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## Post-reproductive survival in a polygamous society in rural Africa

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## Chapter 4

# Socio-economic status by rapid appraisal is highly correlated to mortality risks in rural Africa

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## **Abstract**

Socio-economic status is an important determinant of health and survival in rural Africa and necessitates a practical and valid instrument to implement in health studies. Our objective was to investigate the validity of the rapid appraisal method to assess socioeconomic status and its ability to identify individuals at risk.

Among 1,573 households in rural northern Ghana, we calculated the Demographic Health Survey (DHS) wealth index and conducted two rapid appraisal methods: self-reported wealth and interviewer- reported wealth. In addition we followed the 25,184 participants from these households for survival with a mean follow up of 3.9 years, during which 885 participants died.

The DHS wealth index was moderately correlated to self-reported wealth (Spearman Rho 0.59,  $p < 0.001$ ) and interviewer- reported wealth (Spearman Rho 0.75,  $p < 0.001$ ). Mortality risks were significantly higher for people with lower self-reported wealth compared to average (HR 1.30 [95%CI 1.11–1.51]) and lower interviewer reported wealth (HR 1.40 [95%CI 1.21–1.62]). Mortality risks were lower for people with higher self-reported wealth (HR 0.81 [95%CI 0.32–2.03]) and higher interviewer-reported wealth (HR 0.84 [95%CI 0.58–1.21]). Similar discriminative mortality risks were assessed when using tertiles of the DHS wealth index ( $p_{\text{trend}} < 0.001$ ).

### **Introduction**

Socio-economic status (SES) is a difficult concept, both to define and to measure. Here, we interpret SES as a hierarchical position that determines someone's access to human or material resources. SES largely influences health and survival in both developing and developed countries<sup>1</sup>. In developed countries SES is mostly measured as a combination of education, income and occupation<sup>2,3</sup>. In developing countries however, especially in rural areas, most people have little education and income tends to be fluctuant depending both on the season and on the year and is not easily expressed in numbers. Also, the SES in developing countries is largely dependent upon a relative, social position in the community, clan or extended family and this is not always reflected in property<sup>4</sup>. In an attempt to measure SES in resource poor countries, long questionnaires of housing, household items, expenses, income, land use or food intake were constructed<sup>5</sup>. These long property questionnaires, however, were impractical because they were very time-consuming. Expenditure surveys are another method to estimate the socioeconomic status. However, in many rural areas the largest part of the economy is based on the exchange of goods and labor. Expenditure is difficult to measure in these settings. Most countries and institutions now use the Demographic and Health Survey (DHS) wealth index as a practical, valid and comparable method to assess the SES.

The DHS wealth index has some limitations. First, the DHS questionnaire was never developed to measure SES in the first place. All items that are used to construct the DHS wealth index were included in the DHS to assess different health aspects. The availability of a television or radio was included to measure the exposure to mass media health campaigns, the availability of a motorcycle or car to measure the ability to reach a nearby clinic in an emergency. From these possessions, it was later thought possible to construct a wealth index. Because of this historical origin, obvious possessions such as live stock were not included in the original DHS asset list. However, this was also noted by the DHS institution, who proposed an extension of the property assets in 2004<sup>6</sup>. A second limitation to the DHS wealth index is its practical implication. The use of country specific item lists with principal component analysis to weigh the different items allows the wealth index to be employed in different countries and allows a reasonable cross-country comparison. This is practical for public health officers and health policy makers. However, for the clinician-researcher who wants to estimate the SES differences in his study population in a rural resource-poor community, it is less

practical. For medical research in resource-poor countries it is crucial to assess the SES differences of the study population, because these differences have a large effect on health outcomes. However, because of the high workload in medical hospitals in these resource-poor countries it is not always possible to visit the participants at home, or to question all the participants on their possessions. For the clinician-researcher, the rapid appraisal method could be a practical method to assess the differences in SES. The rapid appraisal method is an anthropological method which uses qualitative measures of SES and is designed to rank or stratify participants in wealth categories. Different rapid appraisal methods have been developed. Here we study two rapid appraisals. The first is the self-reported wealth, in which one asks the participant whether he/she regards his/her wealth to be below average, average or above average. The second rapid appraisal is the interviewer-reported wealth, which is more suited for fieldwork, where interviewers visit the participants at home. Based on the interviewers' observations here, the interviewer is asked to rank the household as below average, average or above average. Rapid appraisals, however, have always been looked upon as 'quick and dirty' estimates, while the longer property questionnaires were regarded as more valid and scientific<sup>7</sup>. Development workers have used the rapid appraisals extensively but validation studies are few in number and have not reached the established academic journals<sup>8</sup>.

As questions remain on the validity and on the ability of the rapid appraisal method for health studies to identify individuals at risk, we conducted a comparative study in a rural area in northern Ghana comparing the DHS wealth index with two rapid appraisal methods: self-reported wealth and interviewer-reported wealth. To this end we have followed 25,184 participants from 2002 to 2007 and calculated mortality risks to see whether the rapid appraisal methods are able to identify individuals at risk.

## **Methods**

### *Study area*

The study was conducted in the Garu-Tempane district which is situated in the Upper East Region of the Republic of Ghana<sup>9</sup>. This region is far less developed than the southern part of Ghana, in socioeconomic aspect as well as in agricultural means. The Upper East Region, therefore, more resembles the neighboring countries of Burkina Faso and Togo. The area has a semi-Saharan climate with an average maximum temperature of 32 °C throughout the year and only one rain

season (June–August). The research area measures approximately 375 km<sup>2</sup> with approximately 25,000 participants living in around 40 villages. Most people in the research area rely on traditional medical care, which is equally distributed throughout the area. There is no medical doctor working in the research area and the nearest hospital is 40 kilometers away.

### *Study population*

People in the research area live in polygamous extended families, with an average of 12 persons per household. The families live together in compounds; clay structures with thatched roofs, connected by clay walls. There are some 1,500 compounds in the research area. The people belong to several different tribes, mainly Bimoba, Kusasi and Mamprusi. A small group of more nomadic Fulani are living in the area as well. The vast majority of the people are farmers. The total agricultural process is done by hand. The average per capita income corrected for purchasing power parity of the whole of Ghana in the year 2008 was US\$1,513<sup>10</sup>. In the research area no formal estimation of the per capita income has ever been performed, but because of the agricultural aspect and exchange nature of the economy this seems not very indicative either. The area as a whole however, is much less developed than the rest of Ghana.

### *Socio-economic study*

In 2007 we designed a DHS type questionnaire to assess the SES of the study participants using a free listing technique whereby we asked people from different villages of the research area, both male and female, in focus group discussions to list the household items of most value. These self-listed property questionnaires are reported to be highly correlated to longer property questionnaires<sup>11</sup>. The resulting list of valuable items was comparable to part of the Core Welfare Indications Questionnaire (CWIQ) from the World Bank and to the extended DHS asset list, adapted to our region<sup>5</sup>. Table 1 shows the different items, including mainly domestic livestock and different valuable household items comprising motorbikes, bicycles and iron roofing. From these assets a DHS wealth index was calculated. This was done as explained in paragraph 2.2 of the DHS wealth index comparative report<sup>6</sup>. Using SPSS factor analysis, the indicator variables were first standardized by calculating z-scores. Second, the factor coefficient scores or factor loadings are calculated. The DHS wealth index is the sum of the indicator values

multiplied by the loadings. This index is itself a standardised score with a mean of zero and a standard deviation of one.

As a rapid appraisal we asked the landlord or another senior person of the compound to rate the wealth status of their compound as below average, average or above average as compared to the other households in the research area. We also asked the interviewers to rate the wealth status of the compound as below average, average or above average. The interviewers worked in pairs of two and discussed their rating of the household to find consensus. All interviewers are born in the area, have many years of training and experience with the fieldwork and were explicitly trained for the DHS wealth index and rapid appraisal methods in 2007.

#### *Survival study*

In September 2002 we started with a database of all the inhabitants of the area, set up by the department of Parasitology of the Leiden University Medical Centre<sup>12</sup>. All compounds and inhabitants were registered and each compound was plotted on a map by means of GPS-handheld systems<sup>9</sup>.

From 2002 through 2007 we have annually visited all compounds in the research area from June to August to update demographic data including migration, new-borns and mortality.

#### *Statistical analysis*

The correlation between the DHS wealth index and the rapid appraisal methods was calculated using Spearman's correlation coefficient. The correlation between self-reported wealth and interviewer-reported wealth was calculated with a linear weighted kappa. We used a Cox proportional hazard model with robust standard errors clustered on compound to calculate age and sex adjusted hazard ratios and plotted Kaplan-Meier survival plots. We tested for proportionality of hazards and found no evidence that the assumption of proportionality of hazards was violated. We used robust standard errors clustered on compound because mortality is an individual measurement and the wealth status is a measurement on the compound level. By using robust standard errors of the compound level however, we take into account that two dead children from one compound share more (genetic and environmental) determinants than just SES. Otherwise, our estimate of the importance of SES for mortality risks would be inflated. To plot the Kaplan-Meier plots, we divided the DHS wealth index in tertiles, to compare the DHS method to

the rapid appraisal methods which also uses three categories. However, the p for trend for the DHS wealth index was estimated using the continuous measurement. Because of the different ages of entry in the study we used left-censoring. Using this method we were able to calculate cumulative survival probabilities for all ages using our follow-up data from 2002 to 2007. Because the mortality risks as plotted by the Kaplan-Meier curves are age specific, this also corrects for any differences in age in the different wealth categories. All calculations were performed with SPSS 14.0 (SPSS Inc., Chicago, USA) with the exception of the hazard ratios, Kaplan-Meier plots and weighed kappa analysis which were calculated and plotted with Stata 9.0 (StataCorp LP, Texas USA).

### **Results**

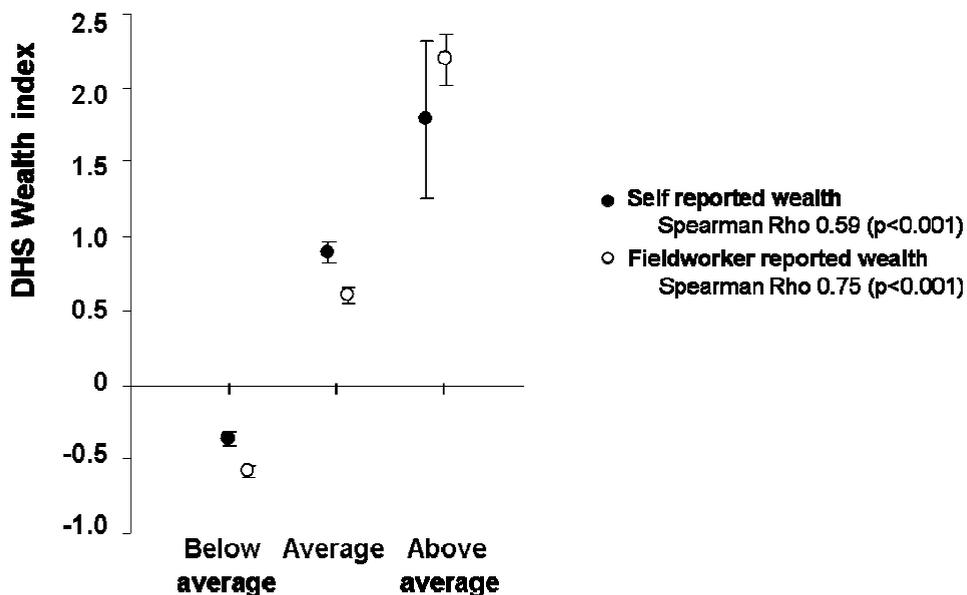
#### *Socio-economic status*

Table 1 shows the characteristics of the study population and results of the DHS wealth index and rapid appraisal methods. There was a correlation between the DHS wealth index and both self-reported wealth (Spearman Rho 0.59,  $p < 0.001$ ) and interviewer-reported wealth (Spearman Rho 0.75,  $p < 0.001$ ) figure 1). Self-reported wealth and interviewer-reported wealth were also correlated with 74% agreement (weighed kappa 0.56,  $p < 0.0001$ ).

**Table 1. Characteristics of the study population**

Participants (n)	25,184	
Male (n)	11,788 (46%)	
Female (n)	13,650 (54%)	
Mean follow up (years)	3.9	
Compounds (n)	1,573	
Participants per compound (n) <sup>1</sup>	12 (1-153)	
<b>DHS wealth index<sup>1</sup></b>		
Number of male cattle	1 (0-16)	
Number of female cattle	0 (0-30)	
Number of goats	3 (0-40)	
Number of sheep	2 (0-60)	
Number of pigs	2 (0-20)	
Number of donkeys	0 (0-9)	
Number of motorbikes	0 (0-9)	
Number of bicycles	2 (0-27)	
Compounds with iron roofing (%)	61%	
Compounds with electricity (%)	15%	
Compounds using fertilizer last season (%)	68%	
<b>Rapid appraisal</b>		
	<b>Compounds</b>	<b>Participants</b>
Self-reported wealth (n)	1,549 (94%)	24,719 (97%)
Below average (n)	1,104 (71%)	14,928 (60%)
Average (n)	436 (28%)	9,560 (39%)
Above average (n)	9 (1%)	231 (1%)
Interviewer-reported wealth (n)	1,548 (94%)	24,696 (97%)
Below average (n)	870 (56%)	10,432 (42%)
Average (n)	618 (40%)	12,462 (51%)
Above average (n)	60 (4%)	1,802 (7%)

<sup>1</sup>Data presented as medians with minimum and maximum.



**Figure 1.** Correlation between rapid appraisal methods (self-reported wealth and interviewer-reported wealth) and DHS wealth index. Data are represented as means with 95% confidence interval.

### *Mortality risks*

To assess whether the rapid appraisal method is able to identify individuals at risk we calculated mortality risks for the different wealth groups. The mean follow-up period was 3.9 years, during which 885 (3.5%) participants had died. We found significantly higher mortality risks for people with lower self-reported wealth (HR 1.30 [95%CI 1.11–1.51]) and lower interviewer-reported wealth (HR 1.40 [95%CI 1.21–1.62]) as compared to average (table 2). Mortality risks were also lower for people with higher wealth status compared to average for self-reported wealth (HR 0.81 [95%CI 0.32–2.03]) and interviewer-reported wealth (HR 0.84 [95%CI 0.58–1.21]). Going from lower to higher wealth status mortality risks decrease both with self-reported wealth ( $p_{\text{trend}}=0.001$ ) and interviewer-reported wealth ( $p_{\text{trend}}<0.001$ ). Similar patterns were observed for males and females separately (table 2). To compare the rapid appraisals with the DHS wealth index we divided the DHS wealth index in tertiles. We found a similar relation of lower wealth with higher mortality risks (HR 1.22 [95%CI 1.02–1.45]) and of higher wealth with lower

mortality risks (HR 0.88 [95% CI 0.73-1.06]). Going from lower to higher DHS wealth index, mortality risks decrease ( $p_{\text{trend}} < 0.001$ ).

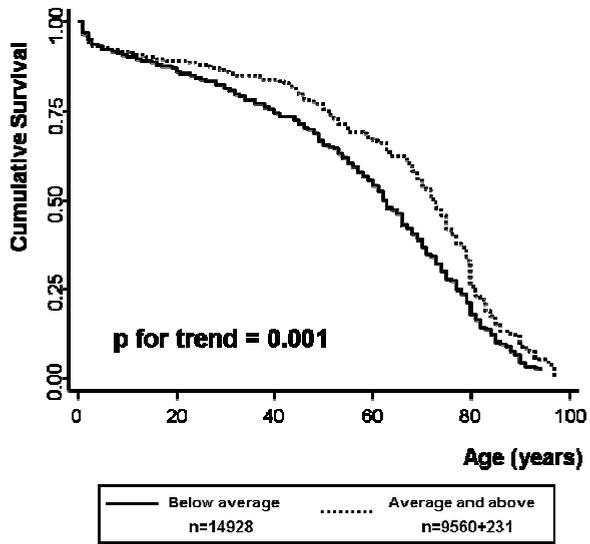
Figure 2a and 2b show the corresponding cumulative survival probabilities of the different wealth categories for both self-reported wealth and interviewer-reported wealth. Figure 2c shows the survival probabilities for the different tertiles of the DHS wealth index.

**Table 2. Mortality risks for different wealth categories**

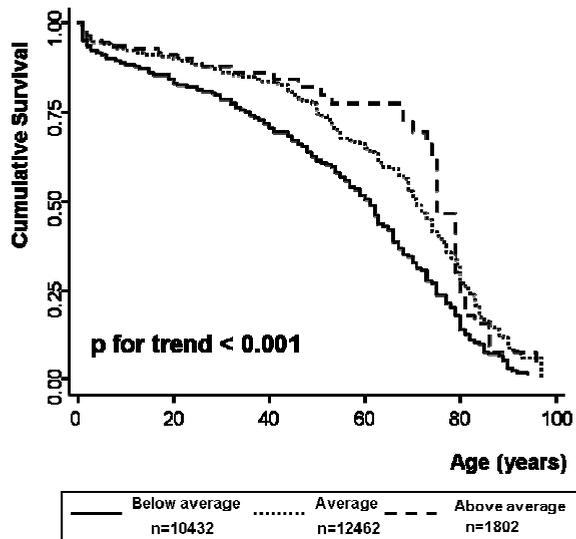
	<b>Below average</b> HR (95%CI)	<b>Average</b> (ref)	<b>Above average</b> HR (95%CI)	<b>p for trend</b>
<b>Self-reported wealth</b>				
All	1.30 (1.11-1.51)	1	0.81 (0.32-2.03)	0.001
Males	1.32 (1.09-1.60)	1	0.93 (0.27-3.19)	0.005
Females	1.26 (1.02-1.55)	1	0.62 (0.15-2.60)	0.029
<b>Interviewer-reported wealth</b>				
All	1.40 (1.21-1.62)	1	0.84 (0.58-1.21)	<0.001
Males	1.51 (1.25-1.82)	1	0.93 (0.62-1.41)	<0.001
Females	1.26 (1.03-1.54)	1	0.74 (0.47-1.18)	0.004
<b>Tertiles of DHS wealth index</b>				
All	1.22 (1.02-1.45)	1	0.88 (0.73-1.06)	<0.001
Males	1.40 (1.13-1.73)	1	0.98 (0.77-1.23)	0.001
Females	1.03 (0.81-1.30)	1	0.83 (0.64-1.06)	0.068

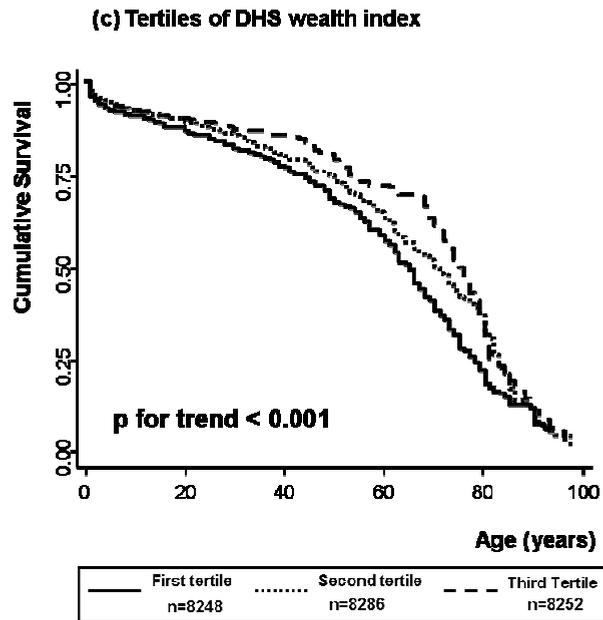
Cox proportional hazard model adjusted and stratified for sex. Data presented as hazard ratios (HR) with 95% confidence intervals (CI). Different wealth categories as reported by the rapid appraisal methods and wealth index divided in tertiles for the DHS wealth index. P for trend estimated for the DHS wealth index using the continuous measurement (see Methods section).

**(a) Self reported wealth**



**(b) Fieldworker reported wealth**





**Figure 2.** Survival probabilities dependent on various estimates of SES. (a) Self-reported wealth (b) Interviewer-reported wealth and (c) Tertiles of DHS wealth index. Estimates based on annual surveys between 2002–2007, analyzed with left censored Cox proportional regression with robust standard errors clustered on compound adjusted for sex. P for trend estimated for the DHS wealth index using the continuous measurement.

## Discussion

In a rural community in northern Ghana we compared the DHS wealth index with two rapid appraisal methods to estimate wealth and to identify individuals at risk. The rapid appraisal methods are very practical to include in health studies in resource-poor environments. Questions remained on their validity however. We conclude that rapid appraisal can be used as a practical method to assess SES in health studies in rural Africa. The rapid appraisals are correlated with the DHS wealth index but more practical; it takes only a minute to rate the wealth status of a compound as below average or above average. The rapid appraisal methods also identify individuals at higher risk of mortality, even a little better than the DHS wealth index. One of the strengths of the rapid appraisal is that it could measure relative wealth, derived from the social status of the household members in the community. This position in family or clan structures is of utmost importance in the rural areas of developing countries and is not always reflected in their property<sup>4</sup>. Therefore, the rapid appraisal method is not only more practical but could indeed be more accurate to identify individuals at risk.

One of the complications of this study was that participants could be inclined to rate their household as below average. This could have happened because the participant might think this would make them more eligible to developmental programs in the area. Also, some participants may have refused cooperation because they were anxious that extra tax measures would be imposed upon them. The interviewers explained to all participants in their own language the reason of our visit and explicitly stated that neither developmental help nor extra taxes would be assigned to them based on their answers. We have also asked the interviewers to give their objective estimate of the household wealth and this resulted in more households being categorized in the above average category. All in all, we reason that if these biases would have occurred, it would have diminished the association with mortality risks and the real effect could therefore only be stronger than reported here. Both rapid appraisal methods are suitable for the measurement of SES, but from this experience the interviewer-reported wealth could be more satisfactory in some studies.

One problem of our study was that the interviewer-reported wealth was estimated after the interviewers had gone through the asset list with the participants. Therefore, the possessions could have influenced the ranking of the interviewer. The correlation between the interviewer-reported wealth and the DHS wealth index could therefore be inflated. We tried to train the fieldworkers to make an unbiased estimation based on their own impression. As the fieldworkers estimates differ from both the property estimates and the self-reported wealth estimates we think this was clearly understood by the fieldworkers. Also, we see a similar correlation of the self-reported wealth with the DHS wealth index and because the participant is already aware of his possessions, his ranking is not influenced by the previous collection of the DHS wealth index. Because many indicator variables are visible to the interviewer when he visits a compound (iron roofing, electricity, bicycles, motorbikes, livestock around the compound) we think that when the fieldworker reported wealth would have been taken before the DHS wealth index, a similar correlation would have been found. However it should be acknowledged that this is one of the limitations of this study.

Another limitation could be that our list of valuable items is limited. However, in this poor rural environment no other common items of value have been found and even the land is common property. Because we have asked the participants

themselves to list all items of value in the area during the preparation of the questionnaire, a technique known as free listing, we are fairly confident that we have covered the items of reasonable value. Previously, it was also shown that a short list created with this technique is equally valid as the longer property questionnaires<sup>11</sup>.

One final limitation of the rapid appraisal method is that it is not able to identify the poorest decile or poorest quartile, while the DHS, as a continuous measurement, is able to do so.

The use of average benchmarks requires that participants or fieldworkers are aware of which area they are comparing over. It should therefore be noted that the rapid appraisal methods are probably best suited for populations that are not too large and where the socioeconomic status is not clustered and evenly spread across the research area. Therefore, rural areas in developing countries seem best suited to this method.

This study shows that rapid appraisal, consisting of only one question and easily incorporated in health studies, is moderately correlated to the DHS wealth index and can identify individuals at risk. This applies to both rapid appraisal methods: self-reported wealth and interviewer-reported wealth.

## **Declarations**

### *Ethical approval*

This study is part of the study "Role of innate immunity into the trade-off between reproductive success and early survival in the Upper East Region of Ghana", for which ethical approval has been given by the Ethical Review Committee of the Ghana Health Service under number GHS-ERC-03/3/06 and also by the Medical Ethical Committee of the Leiden University Medical Centre in Leiden, the Netherlands.

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## Chapter 4

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### *Conflict of interest*

None declared.

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