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Title

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Permalink

<https://escholarship.org/uc/item/21j703fp>

Journal

American Journal of Human Biology, 29(4)

ISSN

1042-0533

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Publication Date

2017-07-08

DOI

10.1002/ajhb.22987

Peer reviewed

Measuring material wealth in low-income settings: A conceptual and how-to guide

Running head: Measuring material wealth in low-income settings

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Number of pages: 12

Number of tables, figures, graphs, and charts: 0

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Grant sponsorship: DJH acknowledges support from the National Science Foundation grant BCS-1150813, jointly funded by the Programs in Cultural Anthropology, Social Psychology Program and Decision, Risk, and Management Sciences.

ABSTRACT

Although wealth is consistently found to be an important predictor of health and well-being, there remains debate as to the best way to conceptualize and operationalize wealth. In this paper, we focus on the measurement of economic resources, which is one among many forms of wealth. We provide an overview of the process of measuring material wealth, including theoretical and conceptual considerations, a how-to guide based on the most common approach to measurement, and a review of important theoretical and empirical questions that remain to be resolved. Throughout, we emphasize considerations particular to the settings in which anthropologists work, and we include variations on common approaches to measuring material wealth that might be better suited to anthropologists' theoretical questions, methodological approaches, and fieldwork settings.

Key words: wealth index, socioeconomic status, asset-based index

Introduction

One of the best established influences on human growth and well-being is the suite of economic resources available to individuals and households. Economic resources can provide opportunities for improved nutrition and sanitation and greater access to clean water, education, medicine, and health services (Godoy et al., 2005, 2010; Hruschka et al., 2014; Kasper and Borgerhoff Mulder, 2015). For these and other reasons, as humans enjoy increasing standards of living, they often grow taller (Steckel, 1995) and heavier (Hruschka, 2012), suffer from fewer infectious diseases but a higher incidence of metabolic disorders (Omron, 1971), and become increasingly buffered from the energetic costs of reproduction (Hruschka and Hagaman, 2015).

Researchers have proposed a number of ways that economic resources can shape health. Materialist approaches focus on the direct effects of absolute wealth through improved nutrition, sanitation, and access to healthcare (Davey Smith and Egger, 1996; Kaplan, 1994). Other researchers argue that economic resources create a hierarchy of socioeconomic position, or inequality, that itself can have health consequences (Marmot et al., 1991; Wilkinson, 1997). These include the negative psychosocial effects of occupying a lower position in the hierarchy, as well as the increased stress and violence potentially experienced in an unequal society. These latter theories predict an effect of inequality over and above that expected from the absolute economic resources held by individuals and households (Singh-Manoux et al., 2005).

Given the important role of economic resources in shaping human biology, social scientists and public health practitioners have developed a number of methods for estimating the economic resources available to individuals and households. Existing literature on wealth is often limited by poor conceptualization and measurement; indeed, a narrow consideration of wealth that accounts for only economic resources is one such limitation. Anthropologists instead understand wealth in a multifaceted way, with a primary distinction being that between tangible wealth (e.g. assets) and intangible wealth (e.g. "wealth in people" (Guyer, 1997), "relational wealth"

(Borgerhoff Mulder et al., 2009; Bowles et al., 2010), and individual endowments, such as education and skills). The latter forms of wealth, also sometimes referred to as human or social capital, have been shown to be important predictors of health and well-being, beyond the effects of material wealth. Anthropologists are increasingly identifying complex relationships among different forms of capital. Such a project demands conceptually distinct measures of wealth. In this paper, rather than presenting an exhaustive review of literature on all forms of wealth or capital, we focus on material wealth. Although it is likely the most often measured form of wealth, it nevertheless tends to be haphazardly operationalized, particularly for the purposes and contexts of anthropological research.

To advance anthropological theory regarding how wealth shapes child growth, adult nutrition, fertility, and infectious disease risk, and other outcomes, researchers must first address the important question of what they mean by material wealth and how to measure it. With a focus on economic resources – hereafter simply referred to as wealth – we outline key theories of how wealth shapes human biology and health, describe methods that have been used to operationalize wealth, and provide a step-by-step guide to assessing wealth in the field.

Constructs and measures

Economic resources come in many forms, and in empirical studies, care should be taken to link one's measure to one's theoretical questions. For the purposes of this paper, we define material wealth as rights over physical property and material goods, as well as access to productive resources (e.g. cultivated land, hunting territories) and basic services (e.g. electricity and clean water).

There are several related concepts that are important to consider in determining how best to operationalize wealth. **Income** refers to money received through work or investments and implies that this occurs with some regularity. Economists often make the distinction between **stocks**—those valuable assets available at a specific point in time—and **flows**—the rate at which resources are coming in through income and going out through expenditures (Pearce, 1992). Often characterized as wealth vs. income, stocks and flows represent conceptually and empirically distinct kinds of economic resources (Howe et al., 2012).

Socioeconomic status (SES) is a related construct and typically refers to relative position at the individual, household or community level, based on a combination of absolute income level, access to material items such as farming implements, vehicles, homes, one's educational achievement, occupation, or a combination of several of these (Robert, 1999). **Socioeconomic position (SEP)** is occasionally used in place of SES, in order to emphasize the importance of one's standing within a community's SES distribution (Howe et al., 2012). Significantly, authors will interchangeably use terms like wealth, SES, or SEP to refer to different research concepts that are treated the same operationally. Indeed, although conceptual definitions of wealth vary, operational definitions tend to be similar. Below, we review these operational concepts.

Moving from definition and theory to actual measurement is riddled with methodological issues, perhaps made more acute by the contexts in which

anthropologists and human biologists often find themselves working. Assessing economic resources in low and middle-income countries, where biological anthropologists often conduct fieldwork, poses a number of conceptual and methodological challenges, as does choosing the appropriate unit of analysis (the individual or household). Understanding how wealth, once measured, is distributed across individuals within the household is an additional challenge (Bevis and Barrett, 2013; Doss, 1996; Quisumbing and Maluccio, 2003) and one that we do not take up in this paper. Individuals and households often derive income from a number of time-varying sources – including daily wage labor, agricultural and livestock production, and sales in informal markets, making it difficult to compare across time and space (Howe et al., 2012). Moreover, assets may be difficult to price. For example, in rural Northwest Bangladesh where one of us works, individuals rarely sell their homesteads, and so it can be challenging to estimate the economic value of a house. Prices for the same asset may vary dramatically across seasons as well; in rural Tanzania the price of a bicycle, for example, can more than double in the dry season relative to the wet season. Below we review a range of decisions to be made in selecting the appropriate measure for one’s research aims.

Relative vs. absolute wealth: Do I have more than you? vs. How much do I have?
The measure of wealth that should be used is critically tied to the demands of the theoretical perspective driving a research question. For example, some theories and research questions implicitly or explicitly call for relative measures of wealth (e.g. does being poorer than others in a society compromise health regardless of one’s absolute level of wealth?), whereas others focus on absolute wealth or income (e.g., what is the relationship between household income and child growth?). The question of wealth comparison is made more difficult when comparisons are made across societies, where an individual or household could score very high within their society’s relative wealth distribution, but very low on an absolute wealth distribution. However, such cross-population comparisons are becoming more common in human biology (Floud et al., 2011; Hruschka and Hagaman, 2015; Steckel, 1995), and we describe different approaches for making such comparisons in a later section.

While less often acknowledged in the non-anthropological literature, some scholars recognize that wealth includes goods that have prestige-based value, even if low market value. The work of Dressler and others on cultural consonance models falls within this realm by arguing that there is typically a culturally-correct basket of goods that one should achieve to be considered well-off in a community. These goods may reflect material-based or prestige-based items or a specific constellation of items (Dressler et al, 2005).

Subjective vs. objective measures; What is the value of what I have? vs. What do I think the value is?

Measures of wealth need to differentiate between one’s objective wealth and one’s subjective sense of wealth. For example, objective measures might collect data regarding various assets, while subjective measures might ask “is your income sufficient to meet your household’s needs?” Note that many “objective” measures of wealth are themselves subjective in that they ask respondents to make an assessment of their wealth holdings – or the value of their wealth holdings – based on their own sense of worth. To ask respondents for a summary assessment of their

overall wealth or income at any point in time is challenging given the many small transactions that many people undertake (Deaton, 1997) and the complex economic portfolios that are found in many small-scale and poor household (Collins et al., 2009).

Relative and subjective measures can co-occur, but this is not necessary. For example, if participants are asked where they fall within their community's wealth distribution, this would be a subjective measure of their relative social status. Subjective measures of social status or socioeconomic position have been found to be associated with a range of health outcomes, including above and beyond objective measures of wealth (Adler et al., 2000; MacArthur and MacArthur, 2007; Ostrove et al., 2000). A commonly used tool to measure one's subjective social status is the MacArthur Scales of Subjective Social Status, also called the "social ladder." This tool is used to ask respondents where they think they stand in terms of income, education, and occupational standing relative to others in their community. Several studies have applied such measures in the field of human biology and public health (Adler et al, 2000; Cohen et al, 2008).

Expenditures, consumption, assets

A primary goal for many researchers interested in measuring wealth is to know something about individual consumption and access to wealth to promote human and embodied capital. Measures of individual and household consumption and expenditure, while often considered a gold standard for assessments of household well-being, are time-consuming and difficult, often taking several hours to collect individual expenditure and consumption of literally hundreds of items (often with little or no known market value; Deaton and Zaidi 1999). In low-income countries, diverse and variable flows of income also raise important challenges to reliable and valid measurement of income (Howe et al., 2011).

Given the time constraints and measurement challenges imposed by the expenditure methods in low-income settings, scholars have devoted considerable attention to identifying low-cost but valid and reliable estimates of household wealth, often through an asset-based approach. Morris and colleagues (2000), for instance, compared simple measures of asset and durable good holdings in Malawi, Mali, and Cote d'Ivoire and showed that these simple counts of assets correlated well ($r > 0.7$ in most cases) with the total value of assets and with expenditures. This work relied on a short period of formative work to identify key assets and durables at the household level, thus increasing local relevance but reducing between-country comparability.

In the 1980s and 1990s, researchers working with the Demographic and Health Surveys (DHS) pioneered another solution to this challenge by using durable assets and goods (TVs, cars, and bicycles) as well household construction and access to electricity and water as proxies for a households' economic resources (Rutstein and Johnson, 2004; Filmer and Pritchett, 2001). This relatively simple approach has become known as the DHS Wealth Index. After identifying and tallying a number of locally relevant assets, researchers would then use one of several methods to weight and add these assets into a single wealth score (see below for detailed description). Such asset-based wealth scores have been shown to correlate strongly

with a number of health, growth, and demographic outcomes (Rutstein and Johnson, 2004; Hruschka and Hagaman, 2012; Hruschka et al., 2014).

Like all measures, asset-based assessments have their shortcomings. A key one here is that over time, durable assets may accumulate, even when underlying wealth stays the same. This notion of “asset drift” and its implications has been a topic of debate (Harttgen et al, 2013). For more in-depth discussion of assets, expenditures, and consumption and their relationship to human biology outcomes, we refer the reader to Carter (2012) and Young (2012).

Because they are relatively easy and quick to collect, as well as providing relatively stable and reliable proxies for wealth, asset-based indices have become the most widely used measures for wealth in low- and middle-income countries. They can be used to produce either absolute or relative measures, making them suitable for a range of research questions. Additionally, asset-based measures enable some degree of validation through visual inspection, making this approach to wealth measurement potentially less prone to social desirability bias than others. Below, we provide guidelines for constructing asset-based wealth indices, with consideration of challenges and issues of particular concern for anthropologists.

How to construct wealth indices

Asset-based wealth indices are composite scores of assets, durable goods, services, and dwelling characteristics and are often used in resource-poor settings (Howe et al., 2011). The general approach to constructing asset-based measures of wealth entails generating items; assessing presence or counts of each item at the household level; constructing a score using simple sums, data reduction, and/or weighting; and comparing those scores to some measure of human growth or achievement. We describe variations on this process that could be useful for certain research questions, including accounting for prestige in asset-based measures and translating a relative wealth index into an absolute measure of wealth.

Step 1: Item generation

Demographic and Health Surveys use a wide range of country-specific indicators for their asset-based Wealth Indices that can provide a useful starting point (ICF International, 2004-2012). Some of the more common items include durables (e.g. radio, TV, bicycle, car), access to services (e.g. toilet type, drinking water source, electricity), dwelling characteristics (e.g. floor material), and other household assets (e.g. owns agricultural land or livestock). As Howe et al. (2011) point out, many of these items have become standard because of the ubiquity of DHS datasets, not because they represent a gold standard approach. The set of indicators likely has different wealth-related meaning in different settings (Gwatkin et al., 2007, Howe et al., 2011).

DHS Wealth Index indicators provide a useful starting point for item generation, but other researchers may also find it useful to use semi-structured interviews, focus group discussions, and informal observations to compile a list of locally relevant indicators of wealth. If index scoring will be based on market value (see below), it is important that this be feasible to establish for selected items.

Locally generating items that meaningfully distinguish among levels of wealth can be accomplished through interviews, focus group discussions, and informal observation (Nolin 2012). For example, Kaiser (2015) noted that standard DHS indicators could not detect differences between the poor and very poor in rural Haiti. She generated items for a wealth index by using interviews and observation to identify goods, services, and dwelling characteristics that were locally perceived to distinguish rich and poor. She then used pile sorting to elicit perceptions about which social classes are able to own each item and selected those items that best distinguished in pile sorting between the poor and very poor, in that they were most often perceived to be owned by only one class or the other (e.g. livestock versus a woven mat for a bed).

Step 2: Collecting asset data

Items included in a wealth index can be collected easily within a survey. Typically, items are elicited from the household head or otherwise collected at the household rather than individual level. The choice of question type should be dictated by the item. For example, a dichotomous question is most appropriate for eliciting presence or absence of most assets and some services (e.g. “Do you own a radio?” or “Do you have electricity in your home?”), while multiple-choice questions are appropriate for dwelling characteristics and some services (e.g. “What is the primary material of your house’s floor?” or “What is your primary source of drinking water?”). Finally, some assets are best collected as counts (e.g. number of livestock). To the extent possible, responses should be validated by enumerators through visual inspection (e.g. verifying presence/absence of visible assets and dwelling characteristics).

Step 3: Weighting items

The easiest approach to scoring wealth indices is a simple additive or equal-weights index (Guiley and Jayne, 1997; Razzaque et al., 1990). This approach has been critiqued because giving equal weight to each item (e.g. scoring a radio equal to a car) does not reflect actual relative contribution to wealth (Bollen et al., 1995; 2007). Several alternatives exist for weighting items. One approach is to use interviews or focus group discussions to produce culturally appropriate rankings of items, as has been used with other measures such as assessing severity of food insecurity (Maxwell et al., 1999). Alternatively, weights can be generated based on the inverse of the proportion of the population who owns each item (Townsend, 1979; Subramanian et al., 2005). This approach assumes that the fewer households own an item, the greater its value. However, this cannot account for the non-linear relationship of assets to living standards, such as items owned more commonly by the middle (e.g. bicycles) but less commonly at either extreme (Howe et al., 2008).

Principal components analysis (PCA) is probably the most commonly-used approach to producing item weights on wealth indices (Howe et al., 2012). PCA is a data-reduction technique that translates a set of correlated variables (items) into a series of uncorrelated dimensions. Each dimension explains some portion of the variances across all items. The first dimension, which explains the largest proportion of total variance, is taken to represent relative wealth. PCA produces weights based on correlations of individual items with the components and ultimately produces a single score for each household. There are limitations to the use of PCA in wealth indices. First, it requires technically advanced analyses that are unfamiliar to many

researchers. Second, typical items on wealth indices are discrete (binary or ordinal) variables, which violates the assumption of PCA that variables are continuous (Howe et al., 2012). However, some argue that this limitation can be largely ignored, as direct comparisons between PCA (designed for use with continuous variables) and the analogous Multiple Components Analysis (designed for use with discrete variables) produce results that do not differ significantly (Howe et al., 2008). Techniques for working with binary data also exist (Bartholomew et al., 2008). See Filmer and Pritchett (2001) and Vyas and Kumaranayake (2006) for detailed descriptions of how to construct wealth indices using PCA and Kolenikov and Angeles (2009) for a solution to the problem of using PCA with nominal variables with more than two categories.

Step 4: Interpretation and comparison

Interpretation of wealth index scores can be difficult for a few reasons. First, the weighted scores are not in units that are easily interpretable or comparable. If one is interested in relative measures of wealth (SES or SEP), a useful approach is to transform weighted scores into wealth quintiles. Such an approach has the benefit of being more easily interpretable.

Second, because the wealth scores created by an asset-based approach provide only a relative ranking of households, it is challenging to compare households across surveys at different times or places. One solution is to multiply asset holdings by market value, which can convert an asset-based relative measure into an absolute measure of wealth (see for example Cole and Tembo, 2012). For example, if a list of assets were surveyed at the household level, the number of each item could be multiplied by current market value to arrive at some estimate of the total value of current asset holdings. However, as this requires determining the local monetary value of every item on an asset-based measure, it can become time-consuming (Gurven et al. 2015). One potential solution to comparing asset-based measures across sites is to use multilevel models to estimate survey-specific effects. However, such survey-specific effects may confound population differences in the meanings of both wealth and the outcome of interest. For example, if we observe a higher mean body mass index for households of median wealth in one country compared to households of median wealth in another country, this difference could be due to: (1) differing levels of basal body build between the two populations or (2) differing meanings of wealth in the two countries (Hruschka and Hadley, 2016). Recently, researchers have developed a novel approach to estimating *absolute* household wealth by combining relative household wealth rankings, mean wealth per capita nationally, and Gini coefficient to fit a wealth distribution for that country (Hruschka, Gerkey, and Hadley, 2015). They have applied this approach in large-scale comparative studies of infant and adult growth (Hadley and Hruschka, 2014; Hruschka et al., 2014), maternal depletion (Hruschka and Hagaman, 2015), and fertility transitions (Hruschka and Burger, 2016).

Although the four steps outlined above provide the foundational approach to developing a wealth index, it is important to note that several challenges and critiques have been raised regarding asset-based wealth indices, and they remain to be resolved. Below, we review several of these critiques, along with further variations on the standard approach outlined above that have been proposed to surmount these challenges, particularly as they apply to the contexts in which much

anthropological research is conducted. For a more detailed description of the strengths and limitations of various approaches to the measurement of wealth and socioeconomic position, see Howe et al. (2009, 2012).

Challenges and limitations

Several critiques have been leveled against asset-based wealth indices. These remain unresolved issues open for future study. The most significant critique is that, although wealth indices are occasionally treated as a proxy for consumption rather than long-run economic capacity (Rutstein and Johnson, 2004), there is poor agreement between wealth indices and consumption expenditures (Howe et al., 2009, 2012; Onwujekwe et al., 2006). This might happen if consumption-based measures are not an appropriate gold-standard for comparisons, particularly in low-income settings, where asset-based indices may be more reliable and stable indicators of wealth (Filmer and Pritchett, 2001; Liverpool and Winter-Nelson, 2010). There is also some evidence to suggest that asset-based indices might demonstrate poor reliability, specifically in terms of having only moderate test-retest and inter-observer reliability (Onwujekwe et al., 2006). When possible, responses should be validated through observation. Additionally, wealth indices rely heavily on indicators, such as access to electricity and water supply, that can be community-level rather than household-level amenities. Depending on the context, these effects can overwhelm household-level indicators (Bingenheimer, 2007; Howe et al., 2011). In some contexts, variability in asset quality (e.g. color vs. black-and white TV) might be an important distinction to capture in measures. However, attempts to account for differential quality or depreciation (Zeller et al., 2001) can become time-consuming and ultimately defeat the purpose of developing an asset measure.

It is important to recognize the assumptions inherent in most approaches to measuring wealth, which remain insufficiently studied to know whether they are justified. For example, current approaches assume a single dimension along which economic capacity varies, and critics have suggested that the presence of different livelihoods in the same setting – livestock-based vs. crop-based vs. wage-based – might pose challenges for interpreting wealth along a single dimension (Bingenheimer, 2007; Ferguson, 1992; Guyer, 1997; Randall and Coast, 2015). For example, Lawson and colleagues (2015) found that households in Tanzania differed meaningfully in wealth scores between a universal measure and one sensitive to local livelihoods. However, others have argued that certain assets are similar enough in their cost and desirability that a universal, unidimensional measure of wealth is indeed possible (Smits and Steendijk, 2015). One option is to convert all forms of wealth into their monetary value; that is, if someone is rich in cattle and a neighbor is rich in radios, they can be compared by converting each of their holdings into current market value. It may also be useful to use PCA or comparable techniques and use and interpret not only the first factor but the second (or perhaps third and fourth). Those who have advanced in wage economies may score high on the first factor, while those who have advanced in agricultural economies may score high on the second. Comparing the power of these different dimensions of wealth to predict health and other outcomes would provide important tests of competing hypotheses in anthropology and social sciences about the multidimensionality and context-sensitivity of wealth.

Finally, a major limitation of the DHS Wealth Index is that it measures wealth largely as it relates to involvement in the modern wage economy. A related limitation is the urban bias of asset-based measures, which reflect access to services (e.g. electricity) that are more available in urban areas and can both inflate wealth of urban dwellers and fail to capture differential wealth at the extremes (urban rich and rural poor; Howe et al., 2012). In fact, traditional forms of wealth – such as owning cattle or land or the control of human labor via kinship systems – have been found to be negatively associated with wealth as measured via the DHS Wealth Index: “An elderly male, for example, may be economically secure because of land and livestock holdings and his ability to call on children and relatives for labor and other forms of assistance, but he may lack virtually all of the assets included in the index” (Bingenheimer, 2007: 84). These challenges may require the generation of multiple wealth scores to capture the full range of variation in economic resources within a given setting.

Conclusion

That such broad questions remain to be answered speaks to the need for further study regarding the concept of wealth and how best to operationalize it. To some extent, the answer might vary based on one’s outcome of interest: what matters in terms of wealth might vary if one is studying risk of acquiring HIV versus human growth. Our opinion is that the concept of material wealth in anthropology has a solid theoretical footing but that empirically the base is much less sure. An aim of this paper has been to delineate rival approaches in part to encourage investigators to think deeply about why they are measuring material wealth, not just how they are measuring it. There is now a tremendous opportunity to empirically assess varying, and at times competing, ideas about what constitutes wealth and ideas about what wealth does: that is, comparing the predictive power of rival metrics to see how well they explain outcomes of interest to human biologists.

Acknowledgments

BNK was supported by a postdoctoral fellowship from the Duke Global Health Institute and the Franklin Humanities Institute Health Humanities Lab. DJH acknowledges support from the National Science Foundation grant BCS-1150813, jointly funded by the Programs in Cultural Anthropology, Social Psychology Program and Decision, Risk, and Management Sciences. We would also like to thank students in the Culture Change and Behavior Lab at Arizona State University – Ella Alzua, Delaney Billig, Kathleen Click, Ian Glatt, Robert King, Victoria Paz, and Azalea Thomson – for constructive feedback on earlier versions of this manuscript.

Author contributions

BNK proposed the paper, and all authors collaborated to outline core themes and contributed to the writing.

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