Villages in Transition: Elevated Risk of Micronutrient Deficiency

William D. Drake (author to whom comment should be directed)
Community Systems Foundation, Ann Arbor, MI USA
School of Natural Resources and Environment, University of Michigan
Department of International Health, School of Public Health, University of Michigan

S. Pak
Community Systems Foundation, Ann Arbor, MI USA
Department of International Health, School of Public Health, University of Michigan

I. Tarwotjo
Nutrition Directorate, Ministry of Health, Republic of Indonesia, Jakarta, Indonesia

Muhilal
Center for Research and Development in Nutrition, Bogor, Indonesia

J. Gorstein
Community Systems Foundation, Ann Arbor, MI USA
Department of International Health, School of Public Health University of Michigan

R. Tilden
Department of International Health, School of Public Health, University of Michigan

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ABSTRACT

Some researchers have suggested that as villages move from traditional living patterns emphasizing self-sufficiency, to ones featuring economic development, there is a vulnerable transition period in which families of the community are at greater health risk. This elevated risk results from many factors such as employment volatility, changes in food consumption patterns, composition of the extended family, temporary migration, and child rearing behavior. Elevated risk, if present, would strike hard at children who are most vulnerable and readily reflect adverse changes in family status.

Analysis of data from the Eastern Islands of Indonesia supports this hypothesis of elevated risk during transition. Villages in the study area were ranked by a classification system used in Indonesia to measure level of development ranging from traditional agricultural villages, to modern, market-oriented villages. This ranking system not only is related to the amount of infrastructure available in the community, but also includes many other factors. The approach followed takes advantage of the multitude of parameters measured in this study by portraying joint risk of vitamin A deficiency, iodine deficiency disorders, iron deficiency

anemia as well as other health indicators such as measles, worm infestation, and diarrheal diseases. By examining community-level prevalences for all three micronutrient deficiencies this methodology offers unique opportunity to study how the risk for these conditions covary at the community level, and thus provides important information for targeting communities with integrated control program activities. Amongst all villages with high prevalences of any of the three micronutrient deficiencies, there is about a 70% 'overlap' in risk between at least two of the three micronutrients, with 22% of the villages being at high risk for all three micronutrient deficiencies.

Villages in transition are shown to have higher prevalences of total goiter rate, lower mean hemoglobin levels, higher helminthic infection rates, and higher prevalences of wasting and underweight malnutrition, all at statistically significant levels. They also tend to have slightly higher prevalences of low serum retinol, although not statistically significant within the sample sizes in this study. While focusing upon villages in transition is but one type of targeting, there is a qualitative difference between this one and other targeting strategies. In this instance the targeting can be based upon *anticipating* the risk rather than reacting to risk estimates based on surveys. Because the government is both planner and resource allocator for its development programs, difficulties experienced during movement through a transition period can be monitored and dampened by allocating special integrated activities to the region receiving development assistance.

INTRODUCTION

Objectives of Study

As governments strive to maximize the effectiveness of their limited resources, the issue of identifying and targeting those most in need of health and nutrition assistance becomes paramount. This paper presents a unique approach to determining these needs for assistance. The approach combines recent theoretical developments in the field of population-environment dynamics with general resource allocation strategies to suggest a method for identifying high-risk population groups. As part of this inquiry, measurements of the extent of overlap among risk factors is made which can be utilized to improve the efficiency of program implementation. Perhaps most important, the methodology which is proposed permits governments to anticipate difficult problems so that preventive rather than solely curative measures can be taken in a timely manner.

This paper begins by describing the setting in which the study was undertaken. Next, the theoretical model is presented along with the possible applicability of the model to real world situations at hand. Third, data is used to determine whether the model has predictive capacity, and finally conclusions and policy implications stemming from the analyses are presented.

The Setting: The Eastern Islands of Indonesia

In 1990 the Government of Indonesia commissioned the Center for Nutritional Research and Development of Bogor, Indonesia to undertake a study on the health conditions of the Eastern Islands. Community Systems Foundation of Ann Arbor, Michigan was asked to provide technical assistance through the A.I.D. VITAL Field Support Project. The Government was especially concerned with deficiencies in micronutrients that were expected to be a strong contributing factor to poor health status of the children in those islands.

A cross-sectional prevalence study was carried out in October 1990 through June 1991. The purpose of the study was to gather data on the prevalence and distribution of specific micronutrient deficiencies, including vitamin A deficiency (VAD), iron deficiency anemia (IDA), iodine deficiency disorders (IDD), and protein energy malnutrition (PEM). It was planned that this information would be used for assistance in the targeting of specific nutrition and health interventions in these remote islands. The study provides the first substantial body of information regarding the prevalence of these conditions in the Eastern Islands.

The Eastern Island provinces of Indonesia include the islands east of Java and Kalimatan (Borneo), the island of Sulewesi (the Celebes), the islands of the province of Maluku, the islands of Irian Jaya, Nusa Tenggara Barat (NTB), Nusa Tenggara Timor (NTT), and Timor Timur (Tim Tim). However, only Maluku, NTT, Tim Tim, and Irian Jaya were selected for this study as these provinces were not fully represented in earlier surveys.

Most of the provinces are culturally distinct from the rest of Indonesia, as well as from each other. Dietary patterns, terrain, and climate also differ, leading to a belief that causes of malnutrition may differ from the rest of the country and among the four provinces.

Irian Jaya, the easternmost island, is populated by subsistence hill tribes whose intertribal warfare has kept development efforts at a minimum until they were released from Dutch Colonial domination in the early 1960s. In the last thirty years, the development of roads, communication networks, construction of schools and health centers have done much to bring this province more into the mainstream of Indonesian life. However, the population and their lifestyle is still quite different from most of the country. Through the transmigration of groups from Java to Irian Jaya, the population is now quite diverse representing a wide range of socioeconomic and cultural backgrounds.

Timor Timur (Tim Tim) is an even more recent addition to the Republic of Indonesia. Until 1974 it was under the jurisdiction of Portugal. In that year, Portugal divested itself of all its colonial possessions, including Tim Tim. Tim Tim was then integrated into the Republic of Indonesia, and for several years specific pockets of resistance to this integration made the expansion of governmental social welfare programs problematic. Under the Portuguese, very little effort was made to educate the rural population, and semi-feudal political systems kept power in the hands of a few rich Portuguese families living in the capital, Dili. The results of this survey suggest that Tim Tim has made progress and is in the process of expanding its rural social welfare systems.

The province of Maluku is the location of the original spice islands for which the European countries originally set sail to the Orient. Nutmeg and mace originated from the island of Banda (which is in this province), and cloves were found on the island of Ambon. During the 16th century this area was a site of confrontation between the Portuguese, the first Europeans to settle in the area, and the Dutch. Different islands in the province still display characteristics which have been adopted from these two western European nations.

Nusa Tenggara Timor (NTT), like Maluku, is one of the original provinces of Indonesia. It has a dryer climate than most of the country. Unlike the other eastern provinces, it has characteristics which are similar to those of the rest of the country, and its level of participation in social welfare programs is the highest of all the provinces in the survey.

Nutritional problems of the area

Vitamin A deficiency — Vitamin A deficiency has long been known to occur in Indonesia. Consequently, Indonesia has been one of the leaders in the world in research of this important problem. Blindness due to xerophthalmia had been the primary justification for these investments. However, in 1985, studies provided some evidence that sub-clinical VAD, even when not associated with nutrition blindness, leads to increased risk of mortality, thereby introducing and additional impetus for its control.

The island of Ambon in Maluku was included in the 1978 National Nutritional Blindness Survey, but the other four provinces were not surveyed because of logistic and cost constraints. The island of Biak was recognized as having high levels of xerophthalmia in 1981, due to the energetic efforts of the head of Kabupaten medical services. It was suggested that xerophthalmia might also be a problem in NTT in the early 1980s.

Nutritional Anemia — Of all the micronutrient deficiencies, nutritional anemia is undoubtedly the most widespread. However, its distribution and magnitude is least known throughout the country. Young children and pregnant and lactating women are the most likely to be at risk. Nutritional anemia has been associated with impaired cognitive and motor development of children, low birthweight, and increased risk for mortality in pregnant women as well as reduced productivity in adult males. Data generated from the present study provides the first population-based prevalence information on anemia available in the country.

Protein Energy Malnutrition — Protein Energy Malnutrition (PEM) is a problem associated with poor food availability and excessive infection. It is identified in children who are short for their age (stunted) and/or underweight for their age, and in some cases with diminished body mass for their stature (wasted). The method by which PEM has been assessed in this study is through anthropometry. The primary measurements taken were the height, weight, and age of preschool children. These different measures were then combined to form three indices: weight-for-age, height-for-age, and weight-for-height. Height-for-age is generally considered a measure of food availability and overall socioeconomic conditions during the development of the child, while weight-for-height (body mass on the frame of the child) is considered to better reflect insult to the child either due to illness or recent acute food shortage. Weight-for-age is a combination of these two indices, although limited since it fails to distinguish, thin children from short children with adequate muscle and fat in the classification of the undernourished.

Iodine Deficiency Disorders — Iodine deficiency disorders are a group of health and developmental problems associated with inadequate iodine intake. Historically, the magnitude of this problem has been measured by palpable goiter rates, which is the most obvious and specific symptom associated with low iodine intake. Among the other symptoms of IDD, cretinism (mental and developmental sub-normalcy) is found in areas in which iodine deficiency is endemic, and a whole spectrum of more subtle symptoms also have been attributed to insufficient iodine nutriture. These include reduced IQ, deafness, and delayed motor skill development. Several biochemical parameters are sometimes used to assess the magnitude of IDD including: urinary iodine, thyroid stimulating hormone (TSH), and levels of other thyroid hormones (T3 and T4).

The Study

The study focuses on vitamin A deficiency (VAD) in children in the age group 0 to 6 years. Ophthalmological examinations were carried out to look for clinical eye signs of VAD Blood collections were performed for the measurement of serum vitamin A in a 11% subsample. From blood samples taken, hemoglobin levels were also assessed. This same group of children were examined for protein energy malnutrition.

Pregnant women in the same communities were tested for anemia. Iodine deficiency disorders (IDD) were studied in elementary school children through examination for palpable goiter as well as through assessing iodine levels in urine specimens collected from a 10% subsample. From each sub-province (kecamatan) surveyed, two elementary schools were chosen which were located close to the village and census unit (wilayah) in order to examine children 0-6 years along with pregnant women.

Every pregnant woman chosen in the survey area was examined for general health conditions, goiter, and hemoglobin. Urine samples to check for iodine levels were not taken.

Data Processing and Analysis

The data was converted to electronic form using a customized computer and entry program equipped with built-in checks to minimize data entry error. In addition, several thorough rounds of data checking and cleaning were carried out, to ensure the internal validity of the data.

Table 1 lists the variables used in the present analysis. Using FoxPro Version 2.0 and SPSS-PC Version 3.0, these variables were created by aggregating household data up to the village level to derive community-level variables. From the 245 villages, 56.3% were accepted with loss due to missing values, leaving a total of 138 villages included in the analysis. Most of this data loss is due to the fact that iodine deficiency in schoolchildren was measured only in those villages with schools.

These continuous variables were chosen from the dataset to depict the nutrition and health of the sample population. The first two variables, MN-VITA and MN-HEMO represent sera data collected in preschoolers in Eastern Island villages from which the serum vitamin A levels and serum hemoglobin levels were assayed. These data were aggregated to the village level as mean serum vitamin A and hemoglobin levels.

MOVING FROM TRADITIONAL TO MODERN VILLAGE LIFE: RISKS DURING TRANSITION

Relative Health Risks at the Community Level

The determination of the prevalence of nutriture deficiency in the Eastern Islands marks the first stage in devising an effective intervention. Another critical element is the determination of the extent to which assistance can be targeted to high-risk populations. The findings of this survey show wide variation in health status among provinces and, more important, within each province. Such variation implies that considerable benefits might accrue from targeting – provided that a practical method could be devised. If the actual identification of high risk groups for targeting is costly, the relative gains from targeting

TABLE 1

All data were gathered for preschool children unless otherwise indicated.

Variable	Description
MN-VITA	Mean Serum Vitamin A Levels
MN-HEMO	Mean Serum Hemoglobin Levels
CASES	Prevalence of Xerophthalmia (X1B)–clinical sign of VAD
MEAS	Prevalence of Measles in the last 3 months
POX	Prevalence of Chicken Pox in the last 3 months
DIA	Prevalence of Severe Diarrhea in the last 3 months
WORM	Prevalence of Parasitic Infestation in last 3 months
MN-WHZ	Mean Weight for Height z-score (wasting)
STUN	Prevalence of moderate Stunting
UNDERWT	Prevalence of moderate Underweight
WAST	Prevalence of moderate Wasting
TGR	Total Goiter Rate (among schoolchildren)
VGR	Visible Goiter Rate (among schoolchildren)
MN-BMI	Mean Body Mass Index (among pregnant mothers)
TGR-M	Total Goiter Rate (among pregnant mothers)
VGR-M	Visible Goiter Rate (among pregnant mothers)
ED-HH	Mean Education level of head of household
ED-MOM	Mean Education level of mother

are lost. For example, in most settings, it is not practical to conduct a careful household survey to determine relative risk. Other less expensive means must be found which can act as a reasonable surrogate for these rigorous but expensive approaches. Thus, the Eastern Islands Prevalence Survey was designed, in part, to test the effectiveness of using variables collected at the desa (village) level to estimate *household* health risk. The question is not whether perfect correspondence exists between village and household but rather, are there easily gathered village-level variables which do a reasonable job in ranking regions. If village estimates can be used to indicate *relative* risk, then a targeting strategy, at the sub-province (Kabupaten or Kecematan) level may be practical. On the other hand, if there is not a strong correspondence, practical targeting is less likely.

A sequence of steps was undertaken to examine this question. First, variables gathered at the community level were related to the average nutritional status for individuals and other health indicators of households in the desa. Next, the strength of association between household and desa-level data was assessed using Pearson correlation coefficients and analysis of variance. The final objective was to select a subset of variables which could be gathered at the desa level and which would relate to household health conditions. A wide range of variables gathered at both the household and community level were analyzed for their targeting effectiveness. These results are presented elsewhere (*Eastern Islands Micronutrient Deficiency Prevalence Study*, Center for Research and Development in Nutrition, Nutrition Directorate, Ministry of Health, Republic of Indonesia, October 1991). In this paper we will explore an alternative (or supplementary) scheme for determining relative risk – one based on emerging theoretical developments in the field of population-environment dynamics.

Elevated Risk for Villages in Transition

Recent research suggests that there is a special vulnerability as a community moves from relative traditional living patterns emphasizing self-sufficiency, to ones featuring economic development (see Drake, W. D. "Toward Building A Theory of Population Environment Dynamics: A Family of Transitions," *Population-Environment Dynamics*, University of Michigan Press, Ann Arbor, 1993). The theory asserts that movement from traditional to "developed" status is characterized by the region passing through a series of transitions in each of many sectors of its society. For example, one well known transition is the demographic transition. At the onset of this transition, births and deaths are both high and are in relative equilibrium with each other. Historically, births exceed deaths by small amounts so that the total population rises only very gradually. Occasionally, famine or epidemic forces a decline in total population but in general, changes in rates are slow. During the transition, however, death rates drop dramatically, usually due to improvement in the health condition of the population. This change in health is caused by many, often interrelating factors. After some time lag, the birth rate begins to drop and generally declines until it is in approximate balance with the death rate again.

But there are in fact many similar transitions each related to different sectors of the community. This dynamic is visualized as a **family** of transitions. That is, not only has demographic and epidemiologic transition been described but also deforestation, toxicity, agricultural, energy, education, and urbanization transitions as well as many others. It is argued that for each transition there is a critical period when society is especially vulnerable. During that period, rates of change are high, societal adaptive capacity is limited, in part due to this rapid change, and there is a greater likelihood that key relationships in the dynamic become severely imbalanced. The trajectory that a community takes through a transition varies, depending upon many factors operating at local and national levels. Transitions not only are occurring in many different sectors but also at different scales, both temporal and spatial. At times, a community experiences several transitions simultaneously, which can raise social vulnerability as they amplify the effects of each other.

It is beyond the scope of this paper to describe the details of these dynamics except to note that for any given location experiencing rapid modernization, such as a village in one of the Eastern Island Provinces of Indonesia, it is reasonable to conjecture that there might be special vulnerability (for a comprehensive description of the transitions existing in a community, see *ibid.* 301-355). If this were true, then health indicators of *at-riskness* might indicate magnified problems in those villages experiencing an overall transition from traditional self-sufficiency to relative modernity. This elevated risk, it is argued, results from many factors such as employment volatility, changes in food consumption patterns, composition of the extended family, temporary migration, and child rearing behavior. Elevated risk, if present, would strike hard at children who are most vulnerable, and readily reflect adverse changes in family health status.

It follows then, if transitional communities are experiencing vulnerability which then translates into heightened child health at-riskness, a targeting strategy might be devised based on some readily available community-level indicator. Such a targeting strategy might provide a practical policy tool.

Classifying Villages According to Their Transition Status

Fortunately, in Indonesia the government has for years maintained an up-to-date record of the "transitional" status of villages throughout the country. Villages in the study area, like all other parts of the country, have been ranked by a classification system used to measure level of development. This ranking system is related to the amount of infrastructure available in the community but also includes many other factors. The village scale ranged from traditional self-sufficiency (Pradesa) to modern market oriented communities (Swasembada) (formal village classification of villages was provided by the Indonesian Government). Pradesa villages (pre-villages) are generally located in remote regions and have relatively little contact with the national economy. The main occupation is agriculture, and education levels are very low. Traditional custom has a dominant influence and these villages are considered "traditional." The next level of development is classified as Swadaya, and is still characterized by very strong influence of traditional custom, "... strong relations among villagers and social control based on the family system." Infrastructure, while more advanced than Pradesa villages, is still relatively basic. Average education is low, communication and transportation are minimal, production methods traditional, and facilities for social activities rarely observed. The third level of development in villages, Swakarya, shows traditional customs further in transition. Influences from outside are observed in the village which are deemed to "... be changing ways of thinking." Job opportunities are shifting from primary to secondary sectors. Secondary sector here is defined as small industry and crafts. Traditional custom and religion is in transition, education and skill levels are judged to be medium, communication and social facilities increasing to a "... medium level," and institutional and governmental tasks functioning in a more developed manner.

The highest development classification level is Swasembada. "Traditional custom and religion is not influencing development ...," education and skill of the villagers is high, and members take initiatives and responsibility for local action. Communication, productivity, marketing, and social facilities are above standard. Village output/yield in all sectors is high and job opportunities are mainly in the "third sector" (commercial and service).

In order to maximize the generality of the results of this study, the balance of this paper will use generic terminology when labelling villages. Pradesa villages will be called traditional, Swadaya and Swakarya called transitional and Swasembada, modern or developed.

TESTING FOR ELEVATED RISKS IN TRANSITION VILLAGES

If there is validity to the hypothesis that there is elevated risk during the time villages are going through a transition from traditional to developed status, then one might expect at least some health status indicators to change unfavorably during this period (it is quite possible that, due to low measurement specificity and sensitivity, indicators could show no heightened at-riskness during transitional periods when, in fact, there were risks but the opposite is less likely to be true.) Analysis of Eastern Islands data supports this hypothesis of elevated risk.

However, as is true for any study, association does not necessarily mean causation. There are always possible alternative or competing explanations for the cause of the observed outcome. In the case of this analysis, the most probable competing explanation for elevated risk in transitional villages would be inherent differences among villages which are unrelated to their level of development. For example, does village topography have an effect upon the outcome, especially for health indicators known to be related to geography such as iodine deficiency?

Other competing explanations know to be related to child health risk, such as educational level of the head of household or of the mother are part of the fabric of a transitional village and, for our purposes, do not need to be separated. In fact, to a large degree, they define the heightened at-riskness of transitional villages. Whenever possible, we shall attempt to provide what evidence there is for refuting this competing explanation. But regardless of the causes, the fact still remains that is associations exist, then an intervention strategy can be proposed which reflects this elevated risk, regardless of its cause.

Table 1 in an earlier section, provides a listing of the available health indicators which, while gathered in some cases at the individual household level, in all instances have been aggregated to the village level. This section presents the results of analysis for the major indicators available, organized by village transitional status. It should be remembered that due to data gathering protocol, the number of villages available for analysis, varies by each indicator variable.

Undernutrition

A sample of the nutritional status of preschool children in each of 138 villages was taken during the course of this study. Height, weight, and age were measured and key anthropometric indices of child nutriture were calculated and standardized using the NCHS reference standard. Village prevalence estimates were determined from these samples and related to village transition status. Both weight-for-height (wasting) and weight-for-age showed statistically significant association with village type. Weight-for-height (a measure of stunting) was also at a higher rate in transitional villages although not statistically significant. Figure 1 presents the prevalence of wasting by village type. Both types of transitional villages (early and late) showed statistically significant higher malnutrition. For the purposes of presentation in the figures that follow, both transitional types have been combined into one category.

Figure 2 shows the prevalence of underweight malnutrition for preschool children in the same 138 villages. Transitional villages again show a higher risk for malnutrition. Using the NCHS standard and a cut-pint of less than two standard deviations from mean values, transitional villages experienced 48% malnutrition while traditional and modern villages showed 35% and 41% respectively. These differences were statistically significant at the $p=.01$ levels ($p=.0065$ and .0009 respectively).

Vitamin A Deficiency

Two indicators of vitamin A deficiency were measured during this study; mean serum

FIGURE 1

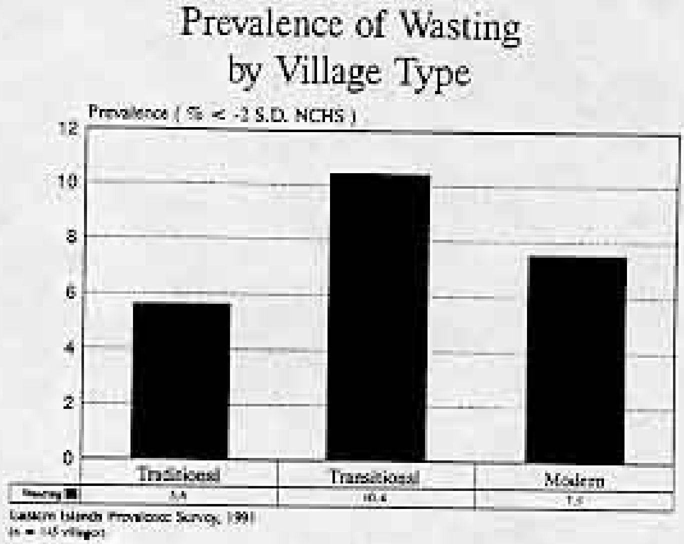


Figure 1. Prevalence of Wasting by Village Type (145 villages). Three bars are displayed in this chart: one for traditional, one for transitional, and one for modern villages. The height of the bar measures the percentage of prevalence (% < -2 S.D. NCHS). Traditional shows wasting of 5.6%; transitional at 10.4%; and, modern at 7.5%. The source is 1991 Eastern Islands Prevalence Survey.

vitamin A level and prevalence of xerophthalmia as indicated by detection of bitot's spots (X1B). Because of an extremely low prevalence of xerophthalmia, the only variable amenable to analysis of transitional villages is vitamin A serum levels. Figure 3 presents the prevalence of low serum retinol in preschool children by village type. The cut-point used to define community at-riskness is the WHO recommended 5% of the population with serum retinol levels < 10 mcg/dl. Although all village types showed prevalences of low serum VA well above the cut-off for being a public health risk, transitional villages experience the highest prevalence of low serum retinol although not at statistically significant levels.

Iodine deficiency (IDD)

Iodine deficiency disorders (IDD) is used to define a group of functional disabilities associated with inadequate levels of iodine ranging from impaired thyroid function to debilitating cretinism. Iodine is normally ingested in water or plants which have extracted it from soil. IDD is most likely to occur in isolated rural areas that are ecologically deficient in iodine and have little contact with food products from areas with higher iodine availability. Three different measures were used to assess iodine deficiency in this study; visible goiter rate, to-

FIGURE 2

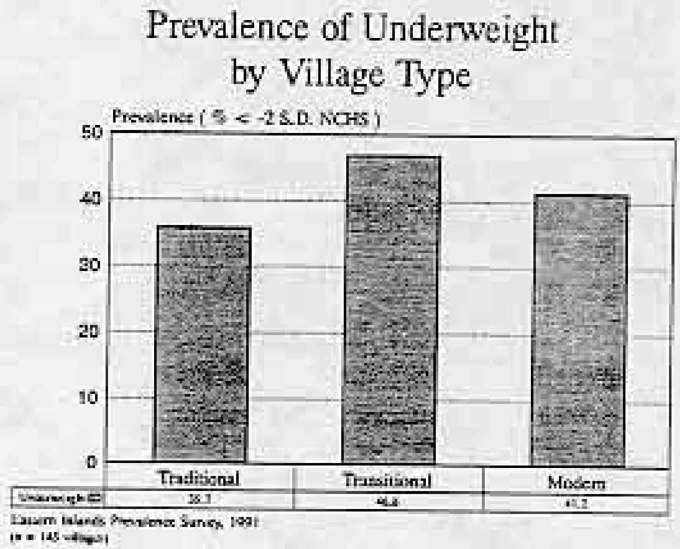


Figure 2. Prevalence of Underweight by Village Type (145 villages). Three bars are displayed in this chart: one for traditional, one for transitional, and one for modern villages. The height of the bar measures the percentage of prevalence (% < -2 S.D. NCHS). Traditional shows underweight of 35.7%; transitional at 46.8%; and, modern at 41.2%. The source is 1991 Eastern Islands Prevalence Survey.

tal goiter rate, and percent of villages with total goiter rate above the WHO defined at-risk prevalence rate of ten percent.

Figure 4 shows the visible goiter rate classified by village category. Again, risk was shown to be highest in transitional villages. Figures 5 and 6 also show much higher risk rates in transitional villages using the other indicators of deficiency, total goiter rates, and percent of villages with high total goiter rates ($p=0.0045$).

Because there is often correspondence between topography and iodine deficiency, an attempt was made to refute this competing explanation for the observed outcome. Figure 7 shows the relationship between topography and village transitional status. Topography was categorized as lowlands, mountainous, and coastal. If the competing explanation for high risk in transitional villages is, in fact, their mountainous topography, one would expect mountainous villages to be overrepresented in the transitional village category. The data in Figure 7 indicate exactly the opposite. Fewer transitional villages lie in mountainous areas than in either the low land or coastal village categories. While this observation does not fully refute the competing explanation, it strongly supports transitional villages as the underlying explanation for high risk.

FIGURE 3

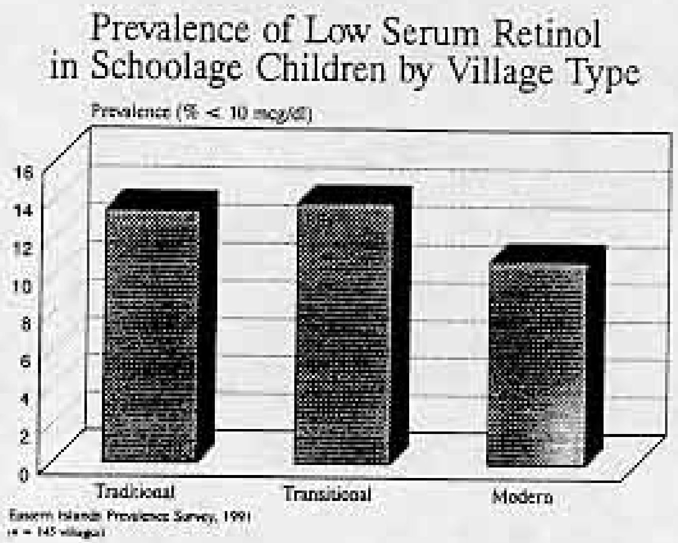


Figure 3. Prevalence of Low Serum Retinol in Schoolage Children by Village Type (145 villages). Three bars are displayed in this chart: one for traditional, one for transitional, and one for modern villages. The height of the bar measures the percentage of prevalence (% < 10 mcg/dl). Traditional shows low serum retinol of about 12.5%; transitional at about 13%; and, modern at about 10%. The source is 1991 Eastern Islands Prevalence Survey.

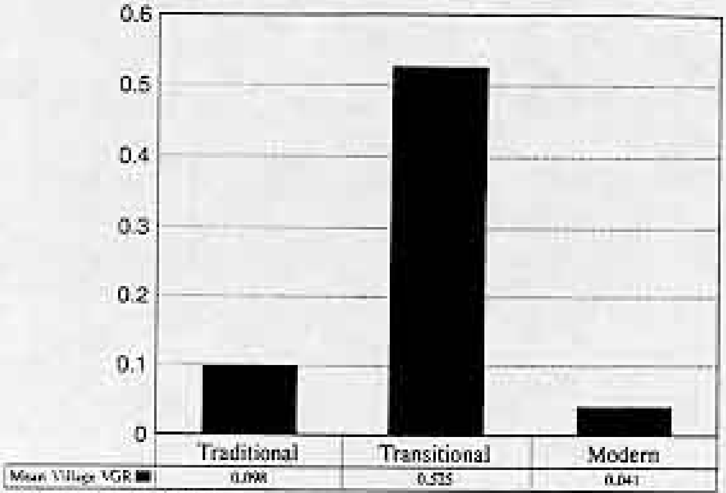
Iron deficiency

Anemia is the most widespread micronutrient disorder in the world. It has profound consequences on adult productivity, impaired cognitive and motor development in children, and in pregnant women can significantly complicate the risk of intrauterine growth, low birthweight, and perinatal mortality. As many as fifty percent of all maternal deaths in developing countries may be associated with anemia and may be the exclusive cause in as many as twenty percent of all maternal deaths (ACC/SCN Workshop; Preventing Anemia; SCN News 6:1-6). In addition to an inadequate intake of iron in the diet, anemia may be brought on by exposure to certain infectious diseases. Malaria, hookworm, schistosomiasis, and other infections are related to the etiology of anemia. In the Eastern Islands of Indonesia, the role that malaria plays in the etiology of anemia cannot be ignored. However, regardless of cause, nutritional anemia must be reckoned with.

Figure 8 indicates the relationship between nutritional anemia in preschool children and village type. Using the WHO cut-off for iron anemia of eleven gm/dl, the mean values of both categories of transitional village fell below the cut-off while traditional and modern villages were above the cut-off. There is a statistically significant difference between village

FIGURE 4

Visible Goiter Rate in Schoolage Children by Village Type



Eastern Islands Prevalence Survey, 1991
(n = 171 villages)

Figure 4. Visible Goiter Rate in Schoolage Children by Village Type (171 villages). Three bars are displayed in this chart: one for traditional, one for transitional, and one for modern villages. The height of the bar measures the mean village visible goiter rate. Traditional shows visible goiter rate of 0.098%; transitional at 0.525%; and, modern at 0.041%. The source is 1991 Eastern Islands Prevalence Survey.

types with p=0.043 for between group differences.

Intestinal worms

Intestinal parasites (helminthic infection) can significantly contribute to malnutrition in adults and even more in children. Reduction in such infections usually requires a multifaceted approach to public health including family education, improved waste disposal, safe water, and proper food preparation. Figure 9 presents evidence on the prevalence of helminthic infection by village type for 169 villages in the Eastern Islands. Again, both early and late transitional villages show a higher mean village worm rate although not at statistically significant levels.

Not all measured variables showed at-riskness in transitional villages. Prevalence of diarrhea, chicken pox, and measles did not show measurably higher rates during the study period. Difference in seasonality of high-risk periods depending on topography and the

FIGURE 5

Total Goiter Rate in Schoolage Children
by Village Type

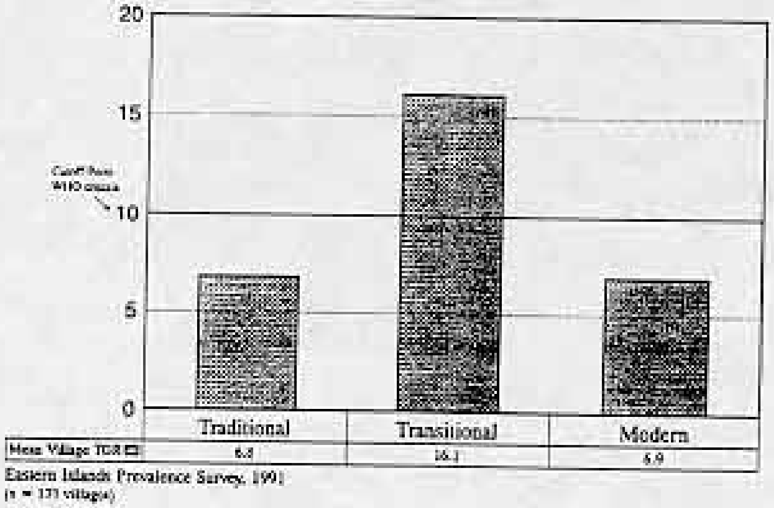


Figure 5. Total Goiter Rate in Schoolage Children by Village Type (171 villages). Three bars are displayed in this chart: one for traditional, one for transitional, and one for modern villages. The height of the bar measures the mean village total goiter rate. Traditional shows total goiter rate of 6.8%; transitional at 16.1%; and, modern at 6.9%. The source is 1991 Eastern Islands Prevalence Survey.

episodic character of some of these diseases may be factors which preclude indication of heightened risks by village type.

TESTING FOR RISK OVERLAP WITHIN THE HEALTH SECTOR

While this dataset provides evidence of the vulnerability of transitional villages to micronutrient deficiencies, and supports the targeting of micronutrient control programs to these villages, it is also pertinent to investigate the general "overlap" in micronutrient deficiency prevalences in all village types. This analysis addresses the issue of integrating VAD control activities with IDD and IDA control programs. As governments examine the possible benefits gained from the integration of VAD control activities with IDD and IDA programs, and a strategies that target high risk populations appear most cost-effective, the examination of the extent to which villages at high risk for one micronutrient deficiency is at the same time at high risk for another micronutrient deficiency becomes a logical research question

FIGURE 6

Percent of Villages with High Total Goiter Rate

(Prevalence of village total goiter rate > 10% - schoolchildren)

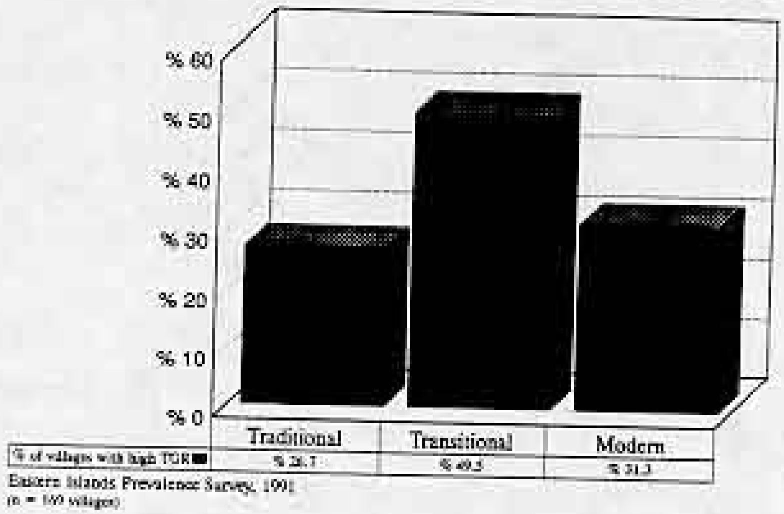


Figure 6. Percent of Villages with High Total Goiter Rate (169 villages). (Prevalence of village total goiter rate ¿ 10% – schoolchildren.) Three bars are displayed in this chart: one for traditional, one for transitional, and one for modern villages. The height of the bar measures the percentage villages with high total goiter rate. Traditional shows percentage of villages with high total goiter rate at 26.7%; transitional at 49.5%; and, modern at 31.3%. The source is 1991 Eastern Islands Prevalence Survey.

with direct programmatic implications. The data gathered from the Eastern Islands Prevalence Survey, provides a unique opportunity to investigate this measurement of the degree of covariance, or "overlap," between these deficiencies.

Methods

In order to address this issue, two types of analyses were carried out. The first set of analyses focused on measuring the correlations between the prevalence of the three micronutrients. Statistical procedures included formulation of a correlogram and multidimensional scaling. (These methodologies are not included in this paper but are available through the primary author in a separate paper presently in draft form.) The second type of analysis was aimed at presenting the relative "overlap" in high prevalences for all three micronutrient deficiencies, and Venn diagrams were constructed to allow for visualization of this

FIGURE 7

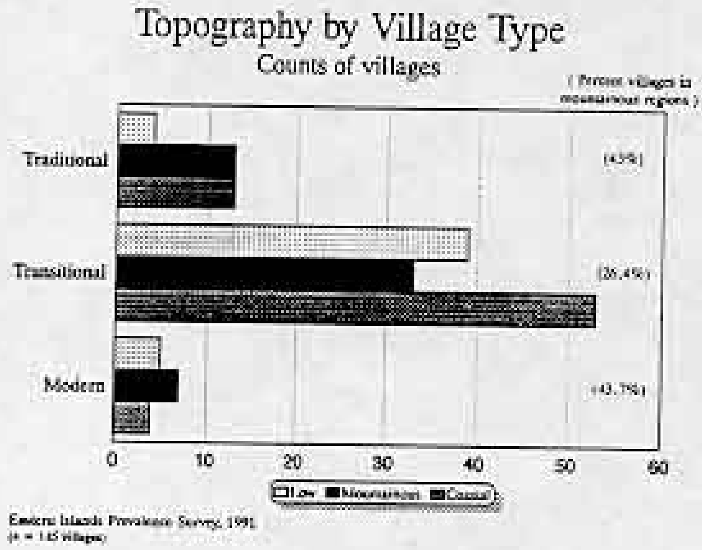


Figure 7. Topography by Village Type: Counts of Villages. (145 villages). (Percent villages in mountainous regions.) Three sets of three bars each are displayed in this chart: one for traditional (low, mountainous, and coastal topography), one for transitional (low, mountainous, and coastal topography), and one for modern (low, mountainous, and coastal topography) villages. The length of the bar measures the percentage of villages in mountainous (or coastal or low) regions. 43% of the traditional villages are mountainous; 26.4% of the transitional villages are mountainous; and, 43.7% of the modern villages are mountainous. The source is 1991 Eastern Islands Prevalence Survey.

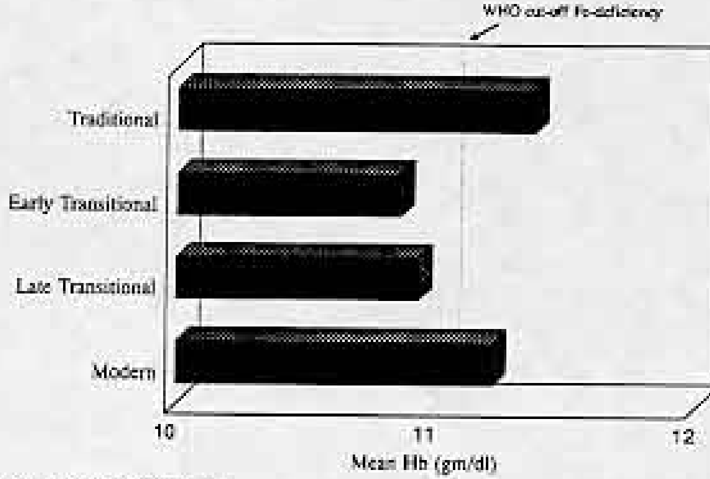
phenomenon.

Determination of Overlap in Risk

Figure 10 is a Venn diagram which shows the overlap in risk for micronutrient malnutrition. It represents aggregated data from 138 villages. VAD, TGR, and IDA are shown to have a substantial overlap among the villages. This overlap, like the broader overlap among different sectors in the community, has important implications for intervention strategies which will be discussed further in the concluding section of the paper.

Figure 11 presents the overlap in risks for the same micronutrient deficiencies in transitional villages and Figure 12 shows these overlaps for traditional and modern villages. It is interesting that the pattern of overlap does not change between transitional and non-transitional villages.

FIGURE 8
Nutritional Anemia in Preschool Children
by Village Type



Eastern Islands Prevalence Survey, 1991
(n = 145 villages)

Figure 8. Nutritional Anemia in Preschool Children by Village Type. WHO cut-off Fe-deficiency is at a value of 11 (measuring mean HB (gm/dl)). (145 villages). Four bars are displayed in this chart: one for traditional, one for early transitional, one for late transitional, and one for modern villages. The length of the bar measures the mean Hb (gm/dl). The bars for the early and late transitional villages fall short of the WHO cut-off line at 11. The bars for the traditional and modern village go beyond the WHO cut-off line. The source is 1991 Eastern Islands Prevalence Survey.

CONCLUSIONS AND POLICY IMPLICATIONS

Summary of Evidence for Elevated Risk in Transitional Villages

The forgoing analysis presents a rather compelling picture of heightened health risk in villages experiencing transition from traditional self-sufficient living patterns to more developed market-oriented economies. Almost every health indicator examined in this study shows that households in villages experiencing transitions were worse off — whether the measure be child malnutrition (PEM), anemia (IDA), vitamin A deficiency (VAD), iodine deficiency (IDD), or helminthic infection. Further, this heightened risk was evident in spite of apparent "improvements" in community infrastructure, both physical and organizational.

Theoretical developments and the first stages of empirical work elsewhere suggest that this heightened risk during transition may be attributable to the vulnerability created by rapid rates of change in each of many sectors of the community especially when they occur simultaneously. Old and often useful patterns of interaction among sectors are damaged or

FIGURE 9

Prevalence of Helminthic Infection
by Village Type

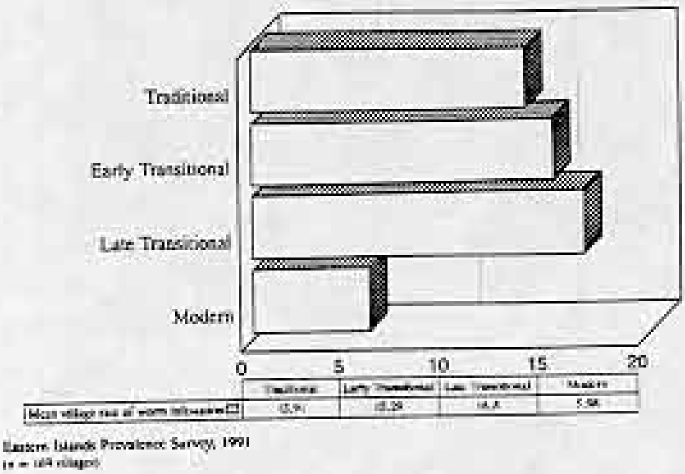


Figure 9. Prevalence of Helminthic Infection by Village Type (169 villages). Four bars are displayed in this chart: one for traditional, one for early transitional, one for late transitional, and one for modern villages. The length of the bar measures the mean village rate of worm infestation. The bar for traditional villages has length 13.91; that for early transitional has length 15.29; that for late transitional has length 16.8; and, that for modern has length 5.98. The source is 1991 Eastern Islands Prevalence Survey.

destroyed and new adaptive patterns have not yet developed. Changes within one sector result, often harmfully, in changes in another. And, perhaps most important, these changes occur so rapidly that societal adaptive capacity is limited during the transition.

Societal vulnerability due to rapid rates of change deserves recognition and, if possible, remediation. Risks are brought about by changes in employment patterns, education levels, more abundant supplies of water, altered waste disposal systems, increased transportation alternatives (and costs), disruption in food production, storage, preparation and consumption, and changes in population density. These overlapping risks call for a community-wide strategy of remediation which explicitly recognizes their interaction. The strategy need not be complex; only conceived broadly enough to explicitly embrace interaction among sectors.

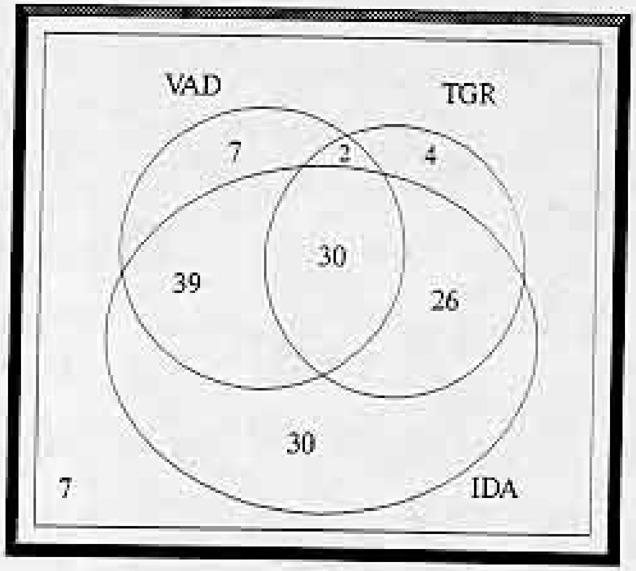
Policy implications

A possible policy implication from the findings of this study suggests planning for special emphasis and corresponding resources devoted to health care activities during periods of rapid social or economic change. Especially when government-sponsored development efforts

FIGURE 10

Overlap in risk for Micronutrient Malnutrition

in the Eastern Islands of Indonesia



n = 145

Figure 10. Three-circle Venn diagram: two circles on top, one below, intersecting to form eight disjoint regions. The circle on the upper left represents VAD; the one on the upper right, TGR; and, the one on the bottom, IDA. Overlap in Risk for Micronutrient Malnutrition in the Eastern Islands of Indonesia (number of villages is 145). Breakdown of the partition by Venn region: 1. VAD and TGR and IDA: 30; 2. VAD and TGR and not-IDA: 2; 3. VAD and IDA and not-TGR: 39; 4. VAD and not-IDA and not-TGR: 7; 5. IDA and TGR and not-VAD: 26; 6. IDA and not-TGR and not-VAD: 30; 7. TGR and not-VAD and not-IDA: 4; 8. not-VAD and not-TGR and not-IDA: 7.

are being implemented, it may be helpful to schedule higher levels of service delivery in order to overcome the anticipated higher risk for children during transition periods.

While focusing upon villages in transition is but one type of targeting, there is a qualitative difference between this and other targeting strategies discussed earlier. In this instance, targeting can be based upon **anticipating** the risk rather than reflecting current or historical risk estimates. Because government is both planner and resource allocator for its development programs, difficulties experienced during movement through a transition period can be dampened by allocating special activities to the region receiving development assistance.

FIGURE 11

Overlap in risk for Micronutrient Malnutrition

in Transitional Villages

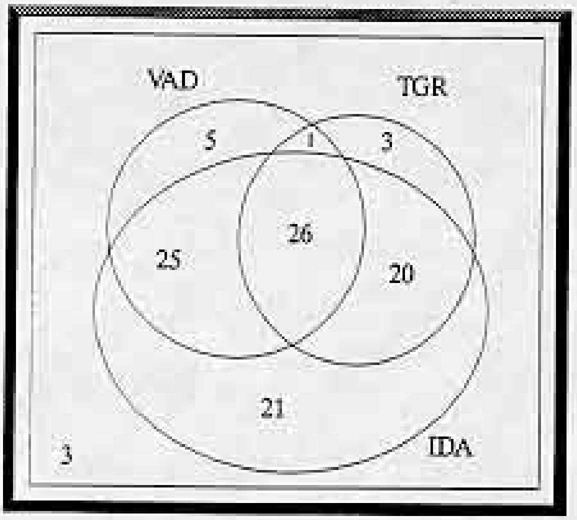


Figure 11. Three-circle Venn diagram: two circles on top, one below, intersecting to form eight disjoint regions. The circle on the upper left represents VAD; the one on the upper right, TGR; and, the one on the bottom, IDA. Overlap in Risk for Micronutrient Malnutrition in the Eastern Islands of Indonesia in Transitional villages. Breakdown of the partition by Venn region: 1. VAD and TGR and IDA: 26; 2. VAD and TGR and not-IDA: 1; 3. VAD and IDA and not-TGR: 25; 4. VAD and not-IDA and not-TGR: 5; 5. IDA and TGR and not-VAD: 20; 6. IDA and not-TGR and not-VAD: 21; 7. TGR and not-VAD and not-IDA: 3; 8. not-VAD and not-TGR and not-IDA: 3.

At the very least, government can monitor local conditions more closely and be prepared to act quickly if problems should arise.

Because this is the first study showing these elevated risks for transition villages and because the results from this analysis should not be extended to other settings without further confirmation, it also might be useful to explore more fully the nature of societal vulnerability in transition communities. A pilot project incorporating a research design which focuses upon this question could be far more robust than was possible in this study and consequently capable of stronger conclusions regarding the strategy's usefulness. If such

FIGURE 12

Overlap in risk for Micronutrient Malnutrition

in Non Transitional Villages

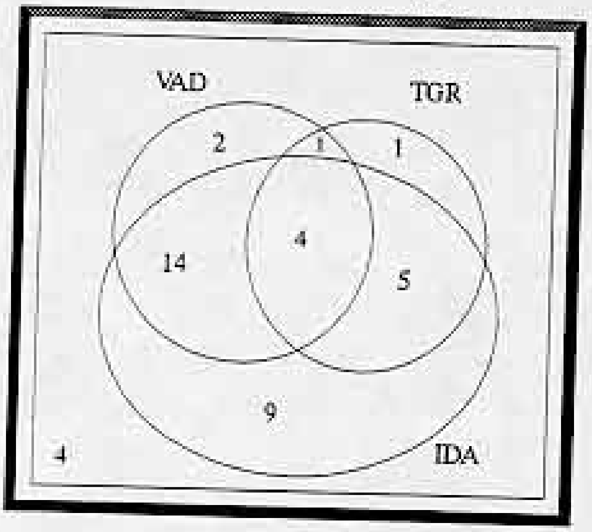


Figure 12. Three-circle Venn diagram: two circles on top, one below, intersecting to form eight disjoint regions. The circle on the upper left represents VAD; the one on the upper right, TGR; and, the one on the bottom, IDA. Overlap in Risk for Micronutrient Malnutrition in the Eastern Islands of Indonesia in Non-transitional villages. Breakdown of the partition by Venn region: 1. VAD and TGR and IDA: 4; 2. VAD and TGR and not-IDA: 1; 3. VAD and IDA and not-TGR: 14; 4. VAD and not-IDA and not-TGR: 2; 5. IDA and TGR and not-VAD: 5; 6. IDA and not-TGR and not-VAD: 9; 7. TGR and not-VAD and not-IDA: 1; 8. not-VAD and not-TGR and not-IDA: 4.

a pilot study is implemented, it would be useful to install a simple monitoring component capable of measuring the gains from this approach.

Implementing a targeting strategy

Implementing a targeting strategy has many practical elements. Ease of gathering data necessary for targeting is crucial. As discussed earlier, data requirements which are too costly or time consuming usually are not useful. One strength of the strategy suggested in this paper is the use of simple village-level variables which are easy to gather but which do a good job of identifying average household at-riskness. But there is another practical dimension which is less easy to quantify. That is, how to blend analytic evidence of at-riskness in a particular sector of a community with local judgment of those closest to the setting. Experience elsewhere indicates that a targeting strategy based only upon analytic considerations is less than optimal. Furthermore, risks organized by type of problem or sector in the community can be less useful than combining risks into one composite. Often it is most practical to allocate resources to the entire community rather than to each component or sector. While it is helpful to keep each risk category separate for analysis purposes, there is also benefit in being able to aggregate risk across sectors. Assessing and acting on at-riskness based on village transitional status permits such a strategy.