(61). Total calories per day, including food secured through the ration, in the private market, and through autoproduction, was estimated at 2277 during 1993 through 1995 (39). This level fell about 9% short of the recommended level of 2500 calories and was 32% below per capita levels prior to sanctions and the Gulf war. These lower calorie levels were last characteristic of Iraq during the 1970s. An average of 1900 calories is believed to be needed to prevent starvation.

Oil for Food Implementation

UN Security Council Resolution 986, permitting the export of $2 billion of petroleum each 6 months, of which about $849 million was available for food import and production in the 15 central and southern governorates, raised hopes of a return to rations covering the majority of calorie and protein needs. Under UN Resolution 986 rations were to rise to 2030 calories per day. It is assumed that outside the ration, the average Iraqi is able to acquire an additional 500 calories worth of food per day. Thus, since mid 1997, most Iraqis have been able to acquire calories above recommended levels and 12% below prewar, presanction levels. Micronutrient levels, however, were not adequately covered by the ration. Especially deficient were supplied levels of iron and vitamin A. Adequate rations would require an estimated $10 per capita per month in additional spending. This would raise the cost of humanitarian supplies by an estimated $2.6 billion per year (65).

Little information is available about nutrition levels of young children prior to the Gulf war. Studies in Baghdad demonstrated 3 to 4% of under five-year-olds to be more than two standard deviations below the mean reference population's weight. Only five health centers were involved in these studies; rates of underweight were very low at four centers and 18% at the fifth (74). A study in Basrah in the period from 1983 through 1984 found that 5% of children under one year had low weight for age. These rates were similar to that for the reference population, indicating a low level of malnutrition in the capital city. Malnutrition was undoubtedly more common in outlying governorates and rural areas. The National Child Health Survey (26) found in 1989 that 89% of mothers ever breast fed.

The percentage of children born under 2.5 kg was reported to be 5% in 1984 and 9% during the period from 1982 through 1988 (31). The Ministry of Health reported that in 1990, 4.5% of the approximately 60% of all births occurring in public hospitals were low in weight (under 2500 gms). A baseline rate of low weight births of 5% prior to the Gulf war is similar to the rates found in many developed countries. The rate of low birth weight births rose to about 20% in Iraqi government hospitals in 1995. An increasing but unknown proportion of all births occurred outside medical facilities during the 1990s. Those giving birth in hospitals are thus likely to be progressively less representative of the general population through 1997. Yet even if low weight births nationally rose only half as much as those occurring in hospitals, to 10%, this represents a doubling of the rate of low weight births. Low birth weight is the most important predictor of mortality; the rise in low birth weight in Iraq almost surely is associated with a sharp rise in mortality in the first month of life.

Problems of undernutrition are found among adults as well as children. The 1997 FAO/WFP survey found that among adults over age 26, 25% of men and 16% of women had low body mass index (BMI) measures, indicating likely undernourishment. The March 1998 MOH/UNICEF/WFP study found that 6% of mothers surveyed had a low BMI, 11% were borderline low, and 8% were obese. Undernutrition was most common among mothers under thirty years of age; there was no urban-rural difference. (49)

Assessing Nutrition by Survey During Sanctions

Data in table 7, Appendix B show information from available nutritional studies in Iraq.[5] It is not possible to directly compare these studies as they differ in their geographic coverage, the method of selecting a sample, the age group included, sample size, the way malnutrition is measured, the individuals doing the assessment, the size of the population included, and the methods of selection of study participants.

The results of only one study were not made available for inclusion in Appendix B. That was the 1996 cluster sample survey carried out in Baghdad by the CESR.

No nationally representative data on malnutrition is available prior to 1990. Reports on several studies from Baghdad suggest that chronic and acute malnutrition rates were modest and were similar to those of a well nourished WHO/NCHS reference population in the U.S. It is assumed that poor Baghdad neighborhoods, outlying governorates, and rural areas experienced higher rates. During January 1989 through August 1990, the Iraqi Ministry of Health reports that about 1% of hospital admissions were for malnourishment. This rose to 2.5% of all admissions during September 1990 through April 1992 (17).

The single most often studied community in Iraq is that served by the Sheik Omar Health Center in a poor Baghdad neighborhood. See Appendix B, table 1. A gradual increase in underweight children is observed through 1992. Other studies in Baghdad overall, or in the poor neighborhood of Saddam City, also show a rise in all three nutrition indicators by 1995; a high level of malnutrition is still found in 1997. See Appendix B, table 2. These data are consistent with that from the hospital in Saddam City, Baghdad.

High rates of malnutrition are observed in most disadvantaged outlying governorates. See Appendix B, table 3. Especially notable are the higher rates of malnutrition found in urban Wasit governorate in comparison to rural Wasit in a 1992 study by Obeid.

Only the four studies presented in Appendix B, table 7 were:

- national or nearly national in scope (the IST failed to include one small governorate);

- generated a sample which was representative or nearly representative. The IST study generated wider variance estimates due to the methodologic impact of clustering. The MICS study did not have this limitation. The 1997 and 1998 Clinic Exit Surveys studies failed to include a small portion of children who did not visit clinics during immunization campaign days;

- had foreign nationals directing the design process and involved in data collection;

- provided independent validity checks on the work of field measurement teams.[6]

The IST data forms the only representative national study available for the immediate postwar period. Thus its estimates that 9.2% of Iraqis under five years of age in 1991 had low weight for age, 18.7% had low height for age, and 3.0% had low weight for height (30) can be considered the postwar baseline. These rates were likely higher than those experienced during the 1980s. The northern governorates, under UN administration since 1991, showed high rates of malnutrition in 1991 (See Appendix B, table 4). High rates of acute malnutrition among under one-year-olds in both the northern and central and southern governorates was observed in the period from 1996 through 1998 (See Appendix B, table 5). Chronic malnutrition then was relatively more prevalent among under five-year-olds in central and southern governorates (See Appendix B, table 6). Acute and chronic malnutrition rose considerably through 1996, leaving under five-year-old Iraqis throughout the country with high rates by 1996. These high rates declined only moderately from August 1996 to March 1998.

The MICS and the 1998 Clinic Exit Survey showed that although acute malnutrition was not predicted by education levels, chronic malnutrition and mixed chronic and acute malnutrition were twice as common among children whose mothers had low educational levels. Male children, and all children in rural areas, those born within two years of a prior birth, those in large households, and those with poor quality sources of water and sanitation had higher malnutrition rates. Acute malnutrition is highest during the weaning period from six to twenty-three months of age, gradually returning to baseline levels afterwards. Chronic malnutrition occurs later in life, rising notably at age twelve to twenty-three months. The rate of chronic malnutrition continues to rise gradually in subsequent months of age. Weight for age, a mixed indicator of acute and chronic malnutrition, similarly rises at age twelve to twenty-three months and stays up thereafter.

Malnutrition varies considerably by geographic area. MICS data showed that the southern governorates had the highest rates. Similarly, southern governorates had lower levels of school enrollment, lower levels of adult literacy, 10 to 15% lower rates of measles immunization, and levels of access to clean water and sanitation facilities which were less than half that in the rest of the country. In these areas, diarrhea and respiratory infections are the most common causes of death among children (35, 36).

By contrast, Baghdad governorate has both higher levels of breast feeding, and higher rates of age-appropriate introduction of weaning foods (49). It has been noted informally that some neighborhoods of Baghdad, especially those with many college graduates, had notable rates of obesity in 1998, while in some poor areas as much as half of the children were stunted.

Estimating Mortality from Data on Malnutrition

Methods and Results

Given the uncertainties and inconsistencies of the various studies on Iraqi mortality rates, and the incomplete nature of Iraqi mortality reports from hospitals and vital statistics registries, there is an urgent need for independent estimates of mortality changes since 1990. Except for IST data for 1991, the only reliable national data sets for Iraq are for malnutrition and other social indicators. This report uses these reliable nutrition data sets to develop estimates for changes in mortality rates in 1996. Methods for estimating under five-year-old mortality rates from these nutrition and related data are presented below. Four analyses, based on three independent data sources, are detailed. These are followed by exploratory regression analysis and, finally, a logistic regression.

Model 1: Correlating Malnutrition and Mortality Data

Data from the 1996 MICS survey for each of the three measures of malnutrition were compared to the data for all other countries in the State of the World's Children Report (41) with levels of malnutrition within a range of 10% higher or lower. Eight countries reported a prevalence of low weight for age in a range of 20 to 26%, twelve countries reported low height for age in a range of 28 to 34%, and ten countries reported low weight for height among under five-year-olds in a range of 9 to 11%. The average under five-year-old mortality rates reported for those countries that shared Iraq's weight for age values were 126.1 ± 67.0, for those countries that shared Iraq's height for age values were 131.2 ± 76.5, and for those countries that shared Iraq's weight for height values were 148.6 ± 64.2. The unweighted average of these three rates is 135.3 ± 69.2. The major weakness in this approach is the assumption that the relationship between mortality and malnutrition in Iraq is likely to be similar to countries with more stable social conditions While higher malnutrition usually implies higher mortality, the relationship is not likely linear and may be heavily influenced by other cultural or material factors.

Model 2: Projections from the Mortality Rate in Baghdad

The mortality rate in the 1996 CESR study in Baghdad cannot be used as a national estimate because, as in most developing countries, mortality is likely to be higher outside the capital city. Data from the IST study provided relative mortality rates for Baghdad and the rest of the country for children under one month of age, one to eleven months of age, and twelve to fifty-nine months of age (29). Among under one-month-olds, excess mortality outside of Baghdad relative to mortality in

Baghdad is 4% and 21% for the periods 1985 through 1990 and January 1991 through August 1991, respectively. Among one- to eleven-month-olds, it is 149% and 250% and among twelve- to fifty-nine-month-olds it is 338% and 505%, for the same two periods of time. The IST found in 1991 that 25% of all under five-year-old deaths occur in the first month, 47% occur during the second to twelfth month of life, and 28% occur during one to four years of age. Using these same rates of proportional mortality among under five-year-olds, total mortality among under five-year-olds outside of Baghdad should be between 1.6 and 3.2 times higher than in Baghdad. Assuming that a quarter of all under five-year-olds live in Bagdad, this suggests a national rate of under five-year-old mortality in a range from 47 to 100. The midpoint estimate of this range is 73.5 ± 26.5. Weaknesses in this method include the imprecision of projecting for the nation from one area, the possibility that variables influencing mortality have not changed proportionally in Baghdad and the rest of the country, and the possibility that proportional mortality by age, estimated from IST data for two periods, could have changed in subsequent years.

Model 3: Comparison with Eight Malnutrition and Mortality Studies

Pelletier et al. identified eight observational studies in six countries where weight for age assessments were correlated with subsequent mortality rates among under five-year-olds (50). While the log of mortality rate in these eight studies generated nearly parallel slopes of increase as malnutrition increased, the baseline levels of mortality among those with mild malnutrition varied eightfold. Point estimates and confidence intervals for mortality among under five-year-olds from these eight studies were 11.4±8.3 per one thousand births for those with normal weights, 19.3 ± 16.1 per thousand among those mildly underweight, 34.4 ± 23.4 per thousand among those moderately underweight, and 91.4 ± 63.2 per thousand for those severely underweight. Each of these rates is multiplied by five to derive the cumulative rate of death among under five-year-olds. Multiplying these rates by the proportion of under five-year-old Iraqi children with normal weights (42.8%), mildly underweight (34.3%), moderately underweight (16.6%) and severely underweight (6.3%) as determined in the MICS survey generates a rate of 92.9 ± 68.7 deaths per thousand under five-year-olds. Limitations in this approach include the imprecision in using as a model data with widely varying values, the wide confidence band generated, and the possibility that malnutrition-mortality dynamics in Iraq may be different from those in countries used to develop this model.

Model 4: Comparison to Countries With Similar Expected Population Attributable Risk

Pelletier et al. (51) observed that although mortality rates varied a great deal, the slopes of the increase in the rate of mortality at various levels of malnutrition were nearly parallel. This permits calculation of an equation for the slope of relative risk of mortality and calculation of the population attributable risk (PAR) associated with stunting. The PAR, in this case, is the proportion of all mortality which is due to the effects of malnutrition. Thus, while the actual mortality rate remains unknown, the proportion of all mortality which is attributable to mild, moderate, and severe malnutrition can be calculated. Rates of the population attributable risk varying from 12% to 66 % were presented for 53 countries (50). Data on the proportion of under five-year-old Iraqis with moderate and severe malnutrition were transformed according to equations provided by Pelletier (50) and fitted to his regression equation to estimate the population attributable risk for malnutrition in Iraq in 1996. The Iraqi rate of 64% PAR was within a 10% range of only the highest three