V.9 HEALTH CARE DELIVERY SYSTEMS

Progress Report

June 1, 1977 - September 1, 1977

Progress To Date:

During this past phase in our project, we have focused largely on four tasks: (1) delineating the interrelationship between demographic and malnutrition indicators on the one hand, and developmental indicators, on the other; (2) developing a questionnaire to be administered through the Ministry of Health field offices to obtain systematic information on the administration of health services and approaches to malnutrition; (3) planning the subsequent phases of this project; and (4) establishing and formalizing a working relationship between the Cairo University/M.I.T. team and the representatives from the Ministry of Health.

A. Relationship between Malnutrition Indicators and Development

The first major task involved developing means for unravelling the relationship between malnutrition and development. This was done in two phases. First, developing the correlation between infant mortality (as a demographic indicator of malnutrition) and various development indicators; and second, describing the interrelationships using regression analysis. In each phase, the governorate was used as the unit of analysis. Governorate-wide data are highly revealing in indicating the differences among various regions of Egypt with respect to child mortality and to development. Although we have also found that the correlation between both sets of variables were generally low, closer investigations revealed high interconnections among the development variables and close relationships to infant mortality. Indeed governorate data are sufficiently refined to enable an initial untangling of major relationships. The correlation and regression analyses are described in project memoranda prepared by Dr. Field and by George Ropes.[1]

Throughout this analysis, the Sinai was excluded from all calculations, on the grounds that it was anomalous in several responses. Thus there were

[1] John O. Field, "Correlation: Infant Mortality and Selected Variables by Governorates," (July 19, 1977), and George Ropes, "A Report on Correlation and Regression Analysis of the Egyptian Health Care Data," (M.I.T., August 23, 1977).

24 cases each representing a governorate. The development variables employed were the following: % women in the paid labor force, crude birth rate, % total illiteracy, % femal illiteracy, % urban, % households with electricity, % households with pure water in the dwelling and % households with pure water in the building.

Two major dependent variables were examined: infant mortality and crude birth rate. The most important results to date include the following: first, there are significant differences among regions of the country in terms of the relationship of demographic and malnutrition variables to developmental ones. Egypt cannot be treated as a single entity if the factors affecting infant mortality in various regions of the country are to be understood.

Second, the results indicate that development is not a simple or direct path to reduced infant mortality. For example, illiteracy alone has little impact on infant mortality (R^2 = .05) and female illiteracy has even less impact. Similarly, reduction of birth rate alone has only a limited impact. For urban governorates R^2 = .23. However, when the effects of total illiteracy and birth rate together are examined, they account for 50% of the observed variance in infant mortality (i.e., R^2 increases to .50). Neither a reduction in the birth rate alone, nor an increase in literacy alone has a direct impact on reducing infant mortality. But together, their combined effect is to reduce infant mortality.

Third, for some regions of the country, other developmental variables, such as urbanization and total illiteracy have important effects on reducing infant mortality. By the same token, the most significant determinants of the birth rate are delineated when the data are disaggregated by governorate. Urbanization is consistently an important factor in reducing the birth rate and, again, there are marked differences among the governorates.

These results are still tentative, pending further analysis and refinement, but point to the importance of focusing on the governorates in order to obtain a more disaggregated, and more accurate, perspective on the relationship between demographic and development variables in Egypt.

B. Developing a Questionnaire on Health Delivery

The second major task undertaken during this past period was the development of a questionnaire to be administered through the bureaucracy and agencies of the Ministry of Health to obtain systematic information on the perspective from the periphery, and on assessments of malnutrition by those who are responsible for administering the Ministry's policies on these issues. The draft questionnaire was prepared initially at M.I.T., and revised following discussions with the Cairo University team and representatives from the Ministry of Health.

The major thrust of the questionnaire is two-fold: (a) to elicit information on the Ministry's perspective on health delivery and malnutrition problems; and (b) to request systematic data from the Ministry's own files, both at the center and at the periphery.

C. Planning Subsequent Phases of the Project

The next phases of this project include:

(a) the final completion of the questionnaire and its dissemination through the Ministry of Health's own administration;

(b) two papers: one by the Cairo University team; the second with the collaboration of the Ministry of Health. Drs. Shafika Nasser and Mervat El Rafie will complete their review of the malnutrition problem in Egypt and the Ministry's approaches to that problem; Dr. Salah Shahbander and Motaz Mobarak of the Ministry of Health will complete their analysis of the history of the health service in Egypt;

(c) a sample survey to be tested on two governorates, one in Upper Egypt and one in Lower Egypt, in order to obtain more systematic data on health status and malnutrition. The pilot will be undertaken in the fall and a large scale survey at a later stage; and

(d) the inclusion of a two week period of weighing children and attendant training of personnel built into the survey activity.

D. Regularizing Working Relationships with the Ministry of Health

Under the direction of Dr. Salah Shahbander, a weekly meeting between the Cairo University group and the Ministry of Health representatives is held to assure coordination of activities and collaboration. The major effect of these meetings is to enable various participants to present to the entire group their own work, obtain assistance, and develop cohesion among the group. The meetings are in the form of a seminar to which visitors from M.I.T. and elsewhere are invited to address the group and, in turn, to share some of the methodological and substantive problems.

Problems At This Stage

So far, the major problems involved collection and analysis of health related data. There appear to be strong inconsistencies in observations for the same variables reported in different years, which draw attention to potentially serious data problems. We have developed some hypotheses about the nature of the difficulties. However, despite the data problems, some patterns emerge in the regression analysis that point to major differences among the governorates with respect to the relationship between infant mortality and developmental indicators.

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Attachment A: Health Care Delivery Systems

MEMORANDUM

To: Shafica S. Nasser
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From: John O. Field

Date: July 19, 1977

CORRELATIONS: INFANT MORTALITY AND SELECTED VARIABLES, BY GOVERNORATE

You will recall that, while in Cairo in June, I attempted a number of correlations using governorate-level data. The idea was to establish some simple empirical relationships between malnutrition and other features of Egyptian life. This memorandum summarizes my findings and includes both the raw data that I employed and the statistical results derived.

<u>The Data</u>

Most of the data analyzed were drawn from "The Preliminary Results of the General Population and Housing Census, 22/23 November 1976 in Egypt," Central Agency for Public Mobilisation and Statistics, mimeo , 1977, 57pp. Included are the following, all broken down by governorate.

- Women in the paid labor force (percent of "economically active" women six years and older)
- Percent illiterate in the population aged ten years and above
- Percent illiterate among females aged ten and above (calculated from the actual numbers; the percentage figures understate the rate of female illiteracy since the population totals include all ages.)
- Percent urban
- Percentage of households with electricity
- Percentage of households without purified drinking water

- Percentage of households with purified drinking water: tap in dwelling

- Percentage of households with purified drinking water: tap in dwelling or inside building

These variables were each correlated with infant mortality rates for 1973 given to me by the Ministry of Health. In addition, infant mortality rates for 1972 documented by CAPMAS were used to test consistency in the correlations given occasionally major differences in the mortality figures for the two years. Of necessity, infant mortality must serve as a proxy for the incidence and seriousness of basic protein-caloric malnutrition. Regrettably, I was not able to screen out mortality for newly born children under four months of age so as to strengthen the mortality-malnutrition connection. This is something that would be worth doing if the data are available in that form. It would also make sense to do similar runs with toddler mortality rates.*

The final variable included in the correlations is the crude birth rate for 1973, also provided by the Ministry of Health.

These variables are all plausibly linked with infant mortality, especially when arranged by governorate for purposes of capturing variation within the country and the extent to which mortality is, in fact, associated with other conditions.

Conspicuous by their absence are data on per capita income by governorate. Please send these data to me, if they are available, along with anything else that you would like me to work on.

Theory

In the main, infant mortality should be correlated with variables such as these. One would also expect the associations to be visible at the governorate level. That is, governorates high in infant mortality might be expected to show high birth rates, high illiteracy, and low indices of development, whereas governorates with low mortality rates would be expected to show relatively low birth rates, less illiteracy, and higher levels of development.

More specifically, as women enter the labor force in increasing numbers, it would be reasonable to hypothesize that infant mortality will decline in response to the greater income earned by the family and the improved wellbeing made possible by this added income. On the other hand, a number of analysts (Hart, Reutlinger-Selowsky, etc.) have posited the opposite effect: decreased child welfare resulting from reduced maternal attention generally and lessened opportunity for breast feeding in particular. Reutlinger and Selowsky, on the strength of data

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* For the country as a whole, it would be useful to portray infant mortality by monthly age for at least the first year of life and, preferably, for the first three years of life.

from Calcutta, refer to a "negative income effect" for these reasons (Shlomo Reutlinger and Marcello Selowsky, Malnutrition and Poverty: Magnitude and Policy Options, World Bank Staff Occasional Papers, No. 23, Baltimore: The Johns Hopkins University Press, 1976, p. 35).

If the "child survival hypothesis" (Wray, Taylor et al., Brewer, etc.) is correct, higher rates of infant mortality should contribute to higher birth rates as parents replace their losses and compensate for anticipated losses, all the while maintaining a high norm of desired family size. Similarly, if what is true elsewhere is true in Egypt, later children in a family will be more vulnerable to malnutrition, health hazards, and mortality than earlier children, again suggesting a positive correlation between birth rates and infant mortality.

Illiteracy and mortality are thought to go together for at least two reasons. First, illiteracy is an indicator of low development conceived as improvement in population attributes and capabilities. Compared with the educated, illiterates are "backward" and less able to cope with changes taking place around them. Second, illiteracy - maternal illiteracy in particular - is sometimes (Kerala studies, etc.) viewed as a direct barrier to appropriate child care. The illiterate mother is bound by traditional beliefs and practices deemed harmful to her vulnerable child, and she is less adept as well as less inclined to seek proper care when necessary.

Urbanization has long been regarded as a prime indicator of development, more urban societies being, presumably, more developed in a whole variety of ways. On the other hand, social deprivation is often accentuated by economic development, notably in the burgeoning of urban slums and in the multiple insults that afflict people living there. According to several studies (Wray, etc.), malnutrition is a more serious problem among the urban poor than among the rural poor. We might, therefore, expect a positive correlation between percent urban and infant mortality in Egypt, although the reverse might also be true to the extent that urbanization entails higher incomes, greater amenities, improved sanitation and water, and easier access to services, including health care. In such cases, greater urbanity would be accompanied by lower infant mortality.

Electrification is another development indicator which, in the present instance, represents a direct benefit to people in their homes. Appropriately, the distributional quality of development is taken into account. While it would require fairly tortuous reasoning to claim that electrification, as such, should reduce mortality, household electrification may, in fact, be a form of disseminated development which alters people's life-styles enough to trigger other changes that are more directly relevant to mortality (such as whether farm animals are kept in the dwelling, or independently housed). In general, one would expect infant mortality to be lower in places where household electrification is most advanced.

If any indice of disseminated development should have a direct bearing on malnutrition/morbidity/mortality, it is the availability of purified drinking water. With the possible exception of environmental sanitation, no other infrastructural change is more likely to make a difference to this cluster of variables. Households without purified drinking water reasonably accessible to them are prime candidates for high infant mortality rates. Households with purified water in their homes are distinctly advantaged in Egypt, and one would expect a markedly lower incidence of infant mortality in such households than elsewhere, unless a tap in the same building constitutes a functional equivalent.

With the data provided by CAPMAS and the Ministry of Health, I have tested these propositions in the most rudimentary way, making simple linear correlations between infant mortality and the other conditions mentioned, with the data broken down by governorate in order to capture intra-country variation. Primary reliance was on the Pearson r (product moment correlation coefficient), supplemented occasionally by the Spearman r (rank correlation coefficient) as a hedge against possibly faulty data. The Spearman test, normally reserved for ordinal data, makes sense on the assumption that the actual figures being correlated are not always accurate but that the relative positioning of governorates is. All relationships excluded the Sinai, a political anomaly. The other three Frontier governorates were also excluded when the lack of matching data made this necessary.

Findings

The raw distributions (see attachments) support the proposition linking higher infant mortality to lower levels of development in that, regionally, mortality tends to be highest in Upper Egypt, where development has typically lagged behind the rest of the country. So a regional pattern is apparent in the data.

On the other hand, at the governorate level the correlations-with near uniformity-are disappointing substantively and insignificant statistically. Although in the predicted direction, for the most part, they are generally quite low, and little confidence can be placed in them.

SEE TABLE ON THE
NEXT PAGE

That infant mortality is not meaningfully related to women in the paid labor force is perhaps explained by the fact that most Egyptian women are in the labor force, albeit without pay. That is, the difference between the two types of labor implied - one traditional and the other in the modern, organized sector - may not be all that relevant to child welfare. On the other hand, the negative sign suggests that the added income derived from a women's working for pay does not contribute to child welfare either, at least as reflected in mortality data. Something on the

CORRELATIONS: INFANT MORTALITY AND SELECTED VARIABLES, BY GOVERNORATE

	Pearson r		Spearman r_{rho}	
	INFANT MORTALITY 1973	INFANT MORTALITY 1972	INFANT MORTALITY 1973	INFANT MORTALITY 1972
WOMEN IN THE PAID LABOR FORCE *	-.203 n.s.	-.187 n.s.	-.04 n.s.	
CRUDE BIRTH RATE *	.352 Sig.at .05 (one tailed test)	.471 Sig.at .01 (one tailed test) Sig.at .02 (two tailed test)	.299 n.s.	.357 Sig.at .05 (one tailed test)
PERCENT ILLITERATE #	-.079 n.s.			
PERCENT FEMALE ILLITERATE *	-.212 n.s.			
PERCENT URBAN *	.106 n.s. NOTE: this correlation is reduced by fact that four governorates are 100% urban.			
PERCENT HOUSEHOLDS WITH ELECTRICITY #	-.019 n.s.			
PERCENT HOUSEHOLDS WITHOUT PURIFIED DRINKING WATER #	.199 n.s.		.166 n.s.	
PERCENT HOUSEHOLDS WITH PURIFIED DRINKING WATER: TAP IN DWELLING #	-.174 n.s.			
PERCENT HOUSEHOLDS WITH PURIFIED DRINKING WATER: TAP IN DWELLING OR INSIDE BUILDING #	-.136 n.s.			

* minus Sinai

\# minus - Frontier governorates for lack of matching data

NOTE: Pearson r is the standard linear correlation coefficient measuring the extent to which the same units occupy the same relative position on two variables. Spearman r_{rho} is a rank order coefficient used here as a hedge against possibly faulty data.

order of a "negative income effect" is apparent but mild. Viewed nutritionally, the proportion of women in the paid labor force is not (yet) a positive development indicator.

The one relationship achieving statistical significance is that between infant mortality and the crude birth rate. Moreover, the fact that the correlation is positive supports a linkage made in the literature (Levinson-Abbott, etc.) uniting nutrition policy and family planning. Either existing children must survive for parents to have fewer of them, later children are more likely to die than earlier children, or some combination of the two. Whatever the case, this is a finding which suggests the need for direct health sector attention to malnutrition/mortality, expecially since development - even disseminated development - has such limited impact on the problem.

That infant mortality is not significantly correlated with illiteracy is a case in point. Education to the level of literacy does not seem to result in better child care. In fact, the relationship is slightly inverse. It is even more inverse when female literacy is considered alone. Governorates with lower levels of infant mortality tend to be governorates with higher proportions of illiterate women, Kafr-El-Sheik being a notable example and Kena being another. Still, the correlations are insignificant, and an element of ecological fallacy may be involved.

The remaining results can be summarized quickly. Urbanity and mortality are very weakly related, and again the direction of the relationship is the opposite of what conventional development theory would predict. Household electrification has almost no discernible impact on mortality. The availability of purified drinking water, theoretically an important factor, turns out to be both insignificant and negative in the correlations.

In sum, the message of this exercise -insofar as there is one - is simple and somewhat unexpected. Mortality and fertility are significantly correlated. Mortality and development, variously defined, are not. The former comes as no surprise; the latter does. The two together suggest that direct nutrition - health interventions will be necessary if infant mortality is to be reduced substantially. Reliance on food subsidies and on economic development, the current "policy" in Egypt, is likely to prove disappointing or at least disappointingly slow.*

<u>Possible Explanations</u>

Lest any of this be taken too seriously, there are several reasons why the correlations are so poor aside from the reality of the situation.

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* As if to verify this observation, the Ministry of Health's own calculations show a net decrease in infant mortality of only 11 per thousand between 1952 and 1972, "Basic Statistical Information of Health Services," Ministry of Health, January 1975, p.2

- Infant mortality is an inadequate indicator of malnutrition. Not only is a fair amount of mortality not nutrition related, much malnutrition does not end in mortality. Infant mortality alone does not capture the dynamics imputed by the propositions mentioned above, at least some of which dynamics have delayed effects and may not be fully manifest until data are available for older age cohorts. It is also possible, of course, that the propositions are themselves weak.

- The data may not be sufficiently accurate for the correlations to portray reality. Conceivably, genuine differences among the governorates are not being picked up, resulting in washed out correlations. Moreover, since mortality is generally considered the dependent variable in the relationships under review, ideally one would want to lag mortality or, barring that, maintain time parity. Unfortunately, the mortality data precede the other data by three to four years. This is a likely source of distortion.

- Another possibility is that the hypothesized relationships exist but are not linear. Linear testing, as in the results reported here, would then understate the degree of association.

- It is also possible that the thrust of the propositions mentioned is correct but that other things are going on, intervening between the one-to-one relationships tested with the effect of washing them out. Many of the linkages imputed between mortality rates and other conditions are quite indirect, and the nature of the associations involved may be missed for lack of more complete data. (Needless to say, were there more complete data and were this more than a vaguely suggestive exercise, we would want to go well beyond simple correlations in our analysis.)

- Finally, in a substantive vein it bears noting that the data convey lots of anomalies, correctly or otherwise, from the standpoint of the theoretical expectations advanced above.

  - Cairo and Alexandria, despite their being centers of modernity, reveal fairly high rates of infant mortality. Illiteracy, however, is quite low - comparatively, as is the proportion of households lacking electricity and purified drinking water. Curiously enough, the crude birth rate is also low in Cairo and Alexandria. In terms of the correlations, none of this "makes sense."

  - Aswan suffers from a very high rate of infant mortality but is otherwise nondescript. Matrouh had the lowest mortality rate of any governorate in 1973 (39/1,000) while at the same time manifesting a birth rate that was well above average. Matrouh is also low on illiteracy and average on urbanity. Assyut, average concerning mortality, has a higher-than-average crude birth rate but is low on purified drinking water. And so on. Patterns such as these are death on significant correlations.

The data for Port Said, Suez, and Ismailia show the effects of their being in or close to the war zone, a possible source of additional anomalies.

The Bottom Line

No analysis resting solely on correlations deserves to be paid serious attention, and the data at my disposal may be unequal even to such simple (and simple-minded) treatment.

On the other hand, the exercise has brought to light two distinct possibilities, both of which are important to policy. First, a significant relationship does seem to exist in Egypt between infant mortality and the birth rate. One may infer from this, and with fairly solid theoretical grounding, that family planning objectives would be furthered by investments in better nutrition and health among the very young. The case for nutrition's becoming a higher priority concern of the Ministry of Health is, thereby, strengthened considerably.

Second, the correlations suggest a very weak - and often inverse - relationship between mortality and development. The implication of this is that development is not its own cure, at least in the short run, for the multiple insults underlying infant (and, we may presume, toddler) mortality. Malnutrition may not be a medical problem, as Dr. Bindary claims;* but as a socio-economic problem, which he also claims, it appears to be remarkably resistant to socio-economic development. Health policy, therefore, becomes one of several ways in which the Government of Egypt can impact the problem by means of direct interventions without waiting for "development," finally, to perform its presumed magic.

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* Conversation with John O. Field, June 1977, in Cairo.

cc Wafik Hassouna — Eckaus/Taylor
George Ropes — Nevin Scrimshaw

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$Y - \bar{Y} = -28.5$ w/o Sinai

REGION	GOVERNORATE	INFANT MORTALITY RATE	Rank	1972 CAPMAS (rank)	1972 CAPMAS	WOMEN IN THE PAID LABOR FORCE	Rank	CRUDE BIRTH RATE	Rank
Urban						[10.8]			
N = 4	Cairo	128	3		152	11.0	3	27.4	21
	Alexandria	103	4²		125	10.7	4	29.2	20
	Port Said	48 war zone		23	47	10.3	6²	3.8 war	23
	Suez	60 war zone		21	56	5.8	18	2.1 war	24
Lower						[10.2]			
	Damietta	85	16		85	7.4	13³	39.2	9
	Dakahlia	79	17		84	9.7	9²	37.0	15
	Sharkia	49	14		103	5.5	20	38.1	12
N = 9	Kalyubia	118	4		144	10.2	8	42.3	4
	Kafr-El-Sheik	55	20	22	67	18.3	1	35.0	16
	Gharbia	99	11		111	9.2	11	34.5	17
	Menoufia	115	5		137	9.7	9²	40.1	8
	Behera	71	19	20	82	13.0	2	37.4	13²
	Ismailia	74 war zone		19	69	8.7	12	16.5 war	22
Upper						[7.3]			
	Gizeh	109	6		139	10.4	5	41.8	5
	Beni-Suef	106	8		128	7.4	13²	43.4	2
N = 8	Fayoum	97	13		128	6.1	17	43.2	3
	Minya	103	9²		127	5.8	18²	40.8	7
	Assyout	98	12		119	6.2	16	41.1	6
	Souhag	88	15		101	10.3	6²	38.4	10²
	Kena	75	18		98	5.2	21	38.4	10²
	Aswan	132	2		140	6.3	15	33.9	19
Frontier						[2.3]			
	Red Sea	180	1		190	3.0	22	34.2	18
	El-Wadi El Gedid	107	7		117	1.9	24	44.5	1
	Matrouh	39	21	24	57	2.2	23	37.4	13²
	Sinai	11 war zone		15	57	1.8	25	1.3 war	
EGYPT		98			116	9.2		35.4	

Excluding Sinai, $X - \bar{X} = -44$

% economically active population (6 years & over) to the total population — CAPMAS 1976

1974 preliminary = 35.7
1975 preliminary = 36.0

Sources: MOH, 1973 (infant mortality); MOH, 1973 (crude birth rate)

REGION	GOVERNORATE	PERCENT ILLITERATE	Rank	FEMALE ILLITERACY %	PERCENT URBAN	Rank
Urban		35.7			100%	
	Cairo	34.6	23	35.8	100	1
	Alexandria	37.4	22	37.4	100	2
	Port Said	34.9	21	35.2	100	3
	Suez	44.4	20	42.9	100	4
Lower		59.4			26.8	
	Damietta	49.4	19	42.4	25.6	15
	Dakahlia	56.3	11	53.7	24.0	18
	Sharkia	62.6	9	57.2	20.2	24
	Kalyubia	53.7	14	49.6	40.9	10
	Kafr-El-Sheik	70.1	5	61.0	20.8	23
	Gharbia	54.9	13	52.8	33.4	12
	Menoufia	56.9	10	56.1	14.7	25
	Behera	66.2	8	58.7	26.8	14
	Ismailia	50.8	17	48.3	47.1	8
Upper		66.7			30.46	
	Gizeh	53.0	15	50.0	57.0	7
	Beni-Suef	64.0	7	60.6	24.9	16
	Fayoum	73.6	1	60.2	24.2	17
	Minya	70.1	4	60.4	21.0	22
	Assyut	68.6	6	60.8	27.7	13
	Souhag	72.8	2	63.9	21.1	21
	Kena	71.2	3	62.4	22.9	19[1/2]
	Asswan	56.0	12	53.9	37.0	11
Frontier		60.9 / 41.4*			51.7	
	Red Sea	31.2	25	41.0	84.9	6
	El Wadi-El Gedid	32.9	24	47.7	22.9	19[1/2]
	Matrouh	50.9	16	58.6	45.3	9
	Sinai ([illegible])	49.6	18	61.4	100	5
EGYPT		56.5		71.0	43.9	
		* my calculation Age 10 and above CAPMAS 1976 Table 20		Male = 43.2 NOTE: These figures [illegible] % illiterate because illiterate figures are for age 10+, while pop. totals [illegible]	Calculated from CAPMAS 1976 figures	Table 12 pp [illegible]

REGION	GOVERNORATE	1 HOUSEHOLDS WITH ELECTRICITY (%)		2	3 HOUSEHOLDS W/O PURIFIED DRINKING WATER (%)		4	5 HOUSEHOLDS WITH PURIFIED WATER TAP IN DWELLING (%)		6 HOUSEHOLDS WITH (5) OR TAP INSIDE BUILDING (%)	
Urban		84.4			1.4			72.5		83.1	
	Cairo	82.1	3		1.6	20		70.1	3	80.7	3
	Alexandria	89.6	1		1.2	22		77.8	2	89.6	1
	Port Said	89.3	2		2.0	19		83.8	1	86.9	2
	Suez	78.6	4		1.3	21		54.4	4	64.9	4
Lower		38.1			26.7			19.3		22.4	
	Damietta	60.8	6		2.4	18		45.1	5	49.6	5
	Dakhalia	34.0	13		16.6	16		25.1	8	28.8	8
	Sharkia	30.0	15		30.4	11		14.5	13	16.2	15
	Kalyubia	55.5	7		38.5	8		16.2	12	19.8	12
	Kafr-El-Sheik	23.2	16		23.2	14		14.1	14	16.9	13
	Gharbia	43.7	9		21.3	15		24.2	9	28.5	9
	Menufia	39.0	10		41.3	6		4.8	18	12.5	18
	Behera	33.3	14		25.0	13		17.5	11	20.0	11
	Ismailia	44.3	8		44.5	4		27.2	7	29.9	7
Upper		29.3			38.3			15.2		15.6	
	Giza	63.1	5		41.6	5		33.5	6	39.7	6
	Beni-Suef	21.0	19		26.8	12		4.6	19	14.6	21
	Fayoum	21.5	18		8.0	17		4.6	19	12.2	19
	Minya	19.8	21		40.4	7		9.0	21	11.4	22
	Assyiut	23.2	16		37.3	9		13.0	15	16.8	14
	Sohag	16.0	22		47.3	3		10.0	16	13.7	17
	Kena	20.2	20		51.8	2		9.9	17	12.3	20
	Asswan	38.0	11		32.9	10		20.0	10	21.8	10
Frontier	Red Sea	37.3	12		57.3	1		14.8		16.1	16
	El wadi El Gedid										
	Matrouh										
	Sinai (liberated)										
EGYPT		45.7			25.2			30.2		35.1	
		CAPMAS, 1976 Table 23 p. 52			CAPMAS, 1976 Table 24 p. 54			CAPMAS 1976 Table 25 p. 54		Calculated from CAPMAS 1976 Table 25 p. 54	

OF SELECTED VARIABLES, BY GOVERNORATE

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	MEAN	VARIANCE	STANDARD DEVIATION	conditions
INFANT MORTALITY				
a) 1973 data (MOH)	94.1	884.9	30.4	minus Sinai
	91.9	503.7	22.9	minus 4 Frontier governorates
b) 1972 data (CAPMAS)	109.1	1142.4	34.5	minus Sinai
WOMEN IN THE PAID LABOR FORCE (CAPMAS, 1976 Table 18, p.47)	8.0	13.4	3.7	minus Sinai
CRUDE BIRTH RATE (1973 data, MOH)	34.2	123.5	11.4	minus Sinai
PERCENT ILLITERATE (CAPMAS, 1976 Table 20, p.49)	57.7	138.9	12.1	minus 4 Frontier governorates
PERCENT FEMALE ILLITERATE (CAPMAS, 1976)* *age 10 yrs +	52.1	77.9	9.0	minus Sinai
PERCENT URBAN (CAPMAS, 1976 Table 12, pp.36-8)	43.6	884.2	29.7	minus Sinai
PERCENT HOUSEHOLDS WITH ELECRICITY (CAPMAS, 1976 Table 23, p.52)	44.2	556.6	24.4	minus 4 Frontier governorates
PERCENT HOUSEHOLDS w/o PURIFIED DRINING WATER (CAPMAS, 1976 Table 25, p.54)	25.49	280.4	17.2	minus 4 Frontier governorates

(over)

	MEAN	VARIANCE	STANDARD DEVIATION	conditions
PERCENT HOUSEHOLDS WITH PURIFIED DRINKING WATER: TAP IN DWELLING (CAPMAS, 1976 Table 25, p.54)	28.6	553.8	24.1	minus 4 Frontier governorates
PERCENT HOUSEHOLDS WITH PURIFIED DRINKING WATER: TAP IN DWELLING OR INSIDE BUILDING (CAPMAS, 1976 Table 25, p.54)	32.6	648.4	26.1	minus 4 Frontier governorates

DRAFT

Attachment B: Health Care Delivery Systems

Progress Report on Correlation and Regression Analysis of Egyptian Health Care Data

Submitted by George Ropes, August 23,1977

The results obtained from John O. Field's correlation analysis of data provided by CAPMAS and the Ministry of Health (see JOF memorandum of July 19,1977) prompted further analysis of those data. Accordingly, at Prof. Field's request I have been engaged for the past several weeks in submitting the data to more complex statistical scrutiny, utilizing MIT's excellent computer facilities. I employed the Statistical Package for the Social Sciences (SPSS).

The data were punched on IBM cards and entered into the computer. Each governorate was considered a case. Sinai was excluded from all calculations, on the grounds that it was anomalous in several respects. There were thus 24 cases. Data were available on a total of eleven variables:

1) Infant Mortality Rate 1973 (Mort73)
2) Infant Mortality Rate 1972 (Mort72)
3) Percent Women in the Paid Labor Force (Pdlabor)
4) Crude Birth Rate (Birth)
5) Percent Total Illiteracy (Totillit)
6) Percent Female Illiteracy (Femillit)
7) Percent Urban (Urban)
8) Percent Households with Electricity (Elec)
9) Percent Households without Pure Water (Nowater)
10) Percent Households with Pure Water in the Dwelling (Watrdwel)
11) Percent Households with Pure Water in the Building (watrbldg)

Twenty-one cases had values for all eleven variables. The Frontier governorates were missing values for Variables 8-11.

The first procedure followed was to reconfirm and extend Prof. Field's correlation computations, employing somewhat refined data. (Female illiteracy rates were recalculated from the CAPMAS data, as were total illiteracy rates for the Frontier governorates.) Means and standard deviations were obtained for all variables. Pearson correlation coefficients were obtained for Mort73 and Mort72 against all the other variables, both for Egypt as a whole, and for the various regions. See the appended table for a summary of the significant correlations. The aggregate data for All Egypt is shown to be masking significant relationships that only become apparent when the data are disaggregated.

Scattergrams were also produced for Mort73, Mort72, and Birth, against all other variables, in order to provide a visual representation of the distribution of the data. These plots tended to confirm the observation that the regions were distinctly different.

Multiple regression is a statistical technique which indicates the combined effect that several independent variables may have in explaining the variance in a given dependent variable. Regression may be used either descriptively or inferentially to predict values from an observed sample. In this case, we were primarily concerned with describing the relationships among our set of demographic and developmental variables. Three different dependent variables were examined: Mort73, Mort72, and Birth.

A large number of computer runs were made, for Egypt as a whole and different regions separately and together, in order to clarify as much as possible our understanding of the interactions among the variables.

In our first runs, four variations were tested, involving all combinations of Totillit and Femillit, and Watrdwel and Watrbldg. The combination of Totillit and Watrbldg proved to be the most descriptive of the four possibilities.

In the course of our proceedings, we became concerned that our R^2 values were being artificially inflated by multi-colinearity among the independent variables. Therefore, each independent variable was successively regressed against all the other independent variables. High F values for these equations were taken to indicate multicolinearity. On the basis of these runs and an examination of the individual F values for the variables in these equations, Elec and Watrbldg were excluded from the final series of runs. The independent variables which were included were: Pdlabor,Birth,Totillit,Urban,Nowater. Parameters were established which caused only those variables which were significant at the 0.1 level and which had at least 25% of their variance not explained by the variables already in the equation to be entered. A summary of results is appended.

Residual plots were also generated. No glaring problems were evident from an examination of these plots.

Discussion:

Substatively, the relationships elucidated by this exercise are extremely informative.

The first point worth of note is the importance, even necessity, of disaggregating the data. Egypt cannot be treated as a single entity if the factors affecting infant mortality in the various regions of the country are to be understood.

Second, the importance of collecting complete and accurate data is underlined. The differences between the results for Mort73 and Mort72 highlight this point. Given good data, one would expect less variability in the relationships from year to year, and from region to region.

Third, it is apparent that development is not, at least directly, the path to reduced infant mortality. For example, total illiteracy alone has little effect on infant mortality (All Egypt: R^2=.05, F=2.27 n.s.). Female illiteracy has even less impact (R^2= -.01, F=0.63 n.s.). Reducing the crude birth rate likewise has only limited impact (Urban/Lower/Upper: R^2=.23, F=7.18). When both are entered, however, Totillit and Birth together account for 50% of the observed variance in Mort73 rates. Most of Totillit's impact on Mort73 is thus indirect, through the Birth variable. Further path analysis of this type will be pursued.

Correlations: MORT73

Region	Significant at .01	Significant at .05
All Egypt	-----	Birth
Urban Lower Upper	Birth	-----
Urban Lower	-----	Birth
Lower Upper	-----	-----
Urban	-----	Birth
Lower	-----	-----
Upper	-----	Totillit Femillit
Frontier	-----	Femillit

Correlations: MORT72

Region	Significant at .01	Significant at .05
All Egypt	Birth	-----
Urban Lower Upper	Birth	-----
Urban Lower	-----	Birth
Lower Upper	Birth	-----
Urban	-----	Birth
Lower	-----	-----
Upper	-----	Totillit Femillit Urban Elec
Frontier	-----	Femillit

MORT73

Urban[1] Lower Upper	Mort73 = 104.778 + 1.827 Birth − 1.283 Totillit (4.663)[c] (3.320)[b]	[R^2=.50, F=10.99 (.001)]
Urban[2] Lower	Mort73 = 148.438 + 1.721 Birth − 2.415 Totillit + 0.688 Nowater (5.987)[c] (5.817)[c] (2.706)[a]	[R^2=.80, F =17.21 (.001)]
Lower[3] Upper	No variables entered at 0.1 level (F)	
Lower[4]	No variables entered at 0.1 level (F)	
Upper[5]	Mort73 = 202.833 − 1.526 Totillit (2.549)[a]	[R^2=.43, F=6.49 (.05)]

Lower[6] Upper Frontier	Mort73 = 205.015 − 1.782 Totillit (2.942)[b]	[R^2=.28, F=8.66 (.01)]

1: 21 cases
2: 13 cases
3: 17 cases
4: 9 cases
5: 8 cases
6: 20 cases

Student t statistic in parentheses (DF=N-k-1) (two-tailed)

a = .05
b = .01
c = .001

MORT72

Group	Equation	Fit
Urban[1] Lower Upper	Mort72 = −34.076 + 3.140 Birth + 0.850 Urban (6.032)[c] (4.122)[c]	[R^2=.63, F=18.42 (.001)]
Urban[2] Lower	Mort72 = −85.122 + 3.337 Birth + 1.288 Urban + 1.025 Nowater (6.601)[c] (5.441)[c] (2.770)[a]	[R^2=.78, F =15.53 (.001)]
Lower[3] Upper	Mort72 = −38.401 + 3.044 Birth + 1.140 Urban (3.783)[b] (2.437)[a]	[R^2=.46, F=7.93 (.005)]
Lower[4]	No variables entered at 0.1 level (F)	
Upper[5]	Mort72 = 249.808 − 1.532 Totillit − 0.700 Nowater (4.275)[b] (3.408)[a]	[R^2=.78, F=13.42 (.01)]

Group	Equation	Fit
Lower[6] Upper Frontier	Mort72 = −42.108 + 1.252 Urban + 2.982 Birth (3.375)[b] (2.941)[b]	[R^2=.40, F=7.57 (.005)]

1: 21 cases
2: 13 cases
3: 17 cases
4: 9 cases
5: 8 cases
6: 20 cases

Student t statistic in parentheses (DF=N-k-1) (two-tailed)

a = .05
b = .01
c = .001

BIRTH (with MORT73)

Urban[1]
Lower
Upper

Birth = 23.272 - 0.286 Urban + 0.243 Mort73 [R^2=.76, F=34.28 (.001)]
(6.693)[c] (4.358)[c]

Urban[2]
Lower

Birth = 14.647 - 0.355 Urban + o.332 Mort73 - 0.266 Nowater + 0.920 Pdlabor
(7.651)[c] (6.665)[c] (2.635)[a] (2.432)[a] [R^2=.90, F =29.8((.001)]

Lower[3]
Upper

No variables entered at 0.1 level (F)

Lower[4]

No variables entered at 0.1 level (F)

Upper[5]

No variables entered at 0.1 level (F)

Lower[6]
Upper
Frontier

No variables entered at 0.1 level (F)

t statistic in parentheses (two-tailed)

a = .05
b = .01
c = .001

1: 21 cases
2: 13 cases
3: 17 cases
4: 9 cases
5: 8 cases
6: 20 cases

BIRTH (with MORT72)

Urban[1] Lower Upper	Birth = 22.573 − 0.280 Urban + 0.213 Mort72 (7.950)[c] (6.032)[c]	[R^2=.84, F=54.63 (.001)]
Urban[2] Lower	Birth = 29.386 − 0.376 Urban + 0.248 Mort72 − 0.275 Nowater (7.982)[c] (6.601)[c] (2.680)[a]	[R^2=.90, F=38.16 (.001)]
Lower[3] Upper	Birth = 27.815 + 0.166 Mort72 − 0.285 Urban (3.783)[b] (2.697)[a]	[R^2=.49, F=8.93 (.005)]
Lower[4]	Birth = 33.754 − 0.480 Urban + 0.159 Mort72 (2.805)[a] (2.667)[a]	[R^2=.60, F=7.23 (.05)]
Upper[5]	No variables entered at 0.1 level (F)	

Lower[6] Upper Frontier	No variables entered at 0.1 level (F)

t statistic in parenthesis (two-tailed)
a = .05
b = .01
c = .001

1: 21 cases
2: 13 cases
3: 17 cases
4: 9 cases
5: 8 cases
6: 20 cases

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MEMORANDUM

TO: Shafica Nasser
Mervat El-Rafie
Salah Shahbandar

FROM: John Field

DATE: August 18, 1977

EXPLAINING INFANT MORTALITY AND THE CRUDE BIRTH RATE IN EGYPT: SOME INITIAL REGRESSIONS

This is an interim report on a regression analysis of Egyptian data performed by George Ropes and myself in late July and early August, 1977. Our objective has been to see how much we can learn about the dynamics of infant mortality and the crude birth rate in Egypt from a restricted, if theoretically relevant, body of data organized at the governorate level. The analysis is still in progress, with our current findings (reported here) being tested for possible violation of the assumptions underlying linear regression. Vital additional data will be introduced as they become available. Caution in interpretation is warranted on both counts. On the other hand, the findings so far are sufficiently striking to justify "early" sharing with our colleagues in the Health Care Delivery Systems Project.

Background

The present work is a spin-off from the correlations calculated by hand and discussed in my memo of July 19, 1977. Two things emerged from that effort. First, infant mortality in Egypt appears to be very weakly (and insignificantly) correlated with various types of development despite all sorts of theoretical reasons for expecting the opposite. Second, infant mortality appears to be positively (and significantly) correlated with the crude birth rate. The inference drawn was that development, variously conceived, has little impact on mortality but that mortality probably does influence fertility quite strongly while being itself influenced by fertility in turn.

The Analysis

Regression analysis permits identification of those variables that have an independent influence on the dependent variable while taking other selected variables into account. It also permits specification of the degree of influence exerted by each variable in the equation and at what level of confidence. Finally, it permits a test of significance for the equation as a whole, and it indicates how much of the total variation in the dependent variable is being "explained" by the variables in the equation. All this is pretty heady stuff, particularly when the results are as impressive as ours seem, at first glance, to be.

Regressions were run with infant mortality in 1973, infant mortality in 1972, and the crude birth rate in 1973 serving as the dependent variables. Independent (i.e., causal) variables include the percentage of each governorate's population that is urban; the percentage illiterate (total and female); the proportion of women in the paid labor force; the percentage of households with electricity; and the proportion of households lacking access to purified drinking water, having purified water in the dwelling, or having it at least in the same building. Regressions were run for Egypt as a whole (minus the four Frontier governorates for lack of data) and regionally comparing Upper and Lower Egypt, the latter including and then excluding the four urban governorates of Cairo, Alexandria, Port Said, and Suez.

A quick caveat is in order. Of necessity we are trying to explain 1972 and 1973 "effects" by reference to 1976 "causes". The mortality and birth data precede the development data in time, although the latter are said to "cause" the former. This is not as preposterous as it sounds if one assumes - as we must - that distributions in 1976 reflect realities in 1972-3 or even earlier as well.

Findings

Table 1 shows the "best model" explaining infant mortality in 1973. Beta weights, i.e., standardized regression coefficients, are given for each variable. This model, and those in succeeding tables, were generated by step-wise regression, with the computer entering variables in descending order of significance to a limit of .05.

Several things stand out in this table. First, only two of seven possible variables - birth and % illiterate - emerge as having an independent and significant influence on mortality. The rest are either redundant, insignificant, or both. Illiteracy is, in fact, strongly intercorrelated with urbanity, electrification, and purified water (suggesting a markedly skewed pattern of development in Egypt). With illiteracy "entered" into the model, none of these other correlates is a sufficiently independent influence to justify inclusion. The variables which best explain variation in infant mortality - as revealed in these data - are the birth rate and illiteracy, the latter simply being the strongest developmental influence.

Table 1: Infant Mortality in 1973 - Egypt (minus Frontier)

MORT73 = 0.947 BIRTH - 0.674 TOTILLIT

Sig.	.01	.01

Equation sig.: .001 (F = 10.99)
Adjusted R^2 : .500

MORT73 = infant mortality in 1973
BIRTH = crude birth rate
TOTILLIT = total illiteracy (%)

Second, whereas the influence of the birth rate is in the predicted direction, that of illiteracy is not. Higher birth rates are conducive to higher mortality rates. This is either a function of more complete reporting of both phenomena in some governorates as against others, or it is a function of the oft-noted tendency for later children to be especially vulnerable to malnutrition, disease, and resulting mortality. Whichever, the beta indicates that 99 times out of 100, a 1% increase (or decrease) in the birth rate will - on the average - produce almost the same change (.9%) in the rate of infant mortality when the effects of illiteracy are held constant. By comparison, the impact of illiteracy is both weaker and inverse, although still highly significant. A 1% decrease in illiteracy will actually <u>increase</u> the incidence of infant mortality by an average of .67% when the effects of the birth rate are taken into account. We shall see this pattern repeated for mortality in 1972.

Third, not only is the equation as a whole significant at .001, it explains a remarkable 50% of the total variation in infant mortality in 1973. That is, two variables - the birth rate and the prevalence of illiteracy - by themselves and in relation to each other - account for half of the variation observed in infant mortality from one governorate to another! Such power from such parsimony is rare.

In sum, we can assert with considerable confidence that infant mortality in 1973 was influenced principally by the birth rate that year, and, to a somewhat lesser extent, by the degree of illiteracy. Other factors were also at work - we simply did not have measures of them, whatever they are; but we can say that several prominent variables available to us failed to show an independent influence. With birth and illiteracy rates known, urbanity, electrification, the absence or presence of purified water, and the like have very little explanatory power of their own. It is even conceivable that, had data for birth rates been a year or two earlier than those for infant mortality, the impact would be greater still.

Table 2 shows the "best model" explaining infant mortality in 1972. A number of similarities and differences are apparent.

Table 2: Infant Mortality in 1972 - Egypt (minus Frontier)

MORT72 = 1.291 BIRTH + 1.679 URBAN - 1.414 WATRBLDG - 0.615 TOTILLIT

	BIRTH	URBAN	WATRBLDG	TOTILLIT
Sig.	.01	.01	.01	.01

Equation Sig.: .001 ($F = 24.52$)
Adjusted R^2 : .824

MORT72 = infant mortality in 1972
BIRTH = crude birth rate
URBAN = urban population (%)
WATRBLDG = households with purified drinking water in the same building (%)
TOTILLIT = total illiteracy (%)

Principle among the differences is the fact that four independent variables enter the equation, each significant unto itself and each able to improve significantly the total equation's adjusted R^2 as well. That three of the four are stronly intercorrelated measures of development (Urban:Watrbldg, .93; Urban:Totillit, .85; Watrbldg:Totillit, .90) does not - in this instance - obviate their having apparently independent effects. Development, it would seem, comes in different guises and with different implications.

A second difference of note is that the causal strength of the constituent variables in the model is generally greater than before. This reflects both the added number of variables in the model and, presumably, differences in the mortality data for the two years. A 1% decrease (increase) in the birth rate may now be expected to result in an average decrease (increase) in infant mortality of 1.3%, holding the rest of the model constant. Purified water has about the same impact (1%: - 1.4%) inversely. Surprisingly, urbanization emerges as a negative influence. Under the conditions specified in the model, a 1% increase in the urban population yields an increment of infant mortality by a substantial average of 1.7% - evidence once again that some economic development actually accentuates human deprivation. The weaker influence of illiteracy (1%: -.62%) is similar to what it was for mortality in 1973, and again it is inverse. Marginal improvements in literacy will actually add to the mortality rate when the effects of birth rate, urbanity, and purified water are held constant.

The final difference worth mention is that this more complete model improves our explanation for variation in infant mortality. Whereas with the 1973 data we were able to account for "only" 50% of the infant mortality in Egypt, the 1972 data enables us to account for fully 82% of the variation. Only 18% of the variation is not explained by our model, an incredibly low figure when it is realized that this model contains no measures of health services and health status, two fairly direct influences on survival.

In the main, the two models are quite similar in their message. Infant mortality is highly conditioned by the crude birth rate; and development - when represented by heightened literacy or by urbanization - can make the problem worse even while the expansion of purified water to more and more households makes it better. Clearly, different types of development dispose in different directions so far as infant mortality is concerned. The net effect of development may well be felt in its significance for fertility. This effect is shown in Table 3.

Table 3: The Crude Birth Rate in 1973 - Egypt (minus Frontier)

a) With infant mortality in 1973 as candidate for entry...

BIRTH = - 0.721 URBAN + 0.470 MORT73
Sig. .01 .01

Equation sig.: .001 (F = 34.28)
Adjusted R^2 : .769

b) With infant mortality in 1972 as a candidate for entry...

BIRTH = -1.253 URBAN + 0.592 MORT72 + 1.034 WATRBLDG + 0.482 FEMILLIT
Sig. .01 .01 .01 .01

Equation sig.: .001 (F = 58.95)
Adjusted R^2 : .921

BIRTH = crude birth rate
URBAN = urban population (%)
MORT73 = infant mortality in 1973
MORT72 = infant mortality in 1972
WATRBLDG = households with purified drinking water in the same same building (%)
FEMILLIT - female illiteracy

At a glance it is apparent that these models accounting for the crude birth rate are remarkably similar to those accounting for infant mortality. The number and type of variables are the same in each instance, depending on whether one uses mortality data for 1973 or 1972. The overall explanatory power of birth rate models is even greater.

Just as the birth rate has a significant influence on infant mortality, infant mortality has a significant influence on the birth rate. This is an interaction which I suspect is of profound substantive importance, an interaction conditioning the effects (on mortality and fertility) of just about everything else going on in Egypt. Additional work is needed to pursue this notion. Suffice it here to note simply that as mortality increases (decreases) by 1% the birth rate will increase (decrease) by roughly 1/2% when other changes are held constant.

Urbanization, seemingly a foe of reduced infant mortality in Table 2, returns as a friend in Table 3 through its negative influence on the birth rate, which in turn varies positively with mortality. Urbanization consistently diminishes fertility on about a 1%:1% basis, with mortality and other influences partialled. Whether urbanization is, on balance, a positive or negative influence on infant mortality cannot be established on the basis of the analysis to date.

Ambiguity returns again in the second equation of Table 3. Purified water, an effective antidote to infant mortality (1972 data), is a positive influence on fertility. The more water, the more births; and the more births, the more mortality even though more water also means, directly, lessened mortality. The two edges of development are apparent once again.

Similarly, illiteracy among women means higher birth rates, which is what one would expect. However, improved literacy in general has a negative effect on infant mortality (Table 2), which is not what one would expect. Again, the Egyptian situation suggests powerful cross-pressures. Perhaps path analysis can sort out the conflicting tendencies evident in the data.

In the midst of all this confusion, two rather formidable figures stand out. Urbanity and mortality (1973) alone account for 3/4ths of the variation in the birth rate from governorate to governorate. Urbanity and mortality (1972), along with purified water and female illiteracy, account for fully 92% of the variation in fertility. These equations display an explanatory virtuosity rarely seen in cross-sectional analysis.

Regional variation is evident in the data and not merely with regard to levels of mortality, fertility, and the like. The dynamics are different, too, if one can believe regressions in which the number of governorates is quite small (N=13 for Lower Egypt, including the four urban governorates of Cairo, Alexandria, Port Said, and Suez; N=8 for Upper Egypt).

Perhaps the most striking difference between Lower/Urban Egypt when infant mortality is the dependent variable, is the failure of the birth rate to enter the equations for Upper Egypt as against being the first to do so for Lower/Urban Egypt. By the same token, with birth rates as the dependent variable mortality emerges as a strong influence in Lower/Urban Egypt but not in Upper Egypt. The message would seem to be that the mortality-fertility dynamic noted consistently at the national level is pretty much a product of circumstances in Lower/Urban Egypt. In Upper Egypt mortality is most influenced by literacy and the availability of purified water, two aspects of "disseminated development", while variation in the birth rate there is not adequately explained by any of the variables currently in the file.

The only other observation worth making is that for Lower Egypt alone without the four urban governorates, only one model is significant: Urbanity (Beta = -.620) and infant mortality 1972 (Beta = +.590) explain 61% of the variation in the crude birth rate [F = 7.23 (.05)]. Further investigation of the dynamics operating in Lower Egypt are indicated.

Table 4 summarizes the regional findings for infant mortality, and Table 5 does so for the crude birth rate.

Table 4: Infant Mortality by Region

	Lower/Urban Egypt (Sig.)	Upper Egypt (Sig.)
MORT73 =	1.104 (.01) BIRTH	-0.721 (.025) TOTILLIT
	-1.261 (.01) TOTILLIT	
	-1.426 (.01) WATRBLDG	
	1.019 (.01) URBAN	
Equation Sig.:	.001 (F=41.68)	.05 (F = 6.49)
Adjusted R^2 :	.931	.439
MORT72 =	1.357 (.01) BIRTH	-0.763 (.01) TOTILLIT
	1.359 (.01) URBAN	-0.608 (.01) NOWATER
	0.504 (.025) NOWATER	
Equation sig.:	.001 (F=15.53)	.01 (F=13.42)
Adjusted R^2 :	.784	.780

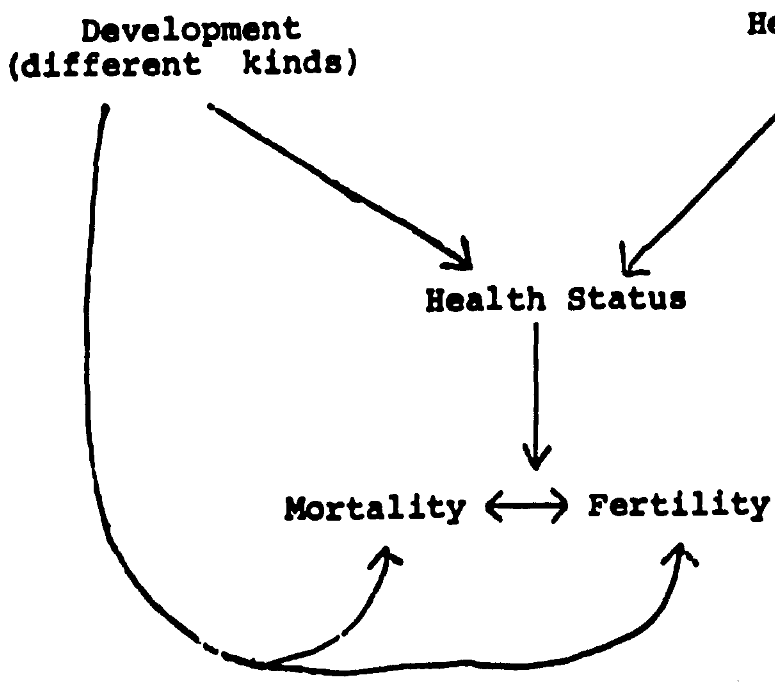
NOWATER = households lacking access to pruified drinking water (%)

Table 5: The Crude Birth Rate by Region

	Lower/Urban Egypt (Sig.)	Upper Egypt
BIRTH =	-0.921 (.01) URBAN	
	0.616 (.01) MORT73	
	-0.321 (.025) NOWATER	
	0.221 (.025) PDLABOR	
Equation Sig.:	.001 (F=29.80)	
Adjusted R^2 :	.906	
BIRTH =	-0.974 (.01) URBAN	
	0.611 (.01) MORT72	
	-0.332 (.025) NOWATER	
Equation Sig.:	.001 (F=38.17)	
Adjusted R^2 :	.903	

The Next Step

At the same time that we are testing the equations already produced for statistical flaws, we need to add new variables in order to enrich the theoretical value of our models. As discussed in our meetings this week, it would be desirable to have measures both of health services (average population per health center or unit, for example) and of health status (extent of gastroenteritis, schistosomiasis, and the like) at the governorate level. We could then explore the following sets of relationships - an exciting prospect.



+ = positive causal relationship

- = inverse causal relationship

cc: George Ropes
Eckaus/Taylor
Nevin Scrimshaw
Joe Wray
Almotaz Mobarak
Mostafa Hammamy
Abdel Monem Fouad
Nabil Nasar
Wafitz Hassouna