

Is the wealth index a proxy for consumption expenditure? A systematic review

L D Howe,^{1,2} J R Hargreaves,¹ S Gabrysch,¹ S R A Huttly¹

► Appendix available online only at <http://jech.bmj.com/content/vol63/issue11>

¹ Department of Epidemiology and Population Health, London School of Hygiene and Tropical Medicine, London UK;

² Department of Social Medicine, University of Bristol, Bristol, UK

Correspondence to:

Dr L D Howe, Department of Social Medicine, University of Bristol, Oakfield House, Oakfield Grove, Bristol BS8 2BN, UK; laura.howe@bristol.ac.uk

Accepted 15 April 2009
Published Online First
29 April 2009

ABSTRACT

Background: Many epidemiological studies require a measure of socioeconomic position. The monetary measure preferred by economists is consumption expenditure; the wealth index has been proposed as a reliable, simple alternative to expenditure and is extensively used.

Methods: A systematic review was conducted of the agreement between wealth indices and consumption expenditure, summarising the agreement and exploring factors affecting agreement.

Results: Seventeen studies using 36 datasets met the inclusion criteria. Of these, 22 demonstrated weak agreement, 10 moderate agreement, and four strong agreement. There was some evidence that agreement is higher: in middle-income settings; in urban areas; for wealth indices with a greater number of indicators; and for wealth indices including a wider range of indicators.

Conclusions: The wealth index is mostly a poor proxy for consumption expenditure.

expenditure figures.³ Complex calculations and assumptions are required to include home-produced goods and estimate the value of housing and consumer durables. There are therefore reliability, financial and logistical incentives for epidemiologists in lower income settings to use alternative measures. Additionally, existing datasets rich in health data, such as the Demographic and Health Surveys (DHS), lack income or consumption expenditure data.

The wealth index as a measure of socioeconomic position

The DHS are nationally representative datasets with a common methodology across countries. Interest in using these datasets to quantify and compare socioeconomic inequalities in health led to the development of the wealth index approach. The DHS do not include traditional economic measures such as consumption expenditure, but they collect data on ownership of durable assets (eg, car, refrigerator, television), housing characteristics (eg, dwelling floor and roof material, toilet facilities) and access to services (eg, electricity supply, drinking water source). These items were originally included in surveys for their direct influences on health, for instance television ownership was of interest to identify households receiving public health messages. A wealth index (or asset index) was developed using these indicators.^{4,5} There is a substantial report by Gwatkin *et al* using wealth indices to compare inequalities in a wide range of outcomes across DHS data from 56 countries.⁶

The wealth index is now widely used in health research for primary data collection and secondary data analysis. A Web of Knowledge search in January 2009 identified 294 papers that cite Filmer and Pritchett⁵—a key paper in generating widespread interest in the wealth index. These are likely to be only a subset of the total number of studies using wealth indices. The studies citing Filmer and Pritchett were conducted in diverse low- and middle-income settings. They used the wealth index to quantify inequalities, explore the determinants of health and control for socioeconomic confounding. Although there was variation in the indicators included in the index, the vast majority used a similar set of assets to the DHS, even when collecting primary data. These assets could be inappropriate in some settings; Gwatkin *et al* acknowledge that the indicators used in the DHS wealth index were selected on grounds of availability rather than for theoretical reasons, and may not represent the optimal indicators (p. 3).⁶

Socioeconomic position (SEP) is a concept widely used in epidemiological research. It has varying definitions and measurement, but generally incorporates physical and social resources and status within a social hierarchy.¹ Measures of SEP are essential for most observational epidemiological research; even if social determinants are not the primary focus, SEP is likely to be an important confounder of many relationships.

While it is widely recognised that living standards are determined by a multitude of factors, monetary measures remain popular. This is partly due to the difficulty in operationalising more complex concepts, and partly because monetary measures could be considered to have clearer policy implications. Consumption expenditure is the measure of monetary living standards preferred by many economists in low- and middle-income settings, although income is more widely used in high-income settings and throughout Latin America. Consumption expenditure is considered more stable than income; people tend to “smooth” their consumption by borrowing or saving in times of temporary income fluctuation.² Data collection for income may be subject to more bias than expenditure in lower income settings, where income may come from multiple sources and vary seasonally.

Despite advantages over income, consumption expenditure is also difficult to measure. Data collection is lengthy, complex and expensive. Respondents must recall their household’s use/expenditure for many items. Prices differ across times and areas, necessitating adjustment of

Some proponents view the wealth index as a simplified proxy for consumption expenditure.⁵⁻⁷ Asset ownership is likely to be based at least partially on economic status, and household assets are unlikely to change in response to short-term economic shocks, so asset ownership could be considered a measure of long-term economic status similar to consumption expenditure. However, consumption expenditure data are collected by an established and theoretically grounded methodology, using lengthy questionnaires with information on an extremely wide variety of expenditures. It is not clear how well a wealth index, a measure born primarily out of convenience and commonly relying on a small number of indicators, can proxy consumption expenditure. The main proponents of the wealth index, while recognising the limitations of the approach, describe the wealth index as “an acceptably reliable proxy for consumption and thus for economic status more generally”,⁶ and state that a wealth index predicts school enrolment as accurately as consumption, if not more so.⁵ The evidence for the ability of a wealth index to proxy consumption expenditure is limited, and until now has not been collated in a systematic way. Despite this lack of clarity, many researchers are using the wealth index as a proxy for consumption expenditure, whether implicitly or explicitly.

There is a substantial body of literature on poverty measurement from Europe, Antipodean countries and Latin America that casts doubt on the likelihood of a wealth index to accurately proxy consumption expenditure. Measures of current living conditions based on “outcomes” of deprivation such as ownership of goods have been used in these settings (referred to as standard of living indices, deprivation indices or indices of unmet basic needs), pioneered largely by Townsend⁸ and Mack and Lansley⁹ and reviewed in several places.¹⁰⁻¹¹ Such measures have been found to have considerable mismatch with current income; examples of such mismatch are reviewed by Perry.¹²

The primary question we sought to answer through this systematic review is how good a proxy of consumption expenditure is a wealth index. Where data were available, we investigated whether level of agreement differs by setting or the type and number of indicators included in the wealth index.

METHODS

Search strategy

We consulted library staff and guidelines on systematic reviews.¹³⁻¹⁵ Fourteen electronic databases, the World Bank website, DHS website and Google were searched using appropriate text words and thesaurus terms, detailed in box 1. Titles and abstracts of hits were screened for potential relevance. Where relevance could not be determined from the abstract, full papers were reviewed.

First authors of included papers and others known to be working in the field were contacted for unidentified or unpublished work, Web of Knowledge citation searches were performed for included papers, and the reference sections of all included papers were screened. Studies identified as potentially relevant from the initial screen were reviewed independently by two authors (LH and SG) against predefined inclusion and exclusion criteria.

Inclusion and exclusion criteria

Studies measuring the unadjusted relationship between household consumption expenditure and a household wealth index were included. No restrictions were placed on how consumption expenditure was measured. A wealth index was considered to be a household-level composite index of any consumer

durables, indicators of access to services, housing characteristics or any other socioeconomic factors. Studies were excluded if consumption expenditure formed part of the wealth index. No restrictions were placed on the measure of agreement between consumption expenditure and the wealth index, although studies only comparing measures in terms of observed inequalities were excluded. Studies were not excluded due to methodological limitations; these were documented using a checklist covering measurement of the wealth index, measurement of consumption expenditure, study design and features of the analysis that may bias results. No restrictions were placed on geographical location, date or language of publication.

Analysis strategy

We identified all datasets used in included studies. Some studies reported results for multiple datasets, while some datasets were represented in more than one study. Furthermore, in some cases, results were presented for (i) more than one measure of agreement between the wealth index and consumption expenditure and/or (ii) more than one method for constructing the wealth index. Results were selected for the whole population if available; results stratified by area were used if no aggregated results were presented. Thus, for each dataset, a single measure of agreement was selected using the following rules:

- ▶ 1. Select measures of agreement for the entire population if available. If results were only available separately for subpopulations (eg, urban and rural), include all available subpopulations.
- ▶ 2. Select the most appropriate measure of agreement (see below).
- ▶ 3. If there are multiple estimates using the same measure of agreement from the same dataset, the strongest association was chosen as our primary hypothesis was that level of agreement would be low.

Choosing the most appropriate measure of agreement

Measures of agreement were selected using the following order of preference:

- ▶ 1. Overall agreement/misclassification between three or more groups of the wealth index and three or more groups of consumption expenditure, with groups based on percentiles. If there are multiple specifications of groups for one dataset, select the higher number of groups.
- ▶ 2. Correspondence index (explained below).
- ▶ 3. R² values of regression on consumption expenditure.
- ▶ 4. Correlation coefficient.
- ▶ 5. Agreement/misclassification/sensitivity, etc. between two groups of the wealth index and two groups of consumption expenditure, eg, poor/non-poor.
- ▶ 6. Agreement/misclassification between three or more groups of the wealth index and three or more groups of consumption expenditure, with groups based on percentiles but agreement not available as an aggregate for all groups.

Agreement of classification was chosen as the preferable measure because of its transparency, ease of interpretation and relevance to the most common way of using wealth indices, ie, division into quantiles.

Sahn and Stifel¹⁶ used correspondence indices to assess agreement between deciles of the wealth index and consumption expenditure. The correspondence index is calculated as follows:

Box 1: Databases, websites and search engines

Electronic databases

- ▶ PubMed
- ▶ Web of Knowledge
- ▶ Ovid Embase
- ▶ IBSS
- ▶ Popline
- ▶ Lilacs
- ▶ Eldis
- ▶ IDS
- ▶ Zetoc
- ▶ Africa Healthline
- ▶ CAB abstracts
- ▶ NBER working papers
- ▶ Academic Search Premier
- ▶ IngentaConnect

Internet resources

- ▶ World Bank website
- ▶ DHS website
- ▶ Google

Search terms

poverty OR socioeconomic OR socio-economic OR economic status OR social class OR wealth OR asset
AND
indicator OR index OR measure OR proxy OR indices
AND
relationship OR correlation OR association OR validity OR reliability OR agree
AND
consumption OR expenditure OR permanent income OR income
(Truncation terms and MeSH terms were used where possible)

$$C = \frac{\sum_{i=1}^n \sum_{j=1}^n (i-j)^2 m_{ij}}{2 \sum_{i=1}^{n/2} (i-n)^2} \times \frac{1}{0.322'}$$

where n is an even number of quantiles, i and j are the row and column quantile, respectively, m_{ij} is the transition share associated with ij -th cell of the transition matrix. The measure only gives weights to the off-diagonal elements of the cross-tabulation. Weights increase as distance from the diagonal increases. A zero value indicates perfect correspondence, ie, no differential classification. A value of one indicates perfect random association.

We grouped the selected measures of agreement into strong, moderate or weak agreement and counted the number of datasets demonstrating each level. Definitions of these three groups for each measure of agreement are provided in table 1. There is no universal consensus on acceptable levels of any of the measures of agreement used. Therefore, we determined the cut-off points based on subjective views of the acceptable strength of relationship for a reliable proxy. Given that the aim of this study was to assess the ability of the wealth index to proxy consumption expenditure, rather than merely evaluating the association, we selected relatively conservative cut-off points. Where measures of both sensitivity and specificity were presented, sensitivity was selected, ie, proportion of those below

an expenditure-based poverty line correctly identified, as this is arguably the most important outcome if a wealth index is to be used for programme targeting. We used a higher threshold for sensitivity than for classification into three or more percentile groups, as a higher degree of agreement can be expected when using a cruder poor/non-poor classification.

Further analyses were conducted to examine the effect on agreement (i) when different types and numbers of indicators are used to construct the wealth index and (ii) in different settings.

RESULTS

Study selection

Database searches carried out in March 2008 identified 5318 abstracts and titles. The process of study selection is shown in figure 1. Seventeen studies met the inclusion criteria. Six studies were excluded because they had no measure of association between the wealth index and consumption expenditure.^{17–22} Four studies were excluded because they had no measure of consumption expenditure.^{23–26} Seven studies were excluded because they had no composite wealth index.^{27–33} One study was excluded because a consumption expenditure aggregate was included in the wealth index.³⁴ A further two studies were excluded because there were no direct comparisons between the wealth index and consumption expenditure; the relationship was assessed by the difference in inequalities only.^{35–36}

The characteristics of the included studies and the full results are detailed in the Appendix. All studies were from low- and middle-income countries. Datasets used were generally large, nationally representative surveys, apart from two studies that used data from rural areas only^{37–38} (NB, Montgomery uses six datasets; all but the Guatemala data are nationally representative), and two studies that used data from regions within a country.^{4–39} Several datasets were represented in more than one study. Overall, the methodological quality of the studies was high, with most studies using nationally representative datasets, full consumption expenditure aggregates and a range of wealth index indicators at least as extensive as those used in the DHS wealth index.

Main findings

In total, 33 datasets were included in the review. In three studies, each with one included dataset, results were only presented for urban and rural populations separately.^{40–43} The number of measures of agreement included is therefore 36. Twenty-two demonstrated weak agreement (61%), 10 showed moderate agreement (28%), and four showed strong agreement (11%) (table 2).

Number and type of indicators included in the wealth index

The mean number of indicators in the wealth index is highest in those datasets demonstrating strong agreement between the wealth index and consumption expenditure, intermediate in those demonstrating moderate agreement, and lowest in those demonstrating weak agreement (table 2). This provides some evidence that a higher number of indicators in a wealth index improves its ability to proxy consumption expenditure. Further evidence to support this hypothesis is found in studies using multiple sets of indicators to construct wealth indices. Ward *et al* found that adding groups of five, 10, 15 and 20 variables to a core set of indicators increased the observed agreement of the index with consumption expenditure.²¹ The gains were not, however, substantial; for each additional five variables, the

Table 1 Cut-off points to assess the strength of agreement

Measure of agreement	Strength of agreement		
	Strong	Moderate	Weak
Agreement of classification into quantiles	>75% correctly classified	60–75% correctly classified	<60% correctly classified
Correspondence index	0–0.25	0.25–0.45	>0.45
R ² values from regression	0.49–1.0	0.25–0.49	<0.25
Correlation coefficients	0.7–1.0	0.5–0.7	<0.5
Sensitivity	>80%	65–80%	<65%

proportion of households classified in the same tercile increased by approximately 1%. Grosch and Baker also demonstrated that reducing the number of indicators reduced the R² value, although again differences were modest.⁴⁴

The proportion of wealth indices that included indicators other than consumer durables, housing characteristics and access to services was highest in the datasets showing strong agreement between the wealth index and consumption expenditure, intermediate in those showing moderate agreement, and lowest in those showing weak agreement (table 2). This implies that including a broader range of indicator types, such as demographics, human capital indicators and livestock,

may improve the ability of the wealth index to proxy consumption expenditure.

Comparisons of multiple wealth indices using different indicators from the same dataset suggest that consumer durables make the highest contribution towards the ability of a wealth index to proxy consumption expenditure. Khe *et al*'s study in Vietnam constructed separate indices for housing indicators and durable assets.³⁷ The sensitivity of the durable asset score with respect to consumption expenditure was considerably higher than that for the housing score; 50.8% and 32.7% respectively. McKenzie created separate indices for housing indicators, utilities/service access and durable assets,

Figure 1 Selection of studies for systematic review.

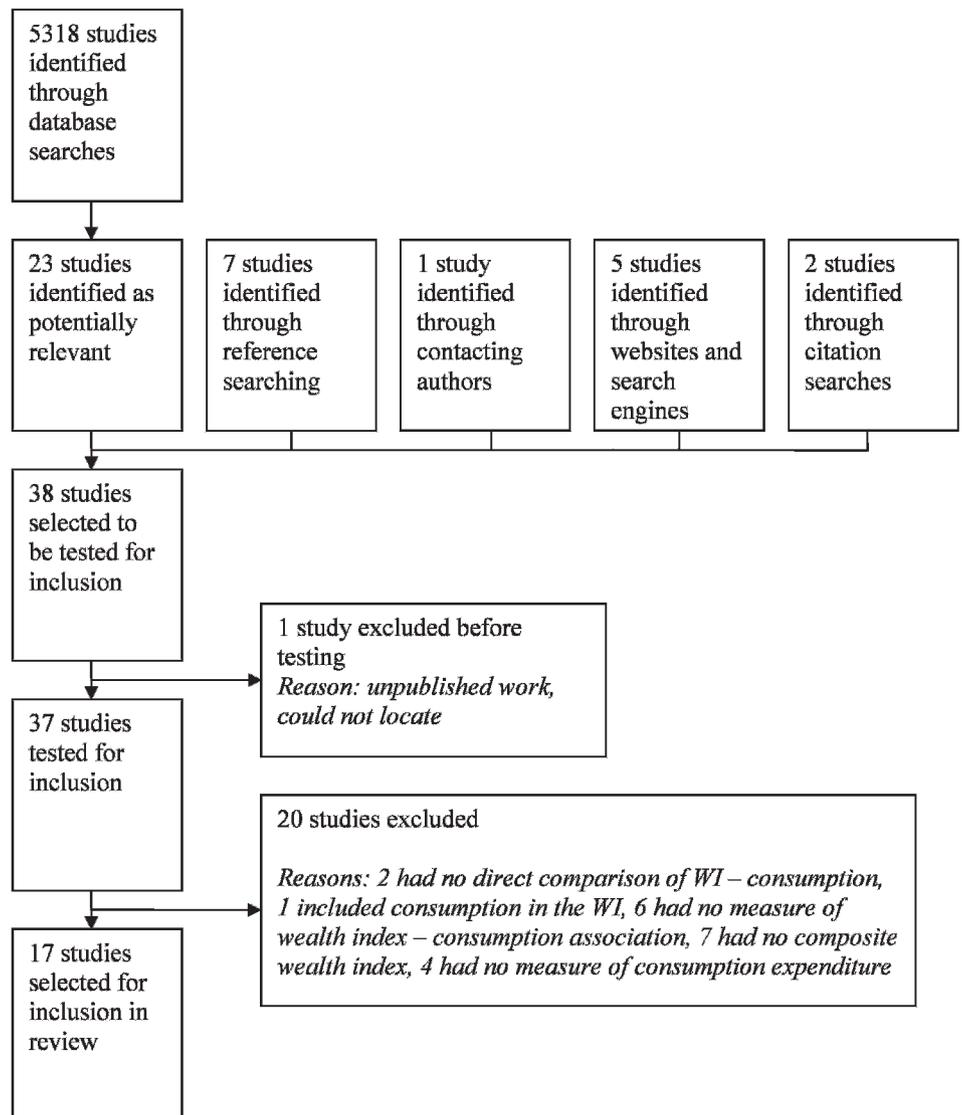


Table 2 Summary of results for 36 measures of agreement

Strength of agreement	Number (%) of measures of agreement	Mean number of indicators	Number (%) using only durables, housing and service indicators in wealth index	Number (%) from datasets from middle-income countries
Strong	4 (11%)	27.8	1 (25%)	2 (50%)
Moderate	10 (28%)	21.2	3 (38%)	8 (80%)
Weak	22 (61%)	14.0	13 (59%)	7 (32%)

and an index with all types of indicators.⁴⁵ The rank correlation coefficients were 0.598 for the housing index, 0.798 for the utilities index, 0.843 for the durable assets index and 0.847 for the overall index. The highest correlation with consumption expenditure was with the overall index, but the durable assets index has a very similar correlation coefficient to the overall index, indicating that in this context the addition of housing and utilities indicators does little to improve the agreement of the wealth index with consumption expenditure. Filmer and Scott also compared indices using durable assets only with indices additionally including housing and services indicators, and also found strikingly similar agreement in each of the datasets they examined.⁴⁶

Setting

The proportion of datasets that are from middle-income countries (according to the World Bank classification) is considerably lower in those datasets demonstrating weak agreement between the wealth index and consumption expenditure, compared with those demonstrating strong or moderate agreement (table 2). It is also interesting that the two datasets that demonstrate strong agreement that are from a low-income country are both from Pakistan, whose gross national income per capita is close to the cut-off between low- and middle-income countries. Of the two datasets demonstrating moderate agreement that are from low-income countries, one is from Vietnam and the other from Tanzania; Vietnam is also reasonably close to the cut-off between low- and middle-income countries. There is thus some evidence that a wealth index is a better proxy for consumption expenditure in middle-income countries compared with low-income countries.

There is also some evidence from within-dataset comparisons that a wealth index is a better proxy for consumption expenditure in urban areas compared with rural areas (table 3). In five of the eight datasets that present agreement separately for urban and rural areas, the agreement between consumption expenditure and the wealth index is stronger in urban areas than in rural areas.

DISCUSSION

Summary of main findings

Our main finding is that wealth indices are generally a poor proxy for consumption expenditure. The literature demonstrating inequalities across a range of outcomes and in diverse settings implies that the wealth index is measuring an important determinant of health. This review, however, indicates that the underlying concept measured by a wealth index is not consumption expenditure.

There is evidence that increasing the number and range of types of indicators included in a wealth index can result in modest gains in the strength of its agreement with consumption expenditure. Wealth indices tend to have stronger agreement with consumption expenditure in middle-income settings

compared with low-income settings, and in urban areas compared with rural areas.

Limitations of this review

Studies may have been missed. Methodological work may be more likely to remain unpublished or in the grey literature.

The categorisation of agreement between wealth indices and consumption expenditure as strong, moderate or weak was somewhat arbitrary. The cut-off points used were conservative; more relaxed cut-offs may lead to more positive conclusions about the ability of the wealth index to proxy consumption. Sensitivity to choice of measure of agreement was assessed by comparing strength of agreement for the nine datasets where multiple measures were available. For five of the nine datasets, the classification of weak, moderate or strong agreement was the same for each study using that dataset. In three of the remaining four datasets, the measure included in this review had stronger agreement than the excluded measure(s). If the choice of measure of agreement has introduced bias, it would appear that it has increased the weight of evidence in favour of the wealth index being a good proxy for consumption expenditure. As our conclusion is in the opposite direction, the effect of this potential bias is likely to be limited.

The studies included in this review were different in many ways. This made meta-analysis of the relationship between the wealth index and consumption expenditure impossible and may also have affected the observed agreement in ways that cannot be unravelled from the available data.

Implications of findings

The wealth index, despite limited theoretical and methodological grounding, is a widely used measure of SEP. This review reveals that there is limited evidence to consider wealth indices—at least as they are commonly constructed—as proxies for consumption expenditure. The theoretical concept being measured by a wealth index and the reasons for its associations with health remain uncertain. The indicators used to construct wealth indices from DHS data were originally chosen for availability rather than on theoretical grounds; a “wealth index” of these non-context-specific items is therefore arguably unlikely to capture “wealth” in the strict economic sense of the term. Certainly, the indicators themselves measure fundamental aspects of living conditions—clean water, sanitation, etc. are clearly important. The interpretation in terms of social stratification of a composite index, however, is uncertain. In particular, the “meaning” of the index in terms of SEP is likely to differ between settings, particularly given the remarkably limited variation across countries in the indicators commonly included in a wealth index.

The implications of the weak agreement between wealth indices and consumption expenditure differ depending on the purpose for which it is being used. For targeting of programmes and interventions, using the wealth index will identify a different set of “disadvantaged” households compared with

Table 3 Wealth indices created separately for different areas within a dataset using the same set of indicators

Study (first author)	Dataset	Wealth index–consumption expenditure association
Jamal ⁴⁰	Pakistan Integrated Household Survey 2001/2	R ² values from regressions of indices on consumption expenditure: <i>Urban</i> : 0.69 <i>Rural</i> : 0.52
Lindelow ⁴⁷	Mozambique National Household Survey on Living Conditions	Re-ranking: urban households ranked higher by wealth index than consumption expenditures; vice versa for rural households. Poorer, more remote areas also lose rank even after controlling for urban/rural residence
Montgomery ³⁸	Ghana 1988 (LSMS)	R ² values from regressions of indices on consumption expenditure: <i>Whole population</i> : 0.104 <i>Urban</i> : 0.082 <i>Rural</i> : 0.014
Montgomery ³⁸	Jamaica 1989 (LSMS)	R ² values from regressions of indices on consumption expenditure: <i>Whole population</i> : 0.143 <i>Urban</i> : 0.094 <i>Rural</i> : 0.106
Montgomery ³⁸	Pakistan 1991 (LSMS)	R ² values from regressions of indices on consumption expenditure: <i>Whole population</i> : 0.030 <i>Urban</i> : 0.036 <i>Rural</i> : 0.025
Montgomery ³⁸	Peru 1994 (LSMS)	R ² values from regressions of indices on consumption expenditure: <i>Whole population</i> : 0.154 <i>Urban</i> : 0.108 <i>Rural</i> : 0.132
Montgomery ³⁸	Tanzania 1993/4 (LSMS)	R ² values from regressions of indices on consumption expenditure: <i>Whole population</i> : 0.155 <i>Urban</i> : 0.114 <i>Rural</i> : 0.017
Skoufias ⁴²	Mexico 1996 ENIGH	Sensitivity: <i>Urban</i> : 53.4% <i>Rural</i> : 67.6%
Ward ²¹	Tanzanian Household Budget Survey 2000/01	% households in correct tercile: <i>Dar es Salaam</i> : 60.4% <i>Urban</i> : 63.5% <i>Rural</i> : 58.6%

LSMS, Living Standards Measurement Survey.

consumption expenditure. For the quantification of inequalities, differences between the wealth index and consumption expenditure will only affect the estimated magnitude of inequalities if re-ranking between the indicators is correlated with the outcome of interest.⁴⁷ Four of the included studies, as well as two of the studies excluded from the main analysis in this review, presented estimates of inequalities in an outcome using both the wealth index and consumption expenditure. Two of the six studies concluded that inequalities tend to be wider when using consumption expenditure compared with the wealth index.^{16, 36} In three of the remaining four studies, inequalities were, on average, greater using the wealth index compared with consumption expenditure.^{5, 35, 47} In the final study, the findings are mixed and vary according to outcome.⁴⁶ Using the wealth index instead of consumption expenditure does, therefore, appear to result in disparity in the observed magnitude of inequalities, but the direction and size of these differences appear to be difficult to predict. It could be argued that a wealth index is capturing a longer term, more stable aspect of economic status than consumption expenditure as the indicators used to construct a wealth index may be slower to change in response to economic shocks than expenditure. The relative importance of longer and shorter term economic status will vary depending on the health outcome under study. However, without further research into the socioeconomic processes underlying a wealth index hierarchy, it remains unclear exactly what a wealth index is measuring.

There will never be a one-size-fits-all SEP indicator. Each measure has advantages and disadvantages, the relative importance of which differs between studies. The wealth index represents a useful addition to the toolbox for the analysis of existing datasets lacking in alternative economic measures. Through analyses of DHS and similar datasets, the wealth index has permitted the quantification and comparison of socioeconomic inequalities in health in lower income settings on an unprecedented scale. This has undoubtedly been valuable in raising awareness of health inequalities. For primary data collection, however, the researcher can consider a range of alternative SEP measures, and balance practical and theoretical considerations.

Although consumption expenditure is considered by some as a “gold standard” measure of economic status, it has considerable reliability issues and does not reflect the many other social factors that are also important determinants of health, such as education, being part of a minority or disempowered group, social capital, etc. The wealth index is also unlikely to capture a very broad concept of SEP. It is imperative that the measures selected for data collection and analysis are determined and justified according to their theorised relationships with the exposures and/or outcomes of interest, and capture those domains of social stratification that the researcher hypothesises are of most importance for a particular study.

If it is determined that a measure of purely economic status is required in a study, this review suggests that a wealth index

What is already known on this subject

The wealth index has been proposed as a reliable, simple alternative to the complex economic measure consumption expenditure. It is one of the most widely used socioeconomic indicators in epidemiological studies in low- and middle-income countries.

What this study adds

This systematic review demonstrates that the wealth index should not be viewed as a proxy for consumption expenditure.

may not be an appropriate choice. Collecting full consumption expenditure data is known to be costly and time-consuming; the consumption module from a Living Standards Measurement Survey (LSMS) typically takes over an hour to complete.⁶ Alternative proxies for consumption expenditure that are potentially more accurate than the wealth index have been proposed. Morris *et al* showed that using a restricted set of expenditure items can result in an accurate proxy for a full consumption expenditure measure.¹⁸ This method, however, requires the existence and analysis of a recent dataset from the setting of interest that contains expenditures for identification of the subset of expenditure items. Such studies exist for many settings, through both the World Bank LSMS programme and many national statistics offices. There is also some evidence that a simple index constructed of consumption adequacy questions (eg, “is your household’s food/clothing/housing/healthcare expenditure more than adequate, just adequate, or less than adequate to meet your household’s needs?”) can accurately predict expenditures.²⁸

Acknowledgements: We thank all of the study authors who responded with information about unpublished studies or provided more details of published studies. We also thank the reviewers for helpful comments and suggestions.

Funding: LH was supported by an Economic & Social Research Council/Medical Research Council Interdisciplinary PhD Studentship; JH is supported by an Economic & Social Research Council/Medical Research Council Post-doctoral Fellowship.

Competing interests: None.

Provenance and peer review: Not commissioned; externally peer reviewed.

REFERENCES

- Krieger N. A glossary for social epidemiology. *J Epidemiol Community Health* 2001;**55**:693–700.
- Friedman M. *A theory of the consumption function*. Princeton, NJ: Princeton University Press, 1957.
- Deaton A, Zaidi S. *Guidelines for constructing consumption aggregates for welfare analysis*. Washington DC: World Bank, 1999.
- Rutstein SO, Johnson K. *DHS Comparative reports 6: The DHS wealth index*. Calverton, MD: ORC Macro; MEASURE DHS 2004.
- Filmer D, Pritchett LH. Estimating wealth effects without expenditure data—or tears: an application to educational enrollments in states of India. *Demography* 2001;**38**:115–32.
- Gwatkin D, Rutstein S, Johnson K, *et al*. *Socio-economic differences in health, nutrition and population in developing countries: an overview. Country reports on HNP*. Washington, DC: The World Bank, 2007.
- Fotso JC, Kuate-Defo B. Socioeconomic inequalities in early childhood malnutrition and morbidity: modification of the household-level effects by the community SES. *Health Place* 2005;**11**:205–25.
- Townsend P. *Poverty in the United Kingdom*. Harmondsworth: Allen Lane and Penguin Books; Berkeley, CA: University of California Press, 1979.
- Mack J, Lansley S. *Poor Britain*. London: Allen & Unwin, 1985.
- Boltvinik J. *Poverty measurement methods—an overview*. New York: United Nations Development Program/Facultad Latino Americana de Ciencias Sociales, 1998.
- Expert Group on Poverty Statistics (Rio Group). *Compendium on best practices in poverty measurement*. Rio de Janeiro: Expert Group on Poverty Statistics, 2006.

- Perry B. The mismatch between income measures and direct outcome measures of poverty. *Soc Policy J NZ* 2002;**19**:101–27.
- Canadian Journal of Public Health. Guidelines for Systematic Reviews.
- Higgins JPT, Green S. *Cochrane handbook for systematic reviews of interventions*, Version 5.0.1 (updated Sept 2008). The Cochrane Collaboration, 2008. Available at <http://www.cochrane-handbook.org>.
- Improving the quality of reports of meta-analyses of randomised controlled trials: the QUOROM statement checklist.
- Sahn D, Stifel D. Exploring alternative measures of welfare in the absence of expenditure data. *Rev Income Wealth* 2003;**49**:463–89.
- Ahmed AIMU. Sociodemographic correlates of rural poverty in Bangladesh: a case study of Galibandha Sadar and Tanore Upazillas, Bangladesh. *e-journal of sociology* 2004;**1**:50–71.
- Morris SS, Carletto C, Hoddinott J, *et al*. Validity of rapid estimates of household wealth and income for health surveys in rural Africa. *J Epidemiol Community Health* 2000;**54**:381–7.
- Kumar TK, Gore AP, Sitaramam V. Some conceptual and statistical issues on measurement of poverty. *J Stat Planning Inference* 1996;**49**:53–71.
- Maluccio JA, Martorell R, Ramirez LF. Household expenditures and wealth among young Guatemalan adults. *Food Nutr Bull* 2005;**26**:S110–19.
- Ward P, Owens T, Kahyrara G. *Developing proxy predictors for household expenditure and income poverty*. Oxford: Oxford Policy Management, 2002.
- Bollen KA, Glanville JL, Stecklov G. Socio-economic status, permanent income, and fertility: a latent-variable approach. *Pop Studies* 2007;**61**:15–34.
- Booyesen F, van der Berg S, Burger R, *et al*. Using an asset index to assess trends in poverty in seven sub-Saharan African countries. *International Conference on “The many dimensions of poverty”*. Brasilia, Brazil, 2005.
- Davies H, Joshi H, Clarke L. Is it cash that the deprived are short of? *J R Stat Soc Series A Stat Soc* 1997;**160**:107–26.
- Maluccio JA, Murphy A, Yount KM. Research note: a socioeconomic index for the INCAP longitudinal study 1969–77. *Food Nutr Bull* 2005;**26**:S120–4.
- Onwujekwe O, Hanson K, Fox-Rushby J. Some indicators of socio-economic status may not be reliable and use of indices with these data could worsen equity. *Health Econ* 2006;**15**:639–44.
- Jere P, Babu SC. An analysis of the indicators of poverty in Malawi. *Agric Econ Anal Rural Dev* 1994;**4**:7–16.
- Lokshin M, Umapathi N, Paternostro S. Robustness of subjective welfare analysis in a poor developing country: Madagascar 2001. *J Dev Studies* 2006;**42**:559–91.
- Ngwane A, Yadavalli V, Steffens F. Poverty in South Africa—a statistical analysis. *Dev S Afr* 2001;**18**:201–16.
- Skoufias E, Davis B, De La Vega S. Targeting the poor in Mexico: an evaluation of the selection of households into PROGRESA. *World Dev* 2001;**29**:1769–84.
- Tarp F, Simler K, Matusse C, *et al*. The robustness of poverty profiles reconsidered. *Econ Dev Cultural Change* 2002;**51**:77–108.
- Wodon QT. Microdeterminants of consumption, poverty, growth, and inequality in Bangladesh. *Appl Econ* 2000;**32**:1337–52.
- Wong CK, Wong H. The case for an expenditure-based poverty line for the newly industrialized East Asian societies. *Issues Studies* 2004;**40**:187–205.
- Klasen S. Measuring poverty and deprivation in South Africa. *Rev Income Wealth* 2000;**33**:5–8.
- Bollen KA, Glanville JL, Stecklov G. Economic status proxies in studies of fertility in developing countries: does the measure matter? *Pop Studies* 2002;**56**:81–96.
- Wagstaff A, Watanabe N. What difference does the choice of SES make in health inequality measurement? *Health Econ* 2003;**12**:885–90.
- Khe ND, Eriksson B, Phuong do N, *et al*. Faces of poverty: sensitivity and specificity of economic classifications in rural Vietnam. *Scand J Public Health* 2003;**31**:70–5.
- Montgomery MR, Gragnolati M, Burke KA, *et al*. Measuring living standards with proxy variables. *Demography* 2000;**37**:155–74.
- Setel P, Abeyasekera S, Ward P, *et al*. Development, validation, and performance of a rapid consumption expenditure proxy for measuring income poverty in Tanzania: experience from AMMP Demographic Surveillance Sites. Paper prepared for the “Asset Index Seminar”, 26–28 March 2003, by DFID’s Health Systems Resource Centre and the University of Southampton. Available at http://www.rdg.ac.uk/ssc/publications/Inc_PovProx.pdf (accessed 3 Jun 2009).
- Jamal H. In search of poverty predictors: the case of urban and rural Pakistan. *Pakistan Dev Rev* 2005;**44**:37–55.
- Sumarto S, Suryadarma D, Suryahadi A. *Predicting consumption poverty using non-consumption indicators: experiments using Indonesian data*. Jakarta, Indonesia: SMERU Research Institute, 2006.
- Skoufias E, Coady DP. Are the welfare losses from imperfect targeting important? *Economica* 2007;**74**:756–76.
- Sumarto S, Suryadarma D, Suryahadi A. Predicting consumption poverty using non-consumption indicators: experiments using Indonesian data. *Soc Indicators Res* 2007;**81**:543–78.
- Grosch M, Baker J. *Proxy means tests for targeting social programs*. Washington, DC: The World Bank, 1995.
- McKenzie DJ. Measuring inequality with asset indicators. *J Pop Econ* 2005;**18**:229–60.
- Filmer D, Scott K. *Assessing asset indices* (WPS 4605). Policy Research Working Paper. Washington, DC: The World Bank Development Research Group, Human Development and Public Services Team, 2008.
- Lindelow M. Sometimes more equal than others: how health inequalities depend on the choice of welfare indicator. *Health Econ* 2006;**15**:263–79.

APPENDIX: MAIN FINDINGS OF SYSTEMATIC REVIEW

Characteristics of datasets included in the systematic review and their agreement with consumption expenditure

Study (first author)	Dataset	Indicators included in wealth index†										Consumption equivalence scale	Wealth index–consumption expenditure association	Strength of agreement between wealth index and consumption expenditure
		Study limitations*	Total	D	S	H	C	A	Other					
Ferguson ⁵⁵	Peru 2000 LSMS; N ~4000	M, H	24	21	1	1	1	1	1	1	Total	Spearman's rank correlation coefficient = 0.734	STRONG	
Jamal ⁶⁰	Pakistan Integrated Household Survey 2001/2 URBAN	M, U, N, H	30	17			2	8	1	2R	Total	R ² value from regressions of indicators on consumption expenditure = 0.69	STRONG	
Jamal ⁶⁰	Pakistan Integrated Household Survey 2001/2 RURAL	M, U, N, H	30	17			2	8	1	2R	Total	R ² value from regressions of indicators on consumption expenditure = 0.52	STRONG	
McKenzie ⁵⁵	Mexico Encuesta Nacional de Ingresos y Gastos de los Hogares 1998; N = 10 773	M	27	18	4	5					Not presented	Rank correlation coefficient = 0.894	STRONG	
Filmer ⁶⁶	Brazil 1996/7 LSMS; N = 4940	M	29	23			6				Per capita	% households in poorest quintile of expenditures in same quintile of wealth index = 68%	MODERATE	
Filmer ⁶⁶	Panama 1991 LSMS; N = 4945	M	27	21	1	5					Per capita	% households in poorest quintile of expenditures in same quintile of wealth index = 72%	MODERATE	
Grosch ⁴⁴	Jamaica LSMS 1989; N ~4000	M, H	24	9	3	5	6	1			Per capita	R ² value from regressions of indicators on consumption expenditure = 0.41	MODERATE	
Sahn ⁶	Peru 1994 LSMS; N = 3623	M	9	5	2	1	1				Per capita	Correspondence index = 0.28	MODERATE	
Sahn ⁶	South Africa 1994 LSMS; N = 8848	M	9	5	2	1	1				Per capita	Correspondence index = 0.31	MODERATE	
Sahn ⁶	Vietnam 1998 LSMS; N = 5999	M	9	5	2	1	1				Per capita	Correspondence index = 0.36	MODERATE	
Skoufias ⁴²	Mexico 1998 Encuesta Nacional de Ingresos y Gastos de los Hogares RURAL; N = 4378	M, U, H	20	13	5	2					Total	Sensitivity = 67.6%	MODERATE	
Sumarto ⁴³	Indonesia National Socioeconomic Survey 1999 URBAN	M, H, N	28	7	2	1	9			1L, 8P	Per capita	Grouped into bottom 30%, middle 40% and top 30%	MODERATE	
Sumarto ⁴³	Indonesia National Socioeconomic Survey 1999 RURAL	M, H, N	31	7	4	1	10			1L, 8P	Per capita	63.7% households in same group Grouped into bottom 30%, middle 40% and top 30%	MODERATE	
Ward ⁵¹	Tanzanian Household Budget Survey 2000/1; N = 20 883	M	26	9	1	6				10P	Per adult equivalent	60.1% households in same group % households in same tercile = 62.1%	MODERATE	

Continued

Appendix Continued

Study (first author)	Dataset	Indicators included in wealth index†										Strength of agreement between wealth index and consumption expenditure
		Study limitations*	Total	D	S	H	C	A	Other	Consumption equivalence scale	Wealth index–consumption expenditure association	
Azzam ⁵⁶	Albania 2002 LSMS; N = 3600	M	13	6	6	1	2	1	1L, 2W	Per capita	% households in same quintile = 56.8%	WEAK
Filmer ⁵	Indonesia DHS 1994; N = 16 242	M, H	13	6	3	4				Per adult equivalent	Classified into poorest 40%, middle 40%, and top 20%. 54.9% households in same group	WEAK
Filmer ⁵	Pakistan Integrated Household Survey 1991 (LSMS); N = 1192	M, H	15	7	4	4				Per adult equivalent	Classified into poorest 40%, middle 40%, and top 20%. 50.0% households in same group	WEAK
Filmer ⁵	Nepal Living Standards Survey 1996 (LSMS); N = 3372	M, H	16	6	4	6				Per adult equivalent	Classified into poorest 40%, middle 40%, and top 20%. 56.0% households in same group	WEAK
Filmer ⁴⁶	Nicaragua 2001 LSMS; N = 4191	M	32	24	4	4				Per capita	% households in poorest quintile of expenditures in same quintile of wealth index = 56%	WEAK
Filmer ⁴⁶	Uganda 2000 LSMS; N = 10 696	M	16	9	2	5				Per capita	% households in poorest quintile of expenditures in same quintile of wealth index = 52%	WEAK
Filmer ⁴⁶	Zambia 2004 LSMS; N = 19 247	M	34	26	4	4				Per capita	% households in poorest quintile of expenditures in same quintile of wealth index = 42%	WEAK
Howe ⁵⁷	Malawi LSMS 2004/5; N = 11 280	M	12	6	4	2				Per capita	% households in same quintile = 29.2%	WEAK
Khe ³⁷	Bavi District epidemiological field study; N = 11 547	L, R, M, H	15	14					1L	Per capita	Sensitivity = 50.8%	WEAK
Lindelow ⁴⁷	Mozambique National Household Survey on Living Conditions; N = 8250	M, H	12	7	3	2				Per capita	% households in same quintile = 25.1%	WEAK
Montgomery ³⁸	Ghana 1998 LSMS; N = 4291	M, H	12	6	5	1				Per adult equivalent	R ² value from regressions of index on consumption expenditure = 0.104	WEAK
Montgomery ³⁸	Guatemala Encuesta de Salud Familiar 1995; N = 2816	L, C, R, M, H	12	6	5	1				Per adult equivalent	R ² value from regressions of index on consumption expenditure = 0.077	WEAK
Montgomery ³⁸	Tanzania 1993/4 LSMS; N = 6742	M, H	10	4	5	1				Per adult equivalent	R ² value from regressions of index on consumption expenditure = 0.155	WEAK
Rutstein ⁴	Guatemala Health Demand and Expenditure Survey 1997; N = 2562	L, R, M, H	13	8	3	2			Total		% households in same quintile = 36%	WEAK

Continued

Appendix Continued

Study (first author)	Dataset	Indicators included in wealth index [†]										Strength of agreement between wealth index and consumption expenditure		
		Study limitations*	Total	D	S	H	C	A	Other	Consumption equivalence scale	Wealth index–consumption expenditure association			
Sahn ¹⁶	Côte d'Ivoire 1988 LSMS; N = 1600	M	9	5	2	1	1	1	1	1	1	Per capita	% households in same quintile = 37.0%	WEAK
Sahn ¹⁶	Ghana 1988 LSMS; N = 3192	M	9	5	2	1	1	1	1	1	1	Per capita	% households in same quintile = 30.6%	WEAK
Sahn ¹⁶	Ghana 1992 LSMS; N = 4552	M	9	5	2	1	1	1	1	1	1	Per capita	% households in same quintile = 30.7%	WEAK
Sahn ¹⁶	Jamaica 1998 LSMS; N = 7375	M	9	5	2	1	1	1	1	1	1	Per capita	Correspondence index = 0.60	WEAK
Sahn ¹⁶	Madagascar 1993 LSMS; N = 4800	M	9	5	2	1	1	1	1	1	1	Per capita	Correspondence index = 0.73	WEAK
Sahn ¹⁶	Papua New Guinea 1996 LSMS; N = 1396	M	8	4	2	1	1	1	1	1	1	Per capita	Correspondence index = 0.64	WEAK
Sahn ¹⁶	Vietnam 1993 LSMS; N = 4800	M	9	5	2	1	1	1	1	1	1	Per capita	% households in same quintile = 35.5%	WEAK
Skoufias ⁴²	Mexico 1998 Encuesta Nacional de Ingresos y Gastos de los Hogares URBAN; N = 9001	M, U, H	20	13	5	2	2	2	2	2	2	Per capita	Sensitivity = 53.4%	WEAK

*Key to methodological limitations: *Measurement of wealth index*: I = included narrower range of indicators than standard DHS indices; *Measurement of consumption expenditure*: L = limited details provided, C = restricted list of items; *Study design*: R = not nationally representative; *Analysis features*: M = missing data excluded or not mentioned at all, U = analysis only performed separately for different areas, N = sample size not reported, H = clustered sampling not discussed or not taken into account in analysis.

[†]Key to indicator types: D, consumer durables (includes all durables, domestic appliances, vehicles, telephones, etc.); S, access to services (includes water supply, sanitation facilities, fuels used, healthcare use); H, housing characteristics (includes dwelling materials, ownership status, etc.); C, demographics and human capital (includes education, occupation, family size and composition, crowding, etc.); A, area; Other categories: P, purchases, consumption indicators and clothing; L, livestock; R, remittances; W, subjective well-being.
LSMS, Living Standards Measurement Survey.