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What are the links between morbidity and economic level? How should these terms be defined? These and other questions are raised in this paper. The author discusses the difficulties involved, and illustrates his discussion with examples selected from a survey carried out on Taiwan.

PROBLEMS IN MEASURING THE INFLUENCE OF ECONOMIC LEVELS ON MORBIDITY

Timothy D. Baker, M.D., M.P.H., F.A.P.H.A.

Introduction

OF what importance is the relation of morbidity to economic levels? Why should we address attention to this problem? If we hope to convert the cycle of poverty, ignorance, malnutrition, and sickness to one of education, improved nutrition, improved health, and economic development, we must gain understanding of the interactions of these variables. Leona Baumgartner, in a recent editorial in this Journal, quoted from Kimball's book "Tropical Africa": "It is bad enough that a man should be ignorant, for this cuts him off from the commerce of other men's minds; it is perhaps worse that a man should be poor, for this condemns him to a life of stint and scheming, in which there is no time for dreams and no respite from weariness. But what surely is worse, is that a man should be unwell, for this prevents him from doing anything much about either his poverty or his ignorance."¹⁷ The problems of ignorance, sickness, and poverty are not restricted to tropical Africa. One finds these problems even in the cities of the United States.

Some economists tell us that eco-

nomie development per se will lead to better health. Educators claim that education will lead to both better health and economic development, while we as health workers often claim that without health, neither education nor economic development can succeed. To plan logically for improvement in all of these areas one must be able to evaluate effects of each, in order to establish priorities.

This paper does not attempt to assess and evaluate the priorities of these factors. The difficulties and shortcomings of use of interview data in lieu of complete, standardized history and physical are not discussed.^{28,29,34} Discussion is limited to problems and pitfalls in the study of the interrelationships of economic level and morbidity as measured by household interview. Examples are drawn mainly from a year-long, nationwide study in Taiwan.

Background

Although interest in the relationship between morbidity and economic level goes back at least as far as Edwin Chadwick's Report on the Sanitary Condition of the Labouring Population of Great

Britain in 1842,² Chadwick's work and other early studies are based more on impressions than on statistics, and were far more concerned with mortality than morbidity. However, in the late 1920's and early 1930's a number of serious attempts were made to evaluate morbidity patterns in the United States. These studies included publication No. 26 of the Committee on Costs of Medical Care,¹¹ which reviewed the incidence of illness and the cost of medical care among representative families; the studies in Essex County and in Hagerstown; and the studies on causes of illness in 9,000 families from the PHS nation-wide periodic canvasses from 1928 to 1931.⁴ The Public Health Service undertook a national health survey in 1935-1936²⁵ which studied the relation of sickness to its social and economic settings. Today, there are far too many morbidity surveys to list them all, but the U. S. National Health Survey deserves special mention. This survey, in continuous operation since 1957, has in many ways set the standards for other national health services. It provides a wealth of useful data for health planners in the United States.²⁴

Major Points

The four major points of this paper are:

First, economic level may be measured in at least three ways—income, expenditure, or wealth. Each of these measures varies in ease of collection and in suitability for analysis.

Second, one may use family or weighted per capita measures. Use of family expenditure shifts the larger families with larger expenditures and more opportunity for multiple wage earners into the higher economic levels. Per capita income or per capita expenditure is probably an improvement over the use of family data. Perhaps the best measure is a scale which takes

cognizance of the fact that each additional unit in a family will not cause as much increase in expenditure as the initial unit.

Third, if one uses expenditure as a measure of economic level in morbidity studies, it may be essential to correct total expenditures by subtracting the medical expenditures, as these are obviously highly correlated with morbidity. Whether this correlation affects the results significantly is another, and in reality the important, question.

Fourth, the definition of morbidity varies. Whether this definition is bed days, days of reduced activity, days of "sickness" or persons sick will influence the relationship of morbidity and economic level.

In considering all of these points we hope to show that morbidity-economic patterns may show quite large, apparent shifts depending upon the method of measuring economic level and the method of measuring morbidity. The explanation of these shifts may lie in the fact that economic level per se has no direct causal relationship with morbidity, but acts through a series of more or less closely correlated variables such as age, sex, health practices, nutrition, housing, availability of medical care, and so forth. The complex interrelationships of the independent variables suggest the use of multivariate analysis and we have used this method on our Taiwan data. Presentation of results would probably not clarify, but confuse this presentation.

Most of the remainder of this article presents examples to illustrate these major points. A few of these examples come from National Health Survey data.^{22,23} The majority are drawn from our study in Taiwan.

The Taiwan Survey

The major purpose of our research in Taiwan was to collect and analyze data for a health manpower plan for

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Taiwan.* To measure the demand for medical services we undertook a random, cluster sample of households, stratified by urban-rural location. The strata were weighted according to total size of the strata components in the whole population. Within each stratum, sampling areas were randomly selected, as were specific households. (Each selected household was the index for three other households; this is similar to the method used by the National Health Survey.) The random selection of households was made by reference to the household register, a most useful heritage of the Japanese occupation. Each month, a district public health nurse, who had been trained in our special course in interviewing, contacted a set number of families. During the interview, the nurse sought to establish the family's expenditure pattern by estimating the value of staple foods consumed, inquiring about expenditures for rent or equivalent rental value for owned housing, education, household staples, and so on, on a monthly basis, and about major expenditures on a yearly basis. In addition to the basic questions about use of health services, the nurse asked about sickness in the family and about days lost from usual activity during the previous month.

When the interview was complete, the nurse forwarded the questionnaires to the central office. The questionnaires were checked, coded, transferred to punch cards and tabulated in the IBM office in Taipei. Questionnaires that were unclear or questionable were returned to the interviewer for rechecking. Two supervising nurse interviewers were used for quality control. The check tests that were run to determine the extent of variation were on the whole reassuring. The quality of our interview data is due

* The health manpower research project was carried out in collaboration with Dr. Mark Perlman, professor of economics, University of Pittsburgh, who deserves thanks for his careful review of this article.

in large part to the dedication of the public health nurse interviewers and the confidence that the public placed in them.

A one-month pilot survey was run, following which 12 monthly surveys, each representative of the island, were carried out. In all, data were secured on 66,000 persons.

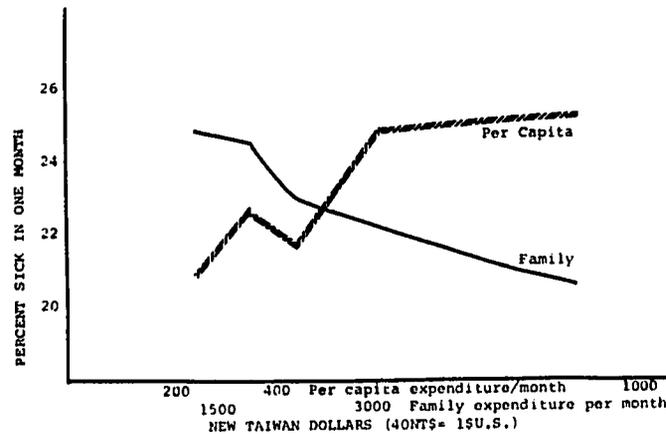
Expenditure, Income, or Wealth?

The controversy over the use of income, expenditure, or wealth as the best measurement of economic well-being, is not new. In the United States, income has been used far more extensively than expenditure as a measure of economic well-being.^{20,21,26} Efforts to diverge from income as a measure usually meet with criticism from the traditionalists.

However, those of us who are interested in the relationship between economic levels and morbidity, and also use of medical services, might find the concept of expenditure more useful in certain circumstances. In Taiwan, it is unlikely that we could have obtained any information on income through direct questions. The instinctive repugnance of a rural population to income questionnaires is well exemplified by the Singhalese rebellion which was triggered by a country-wide income survey. Second, if information had been collected on income, its validity would have been highly questionable. We did, in the special case of physicians, collect information directly on income. A comparison with our estimates of physician income made from our island-wide study of medical expenditures showed that reported physician income figures were less than one-third of what we thought to be a very conservative estimate! Economists familiar with incomes in Taiwan agreed that physician incomes were probably understated to this extent.

Economists point out that an im-

Figure 1—Morbidity in relation to per capita expenditure and to family expenditure



portant drawback to the use of income as a measure of economic level is that income may vary considerably from year to year.³⁵ The same criticism surely applies to the use of expenditure data. To compensate for such deficiencies income could be measured for more than one year to equalize any unusual divergencies in pattern, or expenditures could be measured, deleting all "unusual" outlays for large purchases of durable goods. However, both of these methods have drawbacks.

Expenditure and income are certainly not the only forms of measuring economic level. The third broad category is wealth: accumulated savings, real estate, or durable goods. A study in the early 1930's in rural Wisconsin¹⁸ used a "cow index" as a measure of economic well-being. A "cow index" or similar measure of holdings of property is probably the only appropriate measure for determining economic level in those parts of developing nations which do not yet operate on a monetary economy.

However, one of the major blocks in using net worth or ownership of capital goods for assessing economic level is a lack of suitable gauges that would be applicable in all parts of the country.

There are many problems in comparing data with economic levels set by expenditure, economic levels set by income, and economic levels set by wealth. Expenditure and savings patterns both deserve more attention in correlation with health habits. We did not collect information on income or wealth in our Taiwanese study; we know of no studies which have collected information on both income and total expenditure in relation to health.

Per capita Expenditure, Family Expenditure, or a Combination?

The information on morbidity in the Taiwan study was collected primarily as ancillary information. Our main purpose was to study the pattern of use of health services. However, this morbidity information furnished us with a clue to the great discrepancies that may be introduced by using different measures of economic level. We used per capita expenditure. However, in most economic studies and, indeed, in the National Health Survey, economic level is set on a family basis rather than on an individual basis. Possibly there is some justification for this, just as there is some truth to the old adage that two

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can live as cheaply as one. However, the use of family expenditure (as compared to per capita measures) tends to concentrate the higher morbidity families in the lower economic groups. These higher morbidity families are probably older, one- and two-person families.

The apparent marked differences between the patterns of morbidity in relation to per capita expenditure and in relation to family expenditure are shown in Figure 1. With the change from family income to per capita income the picture may be similar. Data from the Bureau of Labor Statistics show that urban families increase in size with increase in family income.¹³ This increase in family size with increased income reflects either increased earning power of the older heads of households or secondary wage earners within the family. Obviously, converting from family income to per capita income would result in marked changes of distribution of families by income level. We do not have data available from the National Health Survey to see what effect changing from family income to per capita income would have on morbidity rates. However, changing from non age-adjusted rates to age-adjusted rates (which probably parallels the effect of changing from family income to per capita income) lessens the difference in morbidity rates between the richest and the poorest groups, as shown in Table 1.²³

In the past, attempts have been made to allow for the size of family, recognizing that children, in general, do not consume as much as adults, and that there are certain economies of scale in larger families. One of these methods is to give an arbitrary rating factor for additional members in a family. This rating has been termed "adult maintenance unit" or "ammain."²³ (It is interesting that this economic concept also was developed as a part of a health research project, a study of pellagra in southern United States.)

A far more useful concept than either family expenditure or per capita expenditure or even an arbitrarily applied scale of "adult maintenance unit" has been proposed.* In brief, this method divides families into economic deciles, quintiles, thirds (or any other convenient grouping) by use of the distribution of families by income and by size of family. One finds the average income for each family size and sets appropriate boundaries above and below this average to take in the desired percentages of families, using a standard curve-fitting technic. Once one has determined economic levels by this method, the total persons in each economic class can be added and then compared with other variables such as morbidity levels, visits to physicians, educational levels, and others.

"Net" or "Gross" Expenditures?

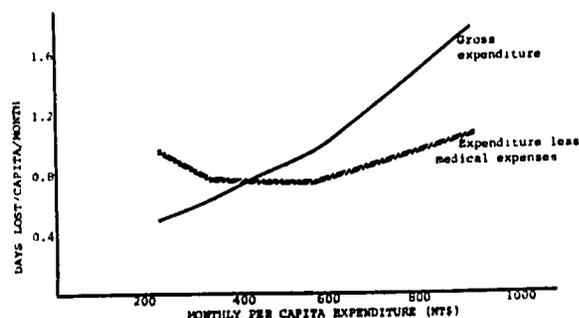
The peculiar association of higher morbidity with higher economic level led me to an initial explanation that we had unduly concentrated sick people in the upper economic levels by including their health expenditures^{1,15} with all other household expenditures. This "association expenditure artifact," as Figure 2 shows, had a substantial influence in overloading the higher economic groups with sick people. (Surprisingly, this

* Dr. William Reinke, assistant professor, Johns Hopkins University (paper in preparation).

Table 1—Restricted activity days per person per year (United States National Health Survey)

Annual Family Income	Unadjusted	Age-Adjusted
<\$2,000	29.1	22.8
2,000-3,999	17.7	17.1
4,000-6,999	13.7	14.8
7,000+	13.1	13.7

Figure 2—Effect of medical expenses on morbidity × expenditure curves



change did not have as great an effect on the economic level morbidity relations as the change from family to per capita expenditure.) This shows that one should usually delete an “associated expenditure” when using expenditure as a measure of economic level. For example, medical expenses should probably be subtracted when studying morbidity or medical care; the same applies to educational expenses when determining the number of persons in college from various economic levels. Inclusion of these unusual expenses would tend to concentrate the very phenomenon one is looking for in higher economic groups than is justified.

Problems in Definition of Morbidity

There is a differential morbidity pattern by economic level in acute and in chronic diseases. Data from the National Health Survey show that occurrences of acute disease seem to have a positive correlation with rising economic levels.²³ Such a relationship would not be suggested by the doctrine that “poverty breeds disease.” A certain amount of this correlation of high acute disease rate with high economic level may be ascribed to differing definitions of morbidity for different social classes.¹⁰

However, in Japan, where there is probably more acute disease than in the United States, there is a curious pattern of generally increasing disease in-

cidence with increasing economic level.⁷ Dr. Sanders³⁰ and before him Drs. Sartwell and Merrill³¹ have raised the question—If the sick die earlier in a given population group, will this lower their morbidity rate?

Certainly the definition of “morbidity” is of major importance in determining the rates from different educational groups, and probably different economic groups. The National Health Survey uses four measures of morbidity—restricted activity days, bed disability days, work loss days, and school loss days.²² In our study in Taiwan we used the concepts of “sick” and “day lost from usual activity.” All these definitions may be subject to a variety of interpretations. Despite the problems in definition, the concepts of a bed day or a day lost from usual activity serve as very useful measures of morbidity. If the woman with premenstrual cramps is indeed “confined to bed” or “loses a day from her usual activity” because it is the “custom” of her social group and educational level, the effect on society is just the same as if she had been really sick.

Another problem in the definition of morbidity is choosing between “episodes of illness per person” or “days lost per person.”^{5,6,9,12} Use of the first measure tends to overemphasize illnesses of short duration, while the second measure can result in distortions of the

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normal pattern, particularly when the sample size is small. Probably the only way to overcome this problem is to use both measures of morbidity, or even to add a third combination, "days lost per episode of illness." The NORC-HIF study showed very clearly that with decreasing income in the United States there was decreasing awareness of the importance of medical care and more of a sense of resignation about physical illness. This might lead to lower reporting of illness in the lower economic groups. Perhaps this concept of illness is also characteristic of the Taiwanese. However, we are not convinced of this, because in Taiwan the illiterate report higher morbidity than the well-educated. We believe that health attitudes are more closely correlated with education than with economic level but have no direct evidence to prove this.

Economic Levels and Factors Directly Influencing Morbidity

Some of the problems in measuring the relationship between morbidity and economic level may be better understood by concurrently studying the associated variables of age, sex, education, and so on.

Perhaps the best established and most widely studied relationship is that of morbidity and age.⁹ Studies in many different countries and at different points in time show that the older persons, particularly those over 65, have substantially higher morbidity rates than any other age group.³ The under-five age group in the developing countries also has higher risks of morbidity than the large population from age five through forty-five. Although higher morbidity seems to be uniformly associated with the highest age group, the correlation of age group with economic level is by no means so universally consistent. In the Taiwan study, we found that the high-risk age group (over age 50) made up 14 per cent of the

total population in our highest economic group, while it made up only 8 per cent of the population in the lowest economic group. In the United States, on the other hand, this pattern is reversed. Persons 45 or over make up 47 per cent of the lowest income group and only 24 per cent of the highest income group. This is due in part to basic demographic differences between the two countries, and in part to the artifact of measurement discussed earlier, under family or per capita expenditure.

Morbidity rates in Taiwan are four times greater in the high-risk, over 50, age group than in the large, low-risk, age five to fifty group. This same ratio exists between the high-risk ages and the low-risk ages shown in the National Health Survey data. In Taiwan, the 0-5 age group had an intermediate rate of morbidity. The National Health Survey data showed 0-5 to be an extremely low morbidity group.

Within certain limits, education has been used as a measure of quality of individual health practices. We found in our Taiwan study that the illiterate suffered twice as much illness as the high school educated group. Only 30 per cent of the population in the highest economic group was illiterate; the lowest economic group had over twice this percentage of illiteracy. Thus, in Taiwan, the correlation of education and economic level has an effect on morbidity-economic relationships which is opposite to the effect of correlation of age and economic level. The National Health Survey does not go into the relationship of education to family income and morbidity.

The correlation of rural-urban location with economic level is also of interest. In Taiwan, people living in the rural areas have 50 per cent more illness than those living in urban areas. The reasons may be lack of availability of medical attention for preventive or early curative treatment, lack of munic-

Table 2—Days lost per capita by education

	Economic Groups				All Economic Groups
	I	II	III	IV	
Illiterate	1.17	1.25	1.47	1.91	1.29
Grade school	1.05	0.88	0.91	1.00	0.98
High school	0.92	0.61	0.47	0.57	0.63

ipal water supplies, or other factors. Whatever the reasons, the factor of increased morbidity for rural dwellers is correlated with the economic level of the people. Fifty-five per cent of the lowest economic group and only 33 per cent of the top economic group are exposed to the higher morbidity risks of rural living. This higher risk of morbidity may be partially due to a higher percentage of illiteracy in the rural areas. In the United States the over-all rural-urban morbidity difference is small, approximately 10 per cent. The National Health Survey has not studied the correlation of this difference with economic level.

Many morbidity studies have shown that presence or absence of water supply is very closely correlated with morbidity levels, particularly for diarrheal diseases. Water supply is also closely correlated with economic level. We found that in the lowest socioeconomic group only 27 per cent of the houses have piped water, while in the highest socioeconomic group 47 per cent of the houses are supplied with water.

Nutrition is an important economy-correlated determinant of morbidity.²⁷ Many studies link malnutrition to increased morbidity from TB and diarrhea.^{8,10,14,32} Malnutrition is also the primary cause of a number of deficiency, and possibly "food excess" diseases.¹⁶ In our Taiwan study we made no measure of nutrition to associate with economic level and general morbidity.

Sex accounted for little variation in

morbidity in the Taiwan study. Even in the childbearing age group, the women showed only a 10 per cent increase in morbidity over the males. This figure is only slightly more than the difference in the other age groups. The excess morbidity of the unemployed was about the same for males and females. Our over-all survey figures showed that our sample had about 2 per cent fewer males than females, which reflected the general demographic pattern of Taiwan. There was very little difference in the distribution of males and females by economic class.

In the United States, however, there are much wider differences between the sexes in morbidity rates. These differences range from 20 per cent to 40 per cent, the variation being based on difference of definition of morbidity. There is a small excess of females in the lowest family income group.

Conclusion

This article describes some of the problems involved in studying the effects of economic level on morbidity. It attempts to show that the origin of these interesting problems often lies in correlated variables. We hope that the reader has been made aware of the need for caution in interpreting and comparing economic and morbidity data.

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Dr. Baker is associate director, Division of International Health, Johns Hopkins University School of Hygiene and Public Health, Baltimore, Md. 21205.

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