The Impact of Micronutrient Fortification On Maternal Mortality Rates in the Developing World

With a Policy Interest in Reducing Iron-Deficiency Anemia Through Programs Aimed at Increasing Micronutrient Consumption

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OBJECTIVE

This paper examines preliminary outcomes of interventional micronutrient fortification programs on maternal mortality rates, comparing the years 2000, 2005, and 2008. Maternal mortality is defined as death resulting from the complications of pregnancy or childbirth. The study also considers the potential to improve maternal outcomes through micronutrient intervention programs aimed at increasing micronutrient consumption, particularly iron consumption, in Sub-Saharan Africa and Southeast Asia.

The micronutrient intervention programs of interest are: (1) food fortification – programs in which iron and other nutrients are added to grain products in the milling process, as in flour; and (2) biofortification of crops – programs in which breeding techniques are used to naturally boost mineral and nutrient content of plants.

This study also relates to the Millennium Development Goals of the United Nations (See Appendices for complete list).

> Goal #1: Eradicate Extreme Poverty and Hunger…. with more scrutiny of malnutrition issues, and
> Goal #5: Improve Maternal Health … aims to reduce maternal mortality ratio by three-quarters by 2015.

International organizations such as the World Health Organization, The World Bank, the United Nations and the Micronutrient Initiative have identified the link between maternal mortality and nutritional deficiencies. Other organizations, such as the International Food Policy Research Institute, and the Bill and Melinda Gates Foundation have encouraged and funded programs relating to nutrition and maternal health. However, no study has attempted to look at the potential impact of micronutrient intervention programs on maternal mortality rates.

LITERATURE REVIEW

Relevant literature related to the paper is grouped into two categories: 1) studies of anemia and maternal mortality; and 2) studies of delivery systems for micronutrients: supplements, fortified foods, and agricultural technologies to fortify crops.

Anemia and Maternal Mortality

The first paper reviewed, (McCarthy and Maine, 1992), sets forth a seminal, conceptual model of analyzing determinants of maternal mortality. The model grouped the determinants as:

- Distant factors (socioeconomic)
- Intermediate factors (health behavior and status, access to services, and unknown)
- Outcomes (pregnancy, morbidity, and mortality)

They determined that maternal anemia, however mild, also increases several-fold the risk of life-threatening postpartum hemorrhage. They also emphasized that there is a lack of resources directed at nutritional strategies to alleviate iron-deficiency anemia

Although micronutrient deficiencies are considered a factor in high maternal mortality rates in the developing world, the second paper reviewed first identified the need for more longitudinal, community-based studies of reproduction in the development world (Rush, 2000). And, because of the lack of comprehensive and accurate statistics relating nutritional status directly to maternal death, Rush looked at the relationship between nutrition and health conditions that are the proximal causes of maternal mortality. He concluded that past efforts to lower maternal mortality rates through nutritional strategies have failed due to lack of resources, lack of interest in women's health issues, and the low status of women in much of the developing world. An additional problem is that nutrition programs are often not associated with health programs. In other words, nutrition programs need to be incorporated into existing health care delivery systems in order to be implemented effectively.

An Analysis of Anemia and Pregnancy-Related Maternal Mortality (Brabin, Hakimi & Pelletier 2001) studied the relationship of anemia as a risk factor for maternal mortality using cross-section, longitudinal, and case-control studies. The study includes data from a 1991 WHO study on the causes of maternal deaths attributable to anemia. Out of 66 reports from 33 countries, anemia was listed as a direct cause of death in 26% of the reports and as an indirect cause in the remainder. The study aimed to identify specific components of attributable risk to predict the effect of anemia on maternal mortality; however, the causes of anemia are multifactorial. They found that the more severe the anemia, the more likely it is to have multiple causes and not be related solely to iron deficiency. Moderate anemias are more common and less strongly associated with other diseases such as malaria. Therefore, the authors conclude that nutritional deficiency anemias would comprise the larger component of anemia-attributable maternal mortality.

Another 2001 study*, Micronutrient Malnutrition and the Pathogeneses of Malarial Anemia* (Nussenblatt, Semba 2001), suggested that the contribution of micronutrient deficiencies to malarial anemia is often overlooked. They concluded that micronutrients are involved in the pathogenesis of anemia and likely play a role in malarial anemia, but that clinical trials have not specifically addressed the impact of micronutrient supplementation on malarial anemia.

In a study by Johns Hopkins University Bloomberg School of Public Health, researchers found a 31% reduction in childhood mortality due to maternal antenatal and postnatal supplementation with iron-folic acid. Interestingly, the researchers reported that "supplementation with iron and folic acid during pregnancy is a common policy in many low-and middle-income countries, although implementation is typically not very good." Their study suggests the importance of this intervention to improve child survival rates.

Delivery Systems for Micronutrients

The most common strategies to combat micronutrient deficiencies are supplementation and fortification. Pregnant and lactating women and infants are most likely to benefit from supplementation (Shrimpton, Schultink, 2002). At the International and Public Health Nutrition Group Symposium: *Achieving a Balanced Diet in the Developing World: Strategies to Meet Micronutrient Needs*, a paper presented described the use of supplements as a programmatic option for increasing micronutrient intakes among the most vulnerable in the developing world. The authors discussed the success of vitamin A capsules and the lack of progress in reducing anemia in women. Additionally, the authors point out that iron supplementation programs have routinely been low priority and that there is a lack of evidence for a link between supplementation and mortality rates. Finally, the study suggests the potential for a new multiple micronutrient supplement being implemented by UNICEF as part of an approach for improving maternal nutritional status.

Unlike supplementation, food fortification programs have the advantage of not requiring consumer participation. Mandatory and voluntary fortification programs have been in place in Western and in many developing countries for decades. However, programs often have not addressed micronutrient bioavailability, optimal levels of addition, efficacy, or monitoring of their impacts. (Allen 2006). Allen's study discussed how there is still limited attention paid to assessing the effect of fortified foods on hematological and biochemical measures of nutritional status. It concluded that even though new technologies/methods have been developed to measure change quantitatively, the techniques need to be applied, and nutrition scientists need to be involved in the design, evaluation and monitoring of programs.

Another paper focused on the potential of genetically modified food crops to improve human nutrition in developing countries (Bouis 2007). The study presented three broad ways that biotechnology may help malnutrition. The first is through improving crop productivity, which could be faster and more efficient than conventional breeding, and through the use of transgenic methods. The second is by adopting Bt-containing crops (insect resistance in the gene coding), which reduces pesticide use and in turn, reduces input costs, and improves farmers' health. The third is using transgenic methods to improve the micronutrient content and/or bioavailability of staple foods.

The study concluded that the usefulness of biotechnology is dependent on fully developing and testing for the potential of nutritionally improved transgenic foods and firmly establishing their safety, acceptability, and efficacy. The author seemed optimistic about the contribution biotechnology could make to reduce malnutrition, but pointed out that it may require many years to inform governments and affect policies; and it will require large investments in agricultural research and infrastructure.

The final paper reviewed, *Plant Breeding and Poverty: Can Transgenic Seeds Replicate the 'Green Revolution' as a Source of Gains for the Poor* (Lipton 2007), looked at the success of the Green Revolution (GR) and explored the limits and prospects of genetically modified crops in reviving poverty reduction today. The study concluded that the Green Revolution worked under conditions when 1) there was adequate international and country-based support for research, and 2) the GR addressed the entitlement problems of the poor. It concluded that the ability of transgenics to affect poverty depends upon social formations and initial situations. Since most of the world's poor still depend on agriculture, seed science seem to be well positioned to improve productivity of crops and cut poverty and hunger.

MATERNAL MORTALITY, ANEMIA, AND MICRONUTRIENTS

In 2008, every day about 1000 women worldwide died of severe bleeding after childbirth, infections, hypertensive disorders, and unsafe abortions. Out of the 1000, 570 lived in sub-Saharan Africa, 300 in South Asia. About 60 percent of the maternal deaths occur during childbirth and the immediate postpartum period, with 50 percent of these deaths occurring within the first 24 hours of delivery. And, these statistics are often underreported or misreported, for several reasons, one of which is that many women give birth outside of healthcare facilities, and their related deaths go unreported. Any look at mortality in the developing regions of the world should examine at the correlates relating to pregnancy outcomes, and maternal survival. Some of the correlates that should be considered are listed below. Unfortunately, data on many of these correlates is suspect, or non-existent.

1. Household behavior and gender inequalities:
   - inequality in education
   - inequality in employment
   - poverty and allocation/lack of control of household resources
   - cost of accessing care, even if free, cost of transportation, or lack of transportation
   - inability to participate in decision-making
   - gender-based violence
   - traditional practices or religion, and how they can relate to feeding, nutrition, use of health care facilities, etc.

2. Demographic variables and risk factors
   - access to improved sanitation
   - access to improved water sources
   - proportion of population that is rural
   - gross national income per capita

3. Prevalence of diseases and nutrition deficiencies
   - HIV/AIDS
   - malaria
   - micronutrient deficiencies, especially iron/anemia risks

4. Health system deficiencies
   - low availability of trained medical personnel
   - lack of antenatal care and prenatal supplements
   - low availability of health care facilities within reasonable distances
   - lack of supplies, resources at health care facilities
   - high out-of-pocket expenses

5. Government accountability problems
   - misuse of funds for health care facilities, providers
   - lack of support and monitoring
   - lack of adequate infrastructure/transportation

Availability and accuracy of data influence the study of causes of, and correlates to, maternal death. For instance, data from hospitals or health institutions is limited in that medically certified deaths at these institutions involve only a small and selective fraction of total deaths. This limitation is greatest in Sub-Saharan Africa where a large proportion of deliveries take place in homes.

Poor nutrition, poor health, and low socioeconomic status are the primary underlying causes of maternal mortality. Many women in developing countries enter pregnancy nutritionally deficient, and therefore are unprepared to cope with the extra physiological demands of pregnancy. Gender bias in the distribution of inadequate food supplies contributes to poor nutrition, and in turn, low body mass. In Eritrea, for example, 37.3 percent of women have a low body mass index, which is an indicator of chronic energy deficiency.[1] Often malnourished women's pelvises are too small for the delivery of babies, causing obstructed labor. Macro- or

[1] Eritrea National Statistics and Evaluation Office, and ORC Macro 2002

micronutrient deficiencies predispose these women to anemia in pregnancy, as well as other problems. Iron deficiency is the principal cause of anemia.

Anemia is highly prevalent in Africa. Nearly 65% of women of childbearing age suffer from anemia. In Southeast Asia, the proportion is 85%. Anemia may cause death on its own or predispose a woman to severe obstetric hemorrhage leading to death.

In chronic anemia, there is a compensatory shift in the oxygen dissociation curve so that women with very low hemoglobin concentrations, if seen by health care providers, may not display overt symptoms of cardiac failure, and yet, they can easily become fatigued with any physical activity. If these women encounter any adverse event in which bleeding occurs, such as labor, their risk of death is high. This is especially true for women in rural areas. In many obstetric emergencies, timely access to medical care, particularly blood transfusions, can mean the difference between life and death.

Micronutrient deficiencies can also be tied to sepsis and pregnancy-induced hypertension (including eclampsia). In the developing world, some studies indicate that the third leading cause of death for women, ages 15 – 44 is iron-deficiency anemia (behind causes relating to HIV and AIDS). Yet, there are no agreed international standards or sets of criteria for attributing death to anemia.

Generally, there is a lack of resources directed at nutritional strategies to alleviate iron-deficiency anemia. Antenatal iron-folic acid supplementation policies exist in many low-income countries, but women in the rural areas of these countries have limited or no access to supplements. In 2008, in the developing countries of Sub-Saharan Africa, 63.6% of the population lived in rural areas, and in South Asia, that proportion was 70.5%.[2] Throughout the developing world, iron deficiencies and other micronutrient deficiencies are exacerbated by HIV/AIDS, malaria, worm infections, and other infectious diseases.

METHODOLOGY

This study reports regression analyses of the incidence of maternal mortality on the socio-demographic factors identified below, in the context of the presence of micronutrient fortification programs among these other controlling factors**.** Supplementation programs are deliberately excluded from this analysis due to incomplete data, weak national programs with low distribution rates, and difficulty assessing compliance.

Biofortification programs have been excluded due to lack of data. Most programs are in their infancy, in small regions of selected countries, and have not been fully studied. However, this paper includes a qualitative review of existing and planned fortification and biofortification programs.

[2] The World Bank. Data Bank. Staff estimates based on the United Nations, World Urbanization Prospects.

DESCRIPTION AND SOURCES OF DATA

Data was reviewed from a wide range of international databases and development studies conducted by international agencies and organizations. Regression analyses are based on data collected from the World Bank and the World Health Organization, from the years 2000, 2005, and 2008 for 63 developing countries of Southeast Asia and Sub-Saharan Africa. The variable of interest is the maternal mortality rate (per 100,000 live births).

The explanatory variables include:

- year
- presence of a fortification program: 1= mandatory or voluntary fortification programs, 0 = no fortification programs
- access to improved sanitation
- access to improved water sources
- proportion of population that is rural
- gross national income per capita PPP (int'l $)
- net official development aid per capita (US$)
- government effectiveness[3]: 2= among the most effective countries worldwide (>50%); 1=moderately effective (25-50%); 0= among the least effective (<25%)
- prevalence of HIV, total (% population ages 15-49)
- proportion of births attended by skilled personnel
- country-specific dummy variables
- regional grouping: Africa = 1, Southeast Asia = 0

[3] **Government effectiveness** (one of six dimensions of governance according to the Worldwide Governance Indicators) captures perceptions of the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies. The World Bank Group, 2010.

Table 1 reports descriptive statistics for dependent and independent variables used in this analysis (exclusive of country dummy variables).

Table 1

Variable	Obs	Mean	Std. Dev.	Min	Max
year	189	4.333333	3.308596	0	8
matmort	189	526.037	350.8165	20	1800
fortif	189	.3280423	.4707473	0	1
improvsanit	186	39.72043	23.74931	7	98
improvh2o	185	68.8973	18.241	21	100
rural	189	64.83603	15.71166	14.96	91.7
gnicap	180	2490.778	2857.085	200	13900
odacap	189	58.38095	80.71056	-9	439
goveffect	189	.7037037	.7698004	0	2
hiv1549	171	4.477778	6.594184	.1	26
attendedbi~h	102	49.56863	23.22235	6	100
anemia	62	49.53387	15.19138	10.6	75.1
af1sea0	189	.6984127	.460166	0	1

Table 2 (See Appendices) is a correlation matrix for the core set of variables that appear in all regressions (matmort, year, fortif, improvsanit, improvh20, rural, gnicap, odacap, goveffect). There are 177 observations, and there is no significant correlation between variables.

Table 3 (See Appendices) is a correlation matrix for the core set of variables plus the HIV and attended birth variables. Again, there is no significant correlation between variables. The anemia variable was tested and then omitted from the regressions because the number of observations dropped significantly due to limited data available.

REGRESSION ANALYSES

(See Appendices for All Tables Referenced Below)

The first regression, Table 4, reports the results of maternal mortality rates against the core set independent variables in Table 2. In general, it is a relatively weak regression because the only statistically significant variable with a negative effect on maternal mortality rates (i.e.: may partially explain a reduction in the number of deaths) is government effectiveness. Access to improved water sources is almost significant (-1.71). The explanatory variable of interest, fortification programs, has a negative t-statistic but an insignificant one (-0.30).

Table 5 reports the results of maternal mortality rates against the same core set of independent variables, but with the addition of the HIV variable. Government effectiveness, again, was statistically significant, as was the presence of HIV in 15-49 year olds (-2.24). The negative t-statistic for HIV seems counterintuitive; however, perhaps the cases of women infected with HIV who die at the time of birth are reported as HIV deaths, instead of being reported as death due to causes relating to childbirth. The only other remarkable difference in this regression is that access to improved water sources goes from being almost significant, to insignificant.

In Table 6, the independent variable, attended birth, was added to the regression. The attended births variable did not show statistically significant results, and the addition of that variable, for which less data was available, caused the number of observations to drop from 160 in Table 5, to 87. Additionally, the HIV variable changed from -2.24 to -1.54. Government effectiveness remained as the only variable that could indicate some significance (-1.86) in reducing maternal mortality rates.

The results in Table 7, maternal mortality rates are regressed against the core set of independent variables and a region variable, 1=Africa, 0=Southeast Asia. Access to improved water is statistically significant (-2.38), as is government effectiveness again (-2.48). The variable of interest, fortification, is again insignificant. The most interesting result in this regression is the significance of region: African countries fair much worse than Southeast Asian nations with a t-statistic of 3.88, which means that with all other variables equal, the region variable, Africa, (3.88) is associated in more maternal deaths. The variable, rural, is almost significant at 1.82.

Table 8 shows results of the core set, region (af=1 sea=0), and the HIV variable. Again, government effectiveness is related to a drop in maternal mortality rates. As in Table 5, HIV is also statistically significant (-4.56). And, as in Table 7, location matters, with an even higher t-statistic of 5.7.

In Table 9, the regression includes all variables from the previous regression, plus it includes attended births. Results are similar to the prior two regressions, although government effectiveness becomes less significant, and attended births is insignificant, which may not necessarily mean that attended births do not matter, but rather that these results reflect relatively few observations. Additionally, the data collected for this category is often estimated and inconsistent.

Table 10 is the first regression using country-specific dummy variables (Thailand removed as the comparison country -- chosen because it is one of the more stable countries in the analysis, and has successfully incorporated a Health Intervention and Technology Assessment Program, driving efficiency improvements in its health system). The addition of these variables brings the adjusted R-squared up to 0.97 with 176 observations. As with all other regressions, the variable of interest, fortification, remains insignificant. The year variable becomes significant (-5.63), which means that over the time period studied (2000 – 2008), maternal mortality rates have dropped. Somehow, the GNI per capita is associated with an increase in maternal mortality (2.96), which seems counterintuitive. However, country-specific t-statistics vary dramatically. Since GNI per capita is uncharacteristically high in some impoverished countries in some years, those GNI spikes may reflect the high income of an extremely small segment of the population – especially in dictatorial states.

Table 11 adds the HIV variable to the previous regression, and the results to not change in a statistically significant way.

Table 12 adds the attended birth variable to the regression in Table 11. The number of observations drops by almost 50%, and the results change some. The only difference from the previous two regressions is that now, government effectiveness, becomes a positive t-statistic (2.97), which may be explained by the individual stories of each of the countries.

The last two regressions, Table 13 and Table 14, specifically look at the presence of mandatory or voluntary fortification programs. In Table 13, which includes country-specific dummy variables, the number of observations drops to 57, yet the adjusted R-squared is 0.996. The results show that the year variable (-2.69) is associated with a drop in maternal mortality rates, and that the GNI per capita is again associated with a rise in rates, as in all of the other regressions that include country-specific dummy variables. Table 14 looks at the presence of fortification programs by region only. The adjusted R-squared goes down to 0.55, and the only statistically significant variable becomes access to improved water sources (-2.27).

OVERALL RESULTS

This analysis shows there is little or no evidence in the regressions of fortification programs having an effect on maternal mortality rates. Results show that government effectiveness and access to improved water sources are generally associated with a reduction in maternal mortality rates. When country-specific dummy variables were added, the specific variations in country experiences seemed to dominate results. There was some evidence that the African experience is worse than the Southeast Asian experience, based on the regression results. Overall, it is clear that maternal mortality rates are affected by multiple factors, and that in order to reach the Millennium Development Goal #5, governments, NGOs, other organizations and foundations will need to look at the most significant factors impacting the lives of women before the moment a child is born.

The lack of significant results for fortification programs should not be considered a failure of these programs to help reduce maternal deaths in the developing world. The fortification variable in the regressions reflects data that is admittedly incomplete, and potentially inaccurate. Mandatory and voluntary fortification programs could vary widely, and yet because of the limited availability of good data, they are clumped into the same category. According to the 2005 reported data collected by Flour Fortification Initiative, only eight countries in this study (out of 63) had mandatory fortification programs. By 2008, that number increased only by one, to nine.

CURRENT PROGRAMS AND CONSIDERATIONS

As previously stated, the third leading cause of death for childbearing age women is iron-deficiency/anemia. 99% of maternal deaths occur in the developing world. Until recently, the only means of delivery of iron to iron-deficient populations was through supplementation. Supplementation programs have not been effective in reducing iron deficiencies. In countries with large rural populations, access to health care is limited or nonexistent, and therefore access to supplements and education is also limited. Determining accurate dosages and measuring absorption can also be problematic. And, for those who have supplements available to them, compliance is another problem. Iron supplements can cause abdominal distress, which may be further aggravated by insufficient food intake and imbalanced diets.

Girls may be severely malnourished well before pregnancy, even during infancy or before birth when deficiencies of calcium, vitamin D and iron begin. They may enter young adulthood malnourished, sometimes stunted; and with each additional pregnancy, there is further depletion of the essential nutrients needed for mother and child.

Flour fortification began in the U.S. and Europe in the 1940’s, and it has been an effective, low-cost means of combating iron deficiency. People living in developing countries have not reaped benefits of fortification advances. Only recently have a handful of countries developed fortification programs, and those programs need to be assessed and probably expanded. Fortification most often happens during the milling process – iron and other nutrients can be added as wheat is milled into flour, for example. Other products, such as cooking oils and soy sauce can also be fortified.

However, fortification programs will likely take longer to have impact in developing countries. Fortified goods are readily available and accessible to almost all consumers in developed countries. In most developing countries, distribution is a problem. The rural poor have little or no access to fortified products. Some large-scale projects are underway, and guided by a coalition of governments, businesses, international organizations and civil society partners in National Fortification Alliances. These large-scale projects will be more sustainable if fortification is mandated and supported by governments in developing countries.

Another micronutrient intervention option is biofortification. This relatively new process uses breeding techniques to naturally boost mineral and nutrient content of plants. Plant breeders incorporate micronutrients into targeted crops, along with traits preferred by farmers, such as drought tolerance and high yields. Biofortified crops could be the answer to fortifying the food of the rural poor. Harvest Plus is leading the initiative to develop, test, implement and evaluate biofortified crops for populations most at risk for micronutrient malnutrition, and is supported by the Bill and Melinda Gates Foundation.

So far, Harvest Plus has successfully biofortified pearl millet and beans with iron. Pearl millet is a staple cereal grown in harsh environments in the arid and semi-arid tropical regions of Asia, as well as in Africa. Harvest Plus plans to release iron-biofortified pearl millet in India in 2012, where the average consumption of pearl millet is 300 grams/capita/day. They estimate that that biofortified pearl millet will contribute 30% of the mean daily iron requirement, and that after 10 years, 28 million people will consume the biofortified crop.

In Rwanda and The Congo, where beans are a staple crop and part of the daily consumption, Harvest Plus will be releasing their iron-biofortified bean in 2012. They are expecting that within 10 years, at least 5 million people in those two countries will be consuming biofortified beans.

FUTURE RESEARCH

Iron deficiency is a serious public health concern, and it may be the most common and widespread nutritional disorder in the world. The consequences of iron deficiency are many. Infants and children are at higher risk for death as well as their mothers. Anemia impairs physical and cognitive development, exacerbates ill health, and prevents a significant proportion of the population in developing countries to have full, productive lives and to earn wages. Additionally, worm infections, malaria and other infectious diseases, which are also prevalent in developing countries, exacerbate anemia.

Fortification and biofortification have great potential, yet neither will affect change quickly. More scientific research is needed to look at the public health problem of iron deficiency, in two broad areas: 1) the interaction between micronutrient deficiencies, infectious diseases, and other potential contributors to anemia; and 2) innovation, development, and implementation of new delivery systems (medical, ingestible, topical, agricultural, etc.) of iron. In response to the latter, this author intends to conduct research to first gather information on all of the known methods of increasing iron levels in the human body; to review past successes and failures; and to consider possible alternatives for further exploration.

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Appendices

The Millennium Development Goals
of The United Nations

Goal 1: Eradicate extreme poverty and hunger

Targets:

- *Halve, between 1990 and 2015, the proportion of people whose income is less than $1 a day.*
- *Achieve full and productive employment and decent work for all, including women and young people*
- *Halve, between 1990 and 2015, the proportion of people who suffer from hunger*

Goal 2: Achieve universal primary education

Target:

- *Ensure that, by 2015, children everywhere, boys and girls alike, will be able to complete a full course of primary schooling*

Goal 3: Promote gender equality and empower women

Target:

- *Eliminate gender disparity in primary and secondary education, preferably by 2005, and in all levels of education no later than 2015*

Goal 4: Reduce child mortality

Target:

- *Reduce by two thirds, between 1990 and 2015, the under-five mortality rate*

Goal 5: Improve maternal health

Targets:

- *Reduce by three quarters, between 1990 and 2015, the maternal mortality ratio*
- *Achieve, by 2015, universal access to reproductive health*

Goal 6: Combat HIV/AIDS, malaria & other diseases

Targets:

- *Have halted by 2015 and begun to reverse the spread of HIV/AIDS*
- *Achieve, by 2010, universal access to treatment for HIV/AIDS for all those who need it*
- *Have halted by 2015 and begun to reverse the incidence of malaria and other major diseases*

Goal 7: Ensure environmental sustainability

Targets:

- *Integrate the principles of sustainable development into country policies and programmes and reverse the loss of environmental resources*
- *Reduce biodiversity loss, achieving, by 2010, a significant reduction in the rate of loss*
- *Halve, by 2015, the proportion of the population without sustainable access to safe drinking water and basic sanitation*
- *By 2020, to have achieved a significant improvement in the lives of at least 100 million slum dwellers*

Goal 8: Develop a global partnership for development

Targets:

- *Address the special needs of the least developed countries, landlocked countries and small island developing states*
- *Develop further an open, rule-based, predictable, non-discriminatory trading and financial system*
- *Deal comprehensively with developing countries' debt*
- *In cooperation with the private sector, make available the benefits of new technologies, especially information and communications*

TABLE 2

correlate matmort year fortif improvsanit improvh2o rural gnicap odacap goveffect (obs=177)

	matmort	year	fortif	improv~t	impro~2o	rural	gnicap	odacap	goveff~t
matmort	1.0000								
year	-0.0838	1.0000							
fortif	-0.0236	0.4300	1.0000						
improvsanit	-0.1241	0.0785	0.1283	1.0000					
improvh2o	-0.1971	0.0855	-0.0091	0.6511	1.0000				
rural	0.1900	-0.0842	0.0272	-0.1923	-0.1891	1.0000			
gnicap	-0.1874	0.1709	0.0761	0.4501	0.3481	-0.2055	1.0000		
odacap	-0.0801	0.2502	-0.0750	-0.0978	-0.0717	-0.0237	0.0080	1.0000	
goveffect	-0.2868	-0.0416	-0.0084	0.2453	0.2049	-0.2390	0.1926	0.0317	1.0000

TABLE 3

correlate matmort year fortif improvsanit improvh2o rural gnicap odacap goveffect hiv1549 attendedbirth (obs=87)

	matmort	year	fortif	improv~t	impro~2o	rural	gnicap	odacap	goveff~t	hiv1549	attend~h
matmort	1.0000										
year	-0.0460	1.0000									
fortif	-0.0714	-0.1332	1.0000								
improvsanit	-0.1627	0.0291	0.1595	1.0000							
improvh2o	-0.2587	0.0054	-0.0121	0.6361	1.0000						
rural	0.0697	-0.0826	-0.0176	-0.2543	-0.2216	1.0000					
gnicap	-0.2588	0.1489	-0.0683	0.4242	0.2972	-0.4236	1.0000				
odacap	0.0522	0.2458	-0.2870	-0.1208	-0.1552	0.0012	0.0935	1.0000			
goveffect	-0.2726	-0.0275	0.1128	0.2734	0.2065	-0.2548	0.4123	0.0044	1.0000		
hiv1549	-0.2053	0.0414	-0.0284	0.1492	0.2055	-0.0309	0.1625	0.2177	0.0255	1.0000	
attendedbi~h	-0.1575	0.2817	-0.0265	0.2872	0.2204	-0.4949	0.6059	0.0811	0.5129	0.1188	1.0000

TABLE 4

```
regress matmort year fortif improvsanit improvh2o rural gnicap odacap
goveffect

      Source |       SS       df       MS              Number of obs =     177
-------------+------------------------------           F(  8,   168) =    3.24
       Model |    2680724     8    335090.5            Prob > F      =  0.0019
    Residual |   17393284   168  103531.453            R-squared     =  0.1335
-------------+------------------------------           Adj R-squared =  0.0923
       Total |   20074008   176  114056.864            Root MSE      =  321.76
------------------------------------------------------------------------------
     matmort |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        year |  -3.574316   8.813628    -0.41   0.686    -20.97405    13.82542
      fortif |  -18.24501   59.86234    -0.30   0.761    -136.4244    99.93433
 improvsanit |   1.499197   1.438659     1.04   0.299    -1.340983    4.339377
   improvh2o |  -3.212529   1.875964    -1.71   0.089     -6.91603    .4909725
       rural |   2.065476   1.600721     1.29   0.199    -1.094643    5.225595
      gnicap |  -.0123942   .0098357    -1.26   0.209    -.0318117    .0070233
      odacap |  -.2775492   .3319327    -0.84   0.404    -.9328458    .3777475
   goveffect |  -101.8953   33.10884    -3.08   0.002    -167.2582   -36.53229
       _cons |   689.7227   164.5115     4.19   0.000     364.9466    1014.499
```

TABLE 5

```
regress matmort year fortif improvsanit improvh2o rural gnicap odacap
goveffect hiv1549

      Source |       SS       df       MS              Number of obs =     160
-------------+------------------------------           F(  9,   150) =    3.11
       Model | 2669360.09     9  296595.565            Prob > F      =  0.0018
    Residual | 14285091.3   150  95233.9417            R-squared     =  0.1574
-------------+------------------------------           Adj R-squared =  0.1069
       Total | 16954451.3   159  106631.769            Root MSE      =   308.6
------------------------------------------------------------------------------
     matmort |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        year |  -5.716009   9.375281    -0.61   0.543    -24.24068    12.80866
      fortif |  -60.77639    62.4229    -0.97   0.332    -184.1181    62.56536
 improvsanit |   1.125237    1.47434     0.76   0.447     -1.78792    4.038393
   improvh2o |  -1.572083   1.924469    -0.82   0.415    -5.374652    2.230486
       rural |   1.437421   1.602831     0.90   0.371     -1.72962    4.604463
      gnicap |  -.0142736   .0106803    -1.34   0.183    -.0353769    .0068297
      odacap |   .2339352   .4750328     0.49   0.623    -.7046846    1.172555
   goveffect |  -101.8318   33.26817    -3.06   0.003    -167.5666   -36.09709
     hiv1549 |  -8.950854   3.997669    -2.24   0.027    -16.84987   -1.051839
       _cons |   673.7835   164.4497     4.10   0.000     348.8465    998.7206
```

TABLE 6

```
regress matmort year fortif improvsanit improvh2o rural gnicap odacap
goveffect hiv1549 attendedbirth

      Source |       SS       df       MS              Number of obs =      87
-------------+------------------------------           F( 10,    76) =    1.70
       Model |  1478048.65    10  147804.865           Prob > F      =  0.0956
    Residual |   6599897.1    76  86840.7513           R-squared     =  0.1830
-------------+------------------------------           Adj R-squared =  0.0755
       Total |  8077945.75    86  93929.6017           Root MSE      =  294.69

------------------------------------------------------------------------------
     matmort |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        year |  -16.91818   23.42564    -0.72   0.472    -63.57438    29.73803
      fortif |  -45.65581   69.11436    -0.66   0.511     -183.309    91.99736
 improvsanit |   1.731622   1.807034     0.96   0.341    -1.867398    5.330643
   improvh2o |  -3.956676   2.484074    -1.59   0.115    -8.904139    .9907859
       rural |  -1.090713   2.448656    -0.45   0.657    -5.967633    3.786208
      gnicap |  -.0216579   .0141263    -1.53   0.129    -.0497927     .006477
      odacap |   .3604786   .5109963     0.71   0.483    -.6572587    1.378216
   goveffect |  -91.44184   49.27099    -1.86   0.067    -189.5735    6.689837
     hiv1549 |  -9.208871    5.98934    -1.54   0.128    -21.13768    2.719932
attendedbi~h |   1.501322   2.064434     0.73   0.469    -2.610355    5.612998
       _cons |   991.1586   294.3825     3.37   0.001     404.8451    1577.472
------------------------------------------------------------------------------
```

TABLE 7

```
regress matmort year fortif improvsanit improvh2o rural gnicap odacap
goveffect af1sea0

      Source |       SS       df       MS              Number of obs =     177
-------------+------------------------------             F( 9, 167) =    4.79
       Model |  4120297.33     9  457810.814           Prob > F      =  0.0000
    Residual |  15953710.7   167  95531.2018           R-squared     =  0.2053
-------------+------------------------------           Adj R-squared =  0.1624
       Total |    20074008   176  114056.864           Root MSE      =  309.08

------------------------------------------------------------------------------
     matmort |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        year |  -4.331594   8.468499    -0.51   0.610    -21.05071    12.38752
      fortif |   -2.07711   57.65359    -0.04   0.971    -115.9009    111.7467
 improvsanit |   1.949057   1.386807     1.41   0.162    -.7888759     4.68699
   improvh2o |  -4.350695   1.825723    -2.38   0.018    -7.955166   -.7462242
       rural |   2.824237   1.550004     1.82   0.070    -.2358913    5.884365
      gnicap |  -.0085086   .0095009    -0.90   0.372     -.027266    .0102488
      odacap |  -.2652429   .3188658    -0.83   0.407    -.8947704    .3642846
   goveffect |  -80.06786   32.29713    -2.48   0.014    -143.8312   -16.30457
     af1sea0 |   207.9939   53.58044     3.88   0.000     102.2116    313.7762
       _cons |   525.8885   163.5663     3.22   0.002     202.9644    848.8126
```

TABLE 8

```
regress matmort year fortif improvsanit improvh2o rural gnicap odacap
goveffect hiv1549 af1sea0

      Source |       SS       df       MS              Number of obs =     160
-------------+------------------------------           F( 10,   149) =    6.76
       Model |  5290982.43    10  529098.243           Prob > F      =  0.0000
    Residual |  11663468.9   149  78278.3149           R-squared     =  0.3121
-------------+------------------------------           Adj R-squared =  0.2659
       Total |  16954451.3   159  106631.769           Root MSE      =  279.78

------------------------------------------------------------------------------
     matmort |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        year |  -8.925362   8.517881    -1.05   0.296    -25.75681    7.906083
      fortif |  -29.74864   56.84719    -0.52   0.602    -142.0794    82.58216
 improvsanit |   1.582438   1.338998     1.18   0.239    -1.063439    4.228314
   improvh2o |  -2.148186   1.747598    -1.23   0.221    -5.601463     1.30509
       rural |   2.576149   1.466418     1.76   0.081    -.3215127    5.473811
      gnicap |  -.0061595    .009784    -0.63   0.530    -.0254928    .0131737
      odacap |   .2365142    .430674     0.55   0.584    -.6145033    1.087532
   goveffect |  -65.82313   30.79667    -2.14   0.034    -126.6778   -4.968498
     hiv1549 |  -17.98905   3.946535    -4.56   0.000    -25.78745   -10.19064
     af1sea0 |   323.0517    55.8223     5.79   0.000     212.7461    433.3573
       _cons |   386.1139   157.1615     2.46   0.015     75.56083     696.667
------------------------------------------------------------------------------
```

TABLE 9

```
regress matmort year fortif improvsanit improvh2o rural gnicap odacap
goveffect hiv1549 attendedbirth af1sea0

      Source |       SS       df       MS              Number of obs =      87
-------------+------------------------------           F( 11,    75) =    2.94
       Model |  2436280.28    11  221480.026           Prob > F      =  0.0027
    Residual |  5641665.46    75  75222.2062           R-squared     =  0.3016
-------------+------------------------------           Adj R-squared =  0.1992
       Total |  8077945.75    86  93929.6017           Root MSE      =  274.27

------------------------------------------------------------------------------
     matmort |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        year |  -17.18214   21.80244    -0.79   0.433    -60.61483    26.25056
      fortif |    -38.175    64.3591    -0.59   0.555    -166.3849     90.0349
 improvsanit |   2.280702   1.688834     1.35   0.181    -1.083628    5.645033
   improvh2o |   -3.98761   2.311952    -1.72   0.089    -8.593254    .6180352
       rural |   .1726192   2.306296     0.07   0.941    -4.421758    4.766996
      gnicap |  -.0129151   .0133736    -0.97   0.337    -.0395567    .0137265
      odacap |    .414134   .4758234     0.87   0.387    -.5337549    1.362023
   goveffect |  -67.21513   46.35633    -1.45   0.151    -159.5617    25.13141
     hiv1549 |  -18.38492   6.138614    -2.99   0.004    -30.61367   -6.156177
attendedbi~h |   1.120773   1.924332     0.58   0.562    -2.712692    4.954238
     af1sea0 |   266.9608   74.79718     3.57   0.001     117.9572    415.9644
       _cons |   704.1891   285.5367     2.47   0.016     135.3708    1273.007
```

TABLE 10

regress matmort year fortif improvsanit improvh2o rural gnicap odacap goveffect afghan angola bang benin bhutan bots burkina burundi camb camer capev centafr chad comor congo cotedi drcongo eritrea ethio gabon gambia ghana guinea guinb india indo iran Kenya laos lesotho liberia madag malawi malay mald mali mauritan maurit mozamb myan Namibia nepal niger nigeria pakis philip rwanda seneg sierral solomon somal southaf sril sudan swazil timorl togo uganda urtanz vietn zamb zimbab

Source	SS	df	MS
Model	19749230.9	69	286220.738
Residual	309620.778	106	2920.95073
Total	20058851.7	175	114622.01

Number of obs	= 176
F(69, 106)	= 97.99
Prob > F	= 0.0000
R-squared	= 0.9846
Adj R-squared	= 0.9745
Root MSE	= 54.046

matmort	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
year	-16.21503	2.878568	-5.63	0.000	-21.92207	-10.50799
fortif	10.39617	14.68681	0.71	0.481	-18.72187	39.5142
improvsanit	2.079948	1.85933	1.12	0.266	-1.606354	5.766251
improvh2o	2.40638	2.029419	1.19	0.238	-1.61714	6.429899
rural	4.330446	4.223302	1.03	0.308	-4.042662	12.70355
gnicap	.0065231	.0022001	2.96	0.004	.0021613	.0108849
odacap	-.1101891	.1091167	-1.01	0.315	-.3265236	.1061454
goveffect	12.42142	16.37568	0.76	0.450	-20.04496	44.8878
afghan	1165.673	81.85537	14.24	0.000	1003.387	1327.96
angola	490.4012	115.2049	4.26	0.000	261.9962	718.8061
bang	-20.26755	74.42948	-0.27	0.786	-167.8312	127.2961
benin	195.7301	88.31638	2.22	0.029	20.63426	370.8259
bhutan	-200.3511	82.72146	-2.42	0.017	-364.3544	-36.34775
bots	-118.6726	119.7104	-0.99	0.324	-356.0101	118.6649
burkina	246.1514	98.08311	2.51	0.014	51.69206	440.6107
burundi	623.1174	117.5486	5.30	0.000	390.0659	856.169
camb	25.91791	82.15112	0.32	0.753	-136.9547	188.7905
camer	350.1477	105.1708	3.33	0.001	141.6363	558.659
capev	-164.934	117.4137	-1.40	0.163	-397.718	67.84998
centafr	596.3223	67.41052	8.85	0.000	462.6743	729.9702
chad	963.3803	82.58222	11.67	0.000	799.653	1127.108
comor	-55.56035	94.31309	-0.59	0.557	-242.5452	131.4245
congo	364.9839	132.019	2.76	0.007	103.2434	626.7245
cotedi	242.5758	98.12792	2.47	0.015	48.02764	437.1239
drcongo	496.9772	80.48312	6.17	0.000	337.4116	656.5429
eritrea	88.99821	98.39179	0.90	0.368	-106.0731	284.0695
ethio	93.17212	108.1462	0.86	0.391	-121.2383	307.5826
gabon	-7.439858	215.6805	-0.03	0.973	-435.0474	420.1677
gambia	242.2375	121.8034	1.99	0.049	.7504284	483.7246
ghana	153.0948	94.59765	1.62	0.109	-34.45428	340.6438
guinea	506.2449	70.0624	7.23	0.000	367.3393	645.1504
guinb	691.5099	82.5563	8.38	0.000	527.834	855.1858
india	-153.9736	61.37443	-2.51	0.014	-275.6544	-32.29282
indo	-228.9452	117.6151	-1.95	0.054	-462.1286	4.238235
iran	-149.1608	158.4129	-0.94	0.349	-463.2299	164.9082

kenya	173.9771	70.96743	2.45	0.016	33.27728	314.677
laos	293.4628	80.43098	3.65	0.000	134.0006	452.9251
lesotho	171.3121	81.13046	2.11	0.037	10.46303	332.1611
liberia	968.5016	144.2297	6.71	0.000	682.5522	1254.451
madag	89.89611	60.57184	1.48	0.141	-30.19345	209.9857
malawi	-20.93843	144.392	-0.15	0.885	-307.2095	265.3327
malay	-397.534	165.7035	-2.40	0.018	-726.0573	-69.01059
mald	-236.9383	54.42506	-4.35	0.000	-344.8413	-129.0353
mali	618.025	68.12743	9.07	0.000	482.9558	753.0943
mauritan	73.27778	114.6724	0.64	0.524	-154.0714	300.6269
maurit	-211.6694	85.47771	-2.48	0.015	-381.1373	-42.20154
mozamb	197.0325	89.29363	2.21	0.030	19.99919	374.0658
myan	-167.4598	83.68695	-2.00	0.048	-333.3773	-1.542264
namibia	-170.8368	76.25014	-2.24	0.027	-322.0101	-19.66346
nepal	146.0445	102.0509	1.43	0.155	-56.2814	348.3704
niger	561.9697	85.3778	6.58	0.000	392.6999	731.2395
nigeria	552.5361	92.45079	5.98	0.000	369.2434	735.8288
pakis	-460.3667	86.48759	-5.32	0.000	-631.8367	-288.8966
philip	30.50141	133.8142	0.23	0.820	-234.7983	295.8011
rwanda	-333.3223	90.2689	-3.69	0.000	-512.2892	-154.3554
seneg	559.2422	83.63604	6.69	0.000	393.4256	725.0588
sierral	165.143	70.36877	2.35	0.021	25.63005	304.6559
solomon	782.5978	124.3428	6.29	0.000	536.0761	1029.119
somal	-421.0406	92.89115	-4.53	0.000	-605.2063	-236.8748
southaf	765.4393	138.2484	5.54	0.000	491.3484	1039.53
sril	-3.99191	85.45758	-0.05	0.963	-173.4199	165.4361
sudan	-306.0846	67.7064	-4.52	0.000	-440.3192	-171.8501
swazil	157.7609	129.5573	1.22	0.226	-99.09906	414.6209
timorl	-224.4882	84.71177	-2.65	0.009	-392.4375	-56.53886
togo	120.0571	65.4705	1.83	0.069	-9.744565	249.8587
uganda	9.02027	98.13963	0.09	0.927	-185.5511	203.5916
urtanz	22.79348	91.37185	0.25	0.803	-158.3601	203.9471
vietn	464.573	57.45319	8.09	0.000	350.6665	578.4795
zamb	-310.8985	68.91628	-4.51	0.000	-447.5317	-174.2653
zimbab	(dropped)					
_cons	-124.5467	345.4189	-0.36	0.719	-809.3733	560.2799

TABLE 11

regress matmort year fortif improvsanit improvh2o rural gnicap odacap goveffect hiv1549 afghan angola bang benin bhutan bots burkina burundi camb camer capev centafr chad comor congo cotedi drcongo eritrea ethio gabon gambia ghana guinea guinb india indo iran kenya laos lesotho liberia madag malawi malay mald mali mauritan maurit mozamb myan namibia Nepal niger nigeria pakis philip rwanda seneg sierral solomon somal southaf sril sudan swazil timorl togo uganda urtanz vietn zamb zimbab

Source	SS	df	MS		
Model	16650548.5	64	260164.821	Number of obs =	159
Residual	288732.776	94	3071.62527	F(64, 94) =	84.70
				Prob > F =	0.0000
				R-squared =	0.9830
				Adj R-squared =	0.9713
Total	16939281.3	158	107210.641	Root MSE =	55.422

matmort	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
year	-15.31794	3.214902	-4.76	0.000	-21.7012	-8.934679
fortif	14.90032	16.05572	0.93	0.356	-16.97869	46.77934
improvsanit	1.68133	2.032773	0.83	0.410	-2.35479	5.717449
improvh2o	2.645118	2.202646	1.20	0.233	-1.728288	7.018524
rural	5.306627	4.457007	1.19	0.237	-3.542865	14.15612
gnicap	.0058921	.0024605	2.39	0.019	.0010067	.0107774
odacap	-.1130936	.1523956	-0.74	0.460	-.4156788	.1894915
goveffect	17.65581	18.06083	0.98	0.331	-18.20439	53.51601
hiv1549	6.314765	8.628773	0.73	0.466	-10.81787	23.4474
afghan	(dropped)					
angola	525.2461	121.8491	4.31	0.000	283.3119	767.1802
bang	-11.84813	81.81443	-0.14	0.885	-174.2926	150.5963
benin	193.8449	96.8935	2.00	0.048	1.460551	386.2292
bhutan	-188.5584	90.49791	-2.08	0.040	-368.2442	-8.872728
bots	-244.0427	220.4295	-1.11	0.271	-681.7107	193.6254
burkina	223.6142	105.0425	2.13	0.036	15.04989	432.1784
burundi	594.6553	126.8868	4.69	0.000	342.7187	846.592
camb	22.62022	86.97135	0.26	0.795	-150.0634	195.3039
camer	359.414	110.7046	3.25	0.002	139.6075	579.2206
capev	(dropped)					
centafr	572.8968	75.8669	7.55	0.000	422.2613	723.5324
chad	945.3448	86.34846	10.95	0.000	773.8979	1116.792
comor	-49.42919	106.529	-0.46	0.644	-260.9451	162.0867
congo	384.1308	137.9938	2.78	0.006	110.1409	658.1207
cotedi	230.4751	102.1122	2.26	0.026	27.72883	433.2213
drcongo	(dropped)					
eritrea	85.3786	102.8155	0.83	0.408	-118.7641	289.5213
ethio	(dropped)					
gabon	30.14778	225.5707	0.13	0.894	-417.7281	478.0237
gambia	256.1774	132.7202	1.93	0.057	-7.341659	519.6964
ghana	151.9019	100.2293	1.52	0.133	-47.10563	350.9095
guinea	507.6505	75.04109	6.76	0.000	358.6546	656.6463
guinb	685.9768	89.2941	7.68	0.000	508.6812	863.2723
india	-152.283	66.93914	-2.27	0.025	-285.1922	-19.37375
indo	-187.3245	127.2614	-1.47	0.144	-440.0049	65.35591

iran	-102.7974	170.7412	-0.60	0.549	-441.8081	236.2132
kenya	133.0661	91.28793	1.46	0.148	-48.18824	314.3204
laos	299.508	90.6899	3.30	0.001	119.4411	479.575
lesotho	12.8796	198.8823	0.06	0.949	-382.0059	407.7651
liberia	992.7862	150.6585	6.59	0.000	693.6502	1291.922
madag	103.0826	65.52896	1.57	0.119	-27.02665	233.1919
malawi	-83.99564	185.1785	-0.45	0.651	-451.6719	283.6806
malay	-342.7499	176.5813	-1.94	0.055	-693.3562	7.856527
mald	-222.5484	59.77952	-3.72	0.000	-341.2421	-103.8548
mali	621.7746	71.51414	8.69	0.000	479.7816	763.7676
mauritan	105.883	123.7185	0.86	0.394	-139.7629	351.5289
maurit	-198.3557	92.08849	-2.15	0.034	-381.1995	-15.51182
mozamb	156.8486	132.7789	1.18	0.240	-106.787	420.4842
myan	-159.763	93.85152	-1.70	0.092	-346.1074	26.58142
namibia	-261.6426	124.0616	-2.11	0.038	-507.9698	-15.3154
nepal	131.2282	107.8443	1.22	0.227	-82.89912	345.3556
niger	556.8538	89.68525	6.21	0.000	378.7816	734.9259
nigeria	555.8527	97.39638	5.71	0.000	362.4699	749.2355
pakis	-435.3514	94.19095	-4.62	0.000	-622.3697	-248.333
philip	70.48359	143.8045	0.49	0.625	-215.0436	356.0108
rwanda	-350.9396	97.77529	-3.59	0.001	-545.0747	-156.8044
seneg	567.0458	90.33787	6.28	0.000	387.6778	746.4137
sierral	178.4197	77.01677	2.32	0.023	25.50111	331.3383
solomon	785.1617	135.9714	5.77	0.000	515.1873	1055.136
somal	-493.179	160.1479	-3.08	0.003	-811.1564	-175.2017
southaf	814.0996	147.8138	5.51	0.000	520.6118	1107.587
sril	-12.54263	90.21661	-0.14	0.890	-191.6698	166.5846
sudan	-429.2775	202.7467	-2.12	0.037	-831.8358	-26.71908
swazil	166.6857	138.7208	1.20	0.233	-108.7476	442.1191
timorl	(dropped)					
togo	(dropped)					
uganda	-44.52926	113.1474	-0.39	0.695	-269.1861	180.1276
urtanz	-8.650553	106.0715	-0.08	0.935	-219.2581	201.9569
vietn	473.884	60.85477	7.79	0.000	353.0554	594.7126
zamb	-383.1668	118.5045	-3.23	0.002	-618.4602	-147.8734
zimbab	(dropped)					
_cons	-213.4547	366.8162	-0.58	0.562	-941.7768	514.8674

TABLE 12

regress matmort year fortif improvsanit improvh2o rural gnicap odacap goveffect hiv1549 attendedbirth afghan angola bang benin bhutan bots burkina burundi camb camer capev centafr chad comor congo cotedi drcongo eritrea ethio gabon gambia ghana guinea guinb india indo iran kenya laos lesotho liberia madag malawi malay mald mali mauritan maurit mozamb myan namibia nepal niger nigeria pakis philip rwanda seneg sierral solomon somal southaf sril sudan swazil timorl togo uganda urtanz vietn zamb zimbab

Source	SS	df	MS		
Model	8064436.87	61	132203.883	Number of obs =	87
Residual	13508.8792	25	540.355168	F(61, 25) =	244.66
				Prob > F =	0.0000
				R-squared =	0.9983
				Adj R-squared =	0.9942
Total	8077945.75	86	93929.6017	Root MSE =	23.246

matmort	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
year	-14.51093	5.021682	-2.89	0.008	-24.85328	-4.168581
fortif	-34.74376	24.266	-1.43	0.165	-84.72052	15.233
improvsanit	-3.653727	2.587514	-1.41	0.170	-8.982812	1.675357
improvh2o	3.135491	3.004213	1.04	0.307	-3.051801	9.322782
rural	13.31178	7.695535	1.73	0.096	-2.537469	29.16104
gnicap	.0066604	.0024848	2.68	0.013	.0015428	.0117781
odacap	-.2369856	.3588387	-0.66	0.515	-.9760276	.5020565
goveffect	44.58858	15.01411	2.97	0.006	13.66643	75.51073
hiv1549	6.607007	10.58232	0.62	0.538	-15.18768	28.4017
attendedbi~h	.9715121	.6935487	1.40	0.174	-.4568782	2.399902
afghan	(dropped)					
angola	824.4971	212.3674	3.88	0.001	387.1183	1261.876
bang	92.37493	95.40528	0.97	0.342	-104.1159	288.8658
benin	120.3147	120.9843	0.99	0.330	-128.8572	369.4865
bhutan	-91.47206	109.2376	-0.84	0.410	-316.4511	133.507
bots	-11.72425	399.1081	-0.03	0.977	-833.7027	810.2542
burkina	-30.95423	137.2051	-0.23	0.823	-313.5335	251.625
burundi	440.536	168.1736	2.62	0.015	94.17595	786.896
camb	-121.8502	101.2978	-1.20	0.240	-330.477	86.77658
camer	612.8125	199.2158	3.08	0.005	202.5198	1023.105
capev	(dropped)					
centafr	626.4686	92.89554	6.74	0.000	435.1467	817.7905
chad	801.6729	113.9244	7.04	0.000	567.0412	1036.305
comor	-90.11711	113.0429	-0.80	0.433	-322.9333	142.6991
congo	599.8908	229.7486	2.61	0.015	126.7146	1073.067
cotedi	336.8337	159.1534	2.12	0.044	9.051069	664.6164
drcongo	(dropped)					
eritrea	-111.4849	140.0063	-0.80	0.433	-399.8333	176.8635
ethio	(dropped)					
gabon	544.497	414.5438	1.31	0.201	-309.2719	1398.266
gambia	(dropped)					
ghana	177.9024	161.4609	1.10	0.281	-154.6326	510.4375
guinea	468.6702	85.74988	5.47	0.000	292.065	645.2753
guinb	626.6735	103.3719	6.06	0.000	413.7751	839.5718

india	-131.0051	67.94728	-1.93	0.065	-270.9451	8.934994
indo	(dropped)					
iran	(dropped)					
kenya	173.2816	110.2002	1.57	0.128	-53.68002	400.2433
laos	245.5359	105.0512	2.34	0.028	29.17904	461.8928
lesotho	-63.51748	250.7241	-0.25	0.802	-579.8935	452.8586
liberia	1151.763	276.0531	4.17	0.000	583.2208	1720.305
madag	137.6457	65.66944	2.10	0.046	2.396984	272.8945
malawi	71.856	195.3933	0.37	0.716	-330.5639	474.2759
malay	221.7162	312.3669	0.71	0.484	-421.6154	865.0479
mald	-190.4407	82.86606	-2.30	0.030	-361.1066	-19.77487
mali	600.1751	84.92365	7.07	0.000	425.2716	775.0787
mauritan	539.5551	175.2867	3.08	0.005	178.5453	900.5648
maurit	-304.7576	117.1881	-2.60	0.015	-546.1109	-63.40426
mozamb	402.8585	152.2831	2.65	0.014	89.22566	716.4913
myan	-199.2862	101.6905	-1.96	0.061	-408.7218	10.14941
namibia	-326.0297	173.3317	-1.88	0.072	-683.0129	30.95352
nepal	-56.58155	155.189	-0.36	0.718	-376.1992	263.0361
niger	406.155	125.5164	3.24	0.003	147.6492	664.6608
nigeria	735.8309	161.4688	4.56	0.000	403.2797	1068.382
pakis	-163.8311	122.7232	-1.33	0.194	-416.5843	88.92206
philip	392.7391	253.6119	1.55	0.134	-129.5844	915.0626
rwanda	-303.1486	114.85	-2.64	0.014	-539.6867	-66.61054
seneg	378.3602	123.9942	3.05	0.005	122.9894	633.7311
sierral	(dropped)					
solomon	675.8296	201.3426	3.36	0.003	261.1567	1090.502
somal	-238.5166	200.1678	-1.19	0.245	-650.7699	173.7368
southaf	1280.318	247.6775	5.17	0.000	770.2164	1790.419
sril	-130.036	147.7288	-0.88	0.387	-434.289	174.2171
sudan	-147.6872	278.9102	-0.53	0.601	-722.1135	426.7391
swazil	449.4599	158.9513	2.83	0.009	122.0936	776.8263
timorl	(dropped)					
togo	(dropped)					
uganda	-221.8461	163.3399	-1.36	0.187	-558.251	114.5589
urtanz	102.4854	116.2808	0.88	0.387	-136.9993	341.9701
vietn	485.7593	71.13113	6.83	0.000	339.262	632.2566
zamb	-262.7239	151.394	-1.74	0.095	-574.5257	49.07792
zimbab	(dropped)					
_cons	-648.625	587.4924	-1.10	0.280	-1858.588	561.3384

TABLE 13

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regress matmort year improvsanit improvh2o rural gnicap odacap goveffect
afghan angola bang benin bhutan bots burkina burundi camb camer capev centafr chad
comor congo cotedi burkina burundi camb camer capev centafr chad comor congo cotedi
drcongo eritrea ethio gabon gambia ghana guinea guinb india indo iran kenya laos
lesotho liberia madag malawi malay mald mali mauritan maurit mozamb myan namibia nepal
niger nigeria pakis philip rwanda seneg sierral solomon somal southaf sril sudan
swazil timor-l togo uganda urtanz vietn zamb zimbab if fortif == 1
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```
      Source |       SS       df       MS              Number of obs =      57
-------------+------------------------------           F( 38,    18) =  387.90
       Model |  6616985.59    38    174131.2           Prob > F      =  0.0000
    Residual |   8080.3427    18  448.907928           R-squared     =  0.9988
-------------+------------------------------           Adj R-squared =  0.9962
       Total |  6625065.93    56  118304.749           Root MSE      =  21.187
------------------------------------------------------------------------------
     matmort |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        year |  -16.02896   5.956814    -2.69   0.015    -28.54376   -3.514158
 improvsanit |  -3.652707   2.749668    -1.33   0.201    -9.429546    2.124131
   improvh2o |  -1.640287   3.398433    -0.48   0.635     -8.78013    5.499556
       rural |  -2.881085   10.96532    -0.26   0.796    -25.91836    20.15619
      gnicap |   .0051627   .0022584     2.29   0.035     .0004178    .0099075
      odacap |   .0504833   .1041598     0.48   0.634    -.1683484     .269315
   goveffect |    22.3321   16.23007     1.38   0.186    -11.76601    56.43021
      afghan |    1337.19   485.1664     2.76   0.013     317.8935    2356.487
      angola |   520.3176   194.9544     2.67   0.016     110.7336    929.9016
        bang |   377.6024   449.5105     0.84   0.412    -566.7841    1321.989
       benin |   209.7068   309.0789     0.68   0.506    -439.6438    859.0575
      bhutan |  (dropped)
        bots |  (dropped)
     burkina |  (dropped)
     burundi |  (dropped)
        camb |   198.5407   506.6842     0.39   0.700    -865.9633    1263.045
       camer |  (dropped)
       capev |  (dropped)
     centafr |  (dropped)
        chad |  (dropped)
       comor |  (dropped)
       congo |  (dropped)
      cotedi |   332.6675   245.2657     1.36   0.192    -182.6167    847.9517
     burkina |  (dropped)
     burundi |  (dropped)
        camb |  (dropped)
       camer |  (dropped)
       capev |  (dropped)
     centafr |  (dropped)
        chad |  (dropped)
       comor |  (dropped)
```

congo	(dropped)					
cotedi	(dropped)					
drcongo	503.8541	380.7637	1.32	0.202	-296.1008	1303.809
eritrea	(dropped)					
ethio	451.6258	549.4554	0.82	0.422	-702.7372	1605.989
gabon	(dropped)					
gambia	(dropped)					
ghana	122.002	234.4154	0.52	0.609	-370.4865	614.4906
guinea	560.7092	373.459	1.50	0.151	-223.899	1345.317
guinb	(dropped)					
india	188.4425	408.6871	0.46	0.650	-670.1772	1047.062
indo	(dropped)					
iran	-237.5649	169.3139	-1.40	0.178	-593.2802	118.1504
kenya	501.3702	505.2985	0.99	0.334	-560.2227	1562.963
laos	(dropped)					
lesotho	381.9944	458.4419	0.83	0.416	-581.1563	1345.145
liberia	(dropped)					
madag	(dropped)					
malawi	740.0234	569.2158	1.30	0.210	-455.8547	1935.901
malay	(dropped)					
mald	(dropped)					
mali	672.7084	399.1303	1.69	0.109	-165.8332	1511.25
mauritan	696.9767	325.0477	2.14	0.046	14.07671	1379.877
maurit	(dropped)					
mozamb	(dropped)					
myan	(dropped)					
namibia	(dropped)					
nepal	227.6758	547.6623	0.42	0.683	-922.92	1378.272
niger	778.7259	537.3168	1.45	0.164	-350.1347	1907.587
nigeria	786.4109	242.416	3.24	0.005	277.1138	1295.708
pakis	34.07598	356.4199	0.10	0.925	-714.7345	782.8865
philip	91.23377	115.587	0.79	0.440	-151.6056	334.0731
rwanda	84.99656	536.1982	0.16	0.876	-1041.514	1211.507
seneg	(dropped)					
sierral	(dropped)					
solomon	(dropped)					
somal	(dropped)					
southaf	1179.106	95.83611	12.30	0.000	977.7613	1380.45
sril	320.9856	553.4337	0.58	0.569	-841.7355	1483.707
sudan	-34.41886	289.062	-0.12	0.907	-641.7156	572.8779
swazil	923.9423	498.8417	1.85	0.080	-124.0853	1971.97
timorl	(dropped)					
togo	(dropped)					
uganda	236.2147	580.3822	0.41	0.689	-983.1231	1455.552
urtanz	539.6636	471.0988	1.15	0.267	-450.0782	1529.405
vietn	744.4583	437.6145	1.70	0.106	-174.9357	1663.852
zamb	-5.394782	351.537	-0.02	0.988	-743.9465	733.157
zimbab	(dropped)					
zimbab	(dropped)					
_cons	630.6983	551.8692	1.14	0.268	-528.7359	1790.133

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Table 14

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regress matmort year improvsanit improvh2o rural gnicap odacap goveffect
af1sea0 if fortif == 1

      Source |       SS       df       MS              Number of obs =      57
-------------+------------------------------           F(  8,    48) =    1.41
       Model |  1258077.45     8  157259.681           Prob > F      =  0.2181
    Residual |  5366988.48    48   111812.26           R-squared     =  0.1899
-------------+------------------------------           Adj R-squared =  0.0549
       Total |  6625065.93    56  118304.749           Root MSE      =  334.38
------------------------------------------------------------------------------
     matmort |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        year |  -18.38279   30.07113    -0.61   0.544    -78.84484    42.07927
 improvsanit |    4.88848   2.603044     1.88   0.066    -.3452911    10.12225
   improvh2o |  -9.037515   3.984961    -2.27   0.028    -17.04982   -1.025215
       rural |   2.437922    2.98979     0.82   0.419    -3.573454    8.449297
      gnicap |   .0001086    .017663     0.01   0.995    -.0354053    .0356225
      odacap |    1.11554    .814492     1.37   0.177    -.5221059    2.753186
   goveffect |  -3.772353   67.21459    -0.06   0.955    -138.9163    131.3716
     af1sea0 |   142.0854   102.0106     1.39   0.170    -63.02064    347.1914
       _cons |   730.8301   368.3827     1.98   0.053    -9.852871    1471.513
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