developed countries links economic well-being and health while an additional set of studies show the association to generally hold among older adults. The nature of this link provides important information for reducing health inequalities, and given the current global tends in population aging, managing health care costs worldwide. The current study, however, takes place in an extreme environment, rural Cambodia, where older people are not only poor by global standards, but have also endured years of civil strife and unfavorable living conditions, such as a lack of adequate health care and otherwise weak infrastructure. Little research exists on health determinants among older adults living in economically deprived regions despite the fact that this describes a large part of the world. Hence, not much is known about how severe lifetime deprivation impacts on the aging process and whether relationships thought to be universal across settings where most health and aging research takes place can be generalized to these environments. Thus, insufficient information exists that might assist with policies aimed at reducing health inequalities among older adults living in very poor countries.

The test of the relationship between wealth and health in the current context suggested more heterogeneity than might have been expected. The wealth index separated the sample into five groups. The bottom quintile consists of older adults living in households that own nothing. Subsequent groups are only slightly wealthier, perhaps owning a radio, television and one or two other assets, although those in the highest quintile do appear to be qualitatively better off in comparison to the rest of the population. The following are some conclusions reached that relate these wealth quintiles to health. 1) There is differentiation in health across gradients of wealth. There is a consistent decline in health problems when moving from the lowest to the second quintile, and a consistent significant decline when moving from the lowest to the third quintile. Therefore, relative inequality seems to matter. 2) Changes in the probability of reporting health symptoms and a sensory impairment are linear with increasing wealth quintiles. Each gradient increase in wealth relates to a noticeably lower probability of reporting health problems. 3) There is a decline in the probability of reporting a functional limitation with increasing wealth, but a leveling off occurs at the highest quintiles. One reason for this may be differentiation in association of wealth on health at very old ages. 4) The relationship between wealth and disability is anomalous. It is U-shaped and the net effect is not as statistically robust.

A limitation of the SEC data is that it is cross-sectional and as such it is difficult to assess causal mechanisms. Therefore, at best, this study is able to present associations but unable to pinpoint a causal sequence. Nonetheless, some speculation is possible based on the results and on earlier theoretical literature. One possibility is that associations run from health to wealth through the ability to work later into life (Smith, 1999). Indeed, Table 4 indicated strong relationships between the probability of working in the past year and health. Bivariate analyses (not shown) indicated healthier individuals are more likely to report having worked in the past year. But, there are also some complications to this viewpoint. First, there is a relatively weak association between work and wealth across the lower four quintiles (see Table 3), and therefore the indirect association leading from health to wealth may not be very strong. Second, conceptually, the wealth measure used here is based on household rather than individual wealth, and it is not clear to what extent the older adult themselves contribute to the wealth of a household regardless of their work status. Third, being a long-term indicator, wealth may better relate to work status over the person's life rather than over the past year, the latter of which is the only measure available in the current dataset.

Assuming that the association runs from wealth to health, it is quite possible that a series of psychosocial and psychobiological factors intervene. In the developed world, factors such as access to health services, behavior, stress, locus of control and social support have been found to mediate socioeconomic status and health (House, Kessler, Herzog, Kinney, Mero and Breslow 1990; House et al. 1994; Kristenson, Eriksen, Luiter, Starke & Ursin, 2004; Kunz-Ebrecht, Krischbaum & Steptoe, 2004; Siegrist & Marmot, 2004). Link and Phelan (1995) provided a notable addition to the psychosocial literature by suggesting that socioeconomic status is a fundamental cause of health due to the basic nature of the association between status and access to resources. This implies that the link should be robust across different countries, cultures and environments even if the specific mechanisms that drive the association change. One might conjecture that since much of old-age life is dependent upon family in rural Cambodia, it may be social support and related exchange factors that are the key intervening mechanisms. Thus, there may be complex connections that run through factors such as household size, intergenerational exchange, quality of interactions, and frequency of interactions. Associations in Table 3 showing that wealth is strongly related to household size and living arrangements support this view.

But, there are also legitimate problems to this line of reasoning. For instance, Table 4 indicated little association between household size and health, bringing into question an indirect association through indicators of support. Another problem is a rather weak link between education and health. Education was in fact found to increase the probability of functional limitation, although other associations with education were not statistically significant (see Table 4). Still, despite this unanticipated result, it should be noted that an inconclusive association between education and health, or even one in the opposite direction as expected, is not without precedent in developing countries (Liang, Liu and Gu, 2001;Liang, McCarthy, Jain, Krause, Bennett & Gu, 2000;Zimmer et al., 2004). Indeed, although there is nothing close to a comfortable accumulation of evidence on the topic, it does appear that education may not be related to health in developing Asian societies in similar ways as in other parts of the world. Part of this may be because there is minimal variation in education while part may be because education is not a good indicator of socioeconomic status in these societies.

It was also unanticipated that the association between wealth and disability would be weak and non-linear. There are several possible reasons for this result. One is that disability and wealth are both related to a third factor, such as household size. That is, older adults tend to live with others when they require assistance in conducting daily tasks. In turn, larger households have greater wealth due to accumulation that is possible with each additional household member. However, if this explanation were correct one would expect to see an association between household size and health, which was absent in Table 4. A second possibility is that the U-shaped association with disability is partly a function of survival, which cannot be observed in cross-sectional data. That is, those in poor households with disabilities may not live long, while those in wealthier households, owing to better health care and other types of support, might survive longer with their disability. In this instance, the incidence of disability could be higher for those in lower wealth quintiles, but prevalence higher for those in the higher quintiles. Still, though life expectancy likely plays a role in determining prevalence rates, it is not clear why survival would have an impact on associations with disability but not associations with other health outcomes. Therefore, it is likely that, at least to some degree, there is something about disability that differs from other health problems, even functional limitation. For instance, there may be reporting differences. Unlike the other health components considered in this study, which are more or less objective, ability to conduct ADLs is a function of environment, social and personal expectations (Freedman & Martin, 1998;Verbrugge & Jette, 1994). Thus, those in the higher quintiles may expect more and therefore perceive their disability problems differently from those in lower quintiles. Nonetheless, the result is still somewhat puzzling.

The current study did not include individuals living in urban areas. The SEC data does contain an urban population, but there are two problems with incorporating them into the analysis. First, the urban sample is very small, consisting of only about 250 unweighted observations. Second, measuring and interpreting wealth and poverty is difficult when pooling those living in urban and rural areas of Cambodia. For instance, based on the measure of wealth used in the current study, nearly every urban respondent would be classified as being rich and nearly every rural respondent as poor even if on a relative basis the urbanites were living in poverty. Moreover, access to health care differs drastically across urban and rural areas. In other words, the part of the social environment that is critical to the current analysis differs greatly for those living in rural and urban areas. Certainly, separate construction of the wealth index would be possible for urban dwellers, but again, the small sample size would make it difficult to obtain stable results. Thus, the current study focused on rural Cambodia, which is exceedingly poverty stricken in comparison to urban areas. Yet, given very different social circumstances existing across rural and urban Cambodia, future analyses that examine health and its determinants across urban and rural areas is certainly needed. The same is true not only for Cambodia, but for most of the developing world.

In sum, the current study is limited in a number of ways. Nonetheless, as a first study examining economic inequality and its association with health in an extreme poverty environment, it has provided some notable results. In particular, a health gradient was found across wealth groups for the very poorest of the poor. In a sense, those having next to nothing were shown to have better health than those having nothing. Many people in the world live in countries where poverty is widespread. This study has intimated an ability to generalize the association between economic well-being and health to populations living in these types of extreme conditions.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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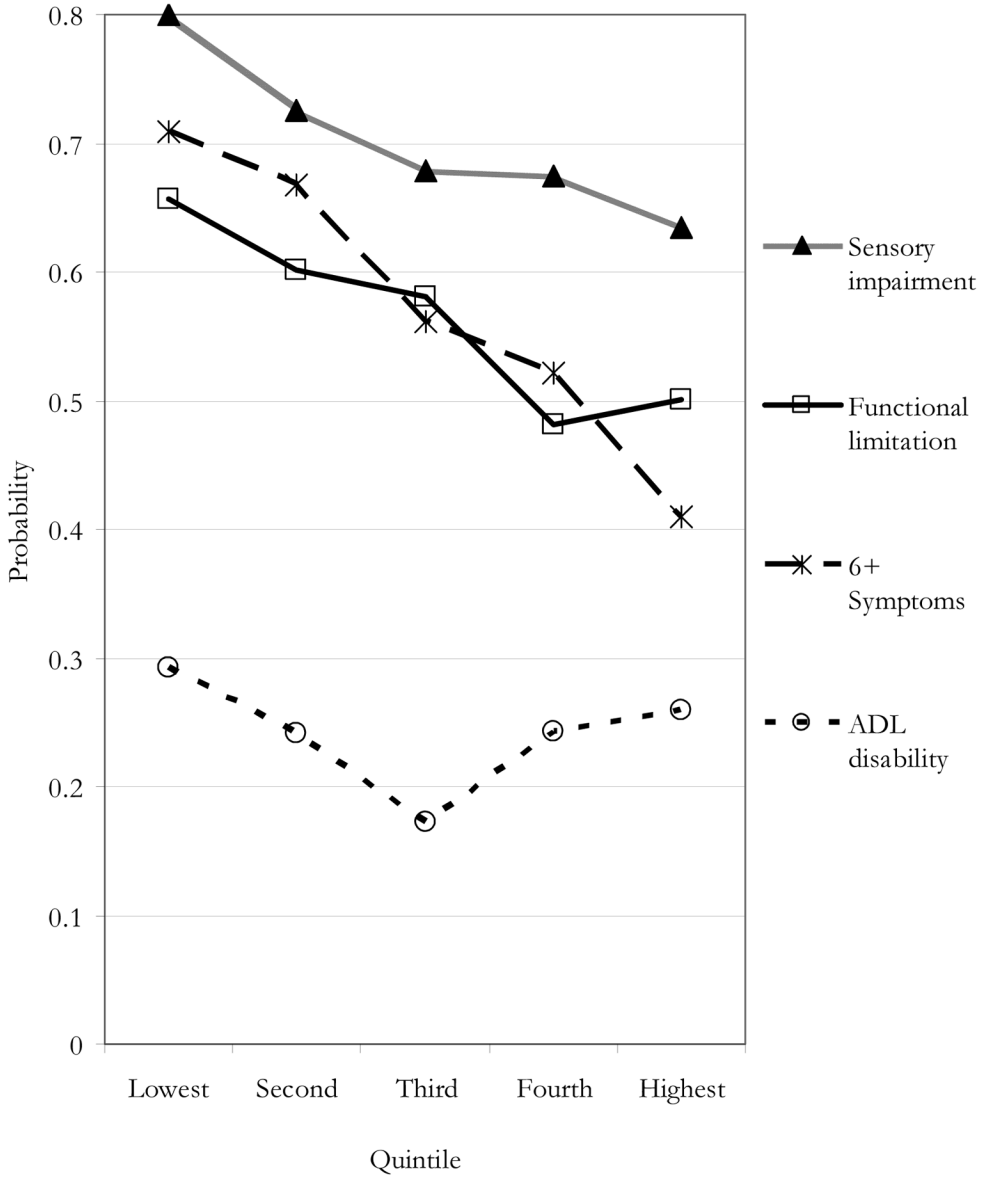

Figure 1.
Predicted probability of reporting health problems by wealth quintile

Table 1

Percent distributions by gender

	Total (N=1011)	Men (N=416)	Women (N=595)	χ^2
Age				
- 60-64	31.9%	32.5%	31.5%	1.8
- 65-69	26.6	28.4	25.3	
- 70-74	21.4	20.2	22.3	
- 75+	20.1	19.0	20.8	
Marital status				
- Married	51.8%	81.0%	31.4%	247.9*
- Widowed	44.4	16.3	63.0	
- Separated/divorced	2.9	2.6	3.0	
- Never married	0.9	0.0	1.5	
Ethnicity				
% Khmer[a]	89.5%	89.9%	89.3%	0.1
Religion				
- Buddhist[b]	95.1%	94.2%	95.8%	1.3
Schooling				
- None	58.2%	25.5%	81.0%	310.1*
- Primary/pagoda	34.6	60.7	16.3	
- More than primary	7.2	13.7	2.7	
Labor force participation				
- Worked last year	38.2%	49.6%	30.3%	38.9*
Occupation most of life				
- Agriculture	78.4%	80.7%	76.8%	24.6*
- Other	18.2	19.3	17.5	
- Never worked	3.4	0.0	5.7	
Living arrangement				
- Lives with 1+ offspring	78.7%	83.9%	75.1%	11.1*
Household size				
- 1	3.6%	1.0%	5.4%	20.7*
- 2	10.7	8.9	11.9	
- 3-5	39.9	45.2	36.1	
- 6+	45.9	45.0	46.6	

* $p < .05$

[a] Others=Cham, Chinese, Vietnamese

[b] Others=Christian, Islam, Non-stated

Table 2

Percent reporting summary health problems by age and sex

	N	Symtpoms[a]	Sensory impairment[b]	Functional limitation[c]	Disability[d]
Age					
- 60-64	346	51.1	56.0	33.1	12.1
- 65-69	258	54.5	69.9	46.1	22.0
- 70-74	206	62.7	78.3	66.7	31.5
- 75+	201	63.5	83.7	82.3	36.0
χ^2		11.7*	55.5*	142.4*	48.7*
Sex					
- Men	416	52.5	70.4	39.0	20.0
- Women	595	60.0	69.9	63.9	26.4
χ^2		5.6*	0.9	60.6*	5.6*
Total	1011	57.0	70.1	53.6	23.7

* $p < .05$, two-tailed test

[a] Experienced six of the following within last month: joint pain, dizziness, headaches, fever, chest pain, coughing, trembling hands, stomach ache, breathing problems, diarrhea, skin problems, vomiting.

[b] Difficulty seeing without glasses and/or hearing without a hearing aid.

[c] A lot of difficulty, or cannot, walk, climb stairs, grasp with findings, lift and/or crouching

[d] Any difficulty eating, dressing, bathing and/or getting up from bed

Table 3

Number assets, percent households owning specific assets, and selected demographic characteristics, by wealth quintiles

		Quintiles					
	Total (N=1011)	**Lowest (N=160)**	**Second (N=226)**	**Third (N=205)**	**Fourth (N=208)**	**Highest (N=218)**	**χ^2 or F-Value[a]**
Panel A. Number assets owned							
Mean	2.4	0.0	1.0	1.9	3.1	5.6	1495.2*
Std. deviation	2.1	0.0	0.0	0.3	0.6	1.6	
Median	2	0	1	2	3	5	
10^{th} percentile	0	0	1	2	2	4	
90^{th} percentile	5	0	1	2	4	8	
Panel B. % households owning assets							
Radio	67.3	0.0	57.1	85.4	86.5	92.5	466.8*
Television	60.5	0.0	36.3	71.7	85.1	97.2	483.4*
Modern toilet	27.4	0.0	0.0	13.7	33.7	84.0	513.0*
Jewelry	25.6	0.0	6.6	16.1	49.5	50.9	241.3*
Motorcycle	25.1	0.0	0.0	5.9	36.2	78.4	505.0*
Modern floor	12.3	0.0	0.0	1.0	13.5	44.1	279.8*
Telephone	10.7	0.0	0.0	0.0	1.0	49.3	428.0*
Fan	10.6	0.0	0.0	0.0	1.9	48.8	412.1*
Car	2.5	0.0	0.0	0.0	1.0	10.8	78.2*
Refrigerator	1.7	0.0	0.0	0.0	0.0	8.0	64.9*
Panel C. Demographic characteristics							
% female	58.9	71.9	58.8	53.7	49.5	63.2	22.6*
% married	51.9	39.4	52.2	54.6	60.1	50.2	16.5*
% with schooling	41.7	25.2	38.5	40.5	53.4	47.7	33.5*
% working	61.7	63.8	56.6	59.0	54.8	74.6	22.6*
% in agriculture	78.4	86.8	85.4	84.9	78.4	58.5	67.9*
% living with child	78.7	62.3	74.3	74.0	88.5	90.6	60.7*
Mean household size	5.4	4.2	4.8	5.3	5.9	6.4	21.2*

* $p < .05$, two-tailed test

[a] Categorical tests use χ^2, mean tests use F-Ratios.

Table 4

Logistic regression results for summary health measures showing odds ratios (with two-tailed p-values in parentheses)

	Model 1				Model 2				Model 3			
	Symptoms	**Sensory impairment**	**Functional limitation**	**Disability**	**Symptoms**	**Sensory impairment**	**Functional limitation**	**Disability**	**Symptoms**	**Sensory impairment**	**Functional limitation**	**Disability**
Quintiles												
- Lowest	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
- Second	0.80 (.22)	0.65 (.21)	0.67 (.09)	0.72 (.16)	0.83 (.33)	0.63 (.19)	0.74 (.26)	0.74 (.22)	0.82 (.28)	0.64 (.22)	0.74 (.28)	0.75 (.24)
- Third	0.51 (.00)	0.50 (.01)	0.44 (.00)	0.45 (.00)	0.55 (.03)	0.50 (.01)	0.51 (.01)	0.49 (.00)	0.52 (.02)	0.50 (.01)	0.47 (.01)	0.48 (.00)
- Fourth	0.42 (.00)	0.46 (.00)	0.35 (.00)	0.67 (.10)	0.47 (.00)	0.48 (.01)	0.42 (.01)	0.78 (.35)	0.44 (.00)	0.49 (.01)	0.39 (.00)	0.76 (.32)
- Highest	0.29 (.00)	0.44 (.00)	0.53 (.01)	0.91 (.76)	0.30 (.00)	0.43 (.00)	0.52 (.02)	0.94 (.86)	0.28 (.00)	0.41 (.00)	0.43 (.01)	0.84 (.62)
Age												
- 60-64					1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
- 65-69					1.13 (.58)	1.82 (.00)	1.83 (.00)	2.12 (.00)	1.13 (.60)	1.57 (.01)	1.59 (.01)	1.97 (.00)
- 70-74					1.57 (.01)	2.79 (.00)	4.18 (.00)	3.33 (.00)	1.43 (.08)	2.24 (.00)	3.16 (.00)	2.86 (.00)
- 75+					1.66 (.01)	4.09 (.00)	10.70 (.00)	4.13 (.00)	1.47 (.07)	3.24 (.00)	7.80 (.00)	3.43 (.00)
Female					1.30 (.08)	0.89 (.45)	2.95 (.00)	1.35 (.07)	1.26 (.26)	0.74 (.18)	2.90 (.00)	1.31 (.33)
In agriculture									1.33 (.13)	0.86 (.38)	1.16 (.43)	0.91 (.61)
Household size									1.06 (.06)	0.98 (.39)	0.99 (.73)	1.01 (.82)
Worked									0.83 (.26)	0.62 (.02)	0.38 (.00)	0.65 (.06)
Married									1.02 (.87)	1.10 (.69)	0.77 (.16)	0.83 (.49)
Has schooling									0.93 (.67)	0.80 (.26)	1.55 (.03)	1.27 (.41)
LL	−668.5	−608.9	−683.5	−547.4	−661.2	−581.3	−582.5	−520.7	−655.8	−575.8	−559.5	−516.5
Δ −2 X LL[a]	44.7 (.00)	15.3 (.00)	29.2 (.00)	12.7 (.01)	42.6 (.00)	14.0 (.01)	16.7 (.00)	9.6 (.05)	40.0 (.00)	12.8 (.01)	18.9 (.00)	8.5 (.08)

[a] Change in −2 X Log-likelihood when adding wealth to a models containing other variables. For Model 1, it is the change when adding wealth to a model containing the constant only.

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