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ABSTRACT

This interim report of the Yale Project describes the progress made on the nutrition and growth study of Tunisian children from September 1, 1972 through February 28, 1973. A major part of the report is devoted to the organizational and data collection problems of the longitudinal study, discussed under the following categories: biomedics, sociology, psychology, and nutrition. Some preliminary results are included at the end of the report, which indicate that a combination of medical care and nutrition does have notable influence on sensory motor abilities and mental test scores, even by the age of 12 months. In addition, when the raw scores of the longitudinal study were converted into standardized scores, the mental scores of Tunisian underprivileged children were slightly higher than the American norm, while their motor scores were slightly lower. (CS)

NUTRITION AND CHILD GROWTH AND DEVELOPMENT IN TUNISIA

Interim Progress Report
September 1, 1972 - February 28, 1973

Tunis
March 31, 1973

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I. Pertinent Data

A. Title of Research: Nutrition and Child Growth and Development in Tunisia

B. Agreement No.: 07-001, Public Law 480 Section 104 (b) (3)

C. Parties to the Agreement:

(1) The United States Government as represented by the National Institutes of Health, DHEW, Bethesda, Maryland 20014, U.S.A.

(2) Tunisian Ministry of Public Health, Tunis, Tunisia

D. Collaborating Institutions:

(1) Tunisian National Institute of Nutrition and Food Technology

(2) Tunisian National Institute of Child Health

E. Co-Principal Investigators:

(1) Dr. Bechir Hamza, Director, National Institute of Child Health, Tunisia

(2) Dr. Zouhair Kallal, Director, National Institute of Nutrition and Food Technology, Tunisia

(3) Dr. Harben Boutourline Young, Associate Professor of Clinical Pediatrics and Public Health, and Director of Yale University Medical and Social Sciences Research Unit, 8 Rue de Nigeria, Tunis, Tunisia

F. This Report Prepared By:

Harben Boutourline Young, M.D.

G. Distribution of this Report:

(1) National Institute of Child Health and Child Development, U.S. Department of Health, Education and Welfare.

(2) The Grant Foundation of New York, for the four-year grant to Yale University, as well as previous years of support.

(3) The Swedish International Development Authority, for providing the services of Miss Kerstin Almrin, Chief of the Nutrition Section.

(4) UNICEF, for providing the entire quantity of "superamine" (valued at $12,000) needed for the three-year duration of the study.

(5) CARE-MEDICO Foundation, for providing cereals, oil and low-fat dry milk.

(6) U.S.A.I.D./Tunis, for financial and logistical support in previous years of the cross-sectional study of approximately 8,000 males and females from birth to 16 years. This study was completed on June 30, 1972 but the data is still being analysed.

(7) National Center of Health Statistics, U.S. Department of Health, Education and Welfare, for financial support in previous years of the cross-sectional study referred to above.

(8) U.S. Peace Corps/Tunis, for providing some needed personnel.

(9) Dr. Charles D. Cook, Project Officer, and Chairman of Department of Pediatrics, Yale University School of Medicine.

(10) Dr. Bechir Hamza, Director, Tunisian National Institute of Child Health.

(11) Dr. Zouhair Kallal, Director, Tunisian National Institute of Nutrition and Food Technology.

(12) The Fogarty International Center, National Institutes of Health: Dr. Morris Jones.

II. Introductory Note

This report presents some preliminary results in analysis of the Cross Sectional Study and also in the present Longitudinal Study. In the Longitudinal Study observations upon the children at 12 months were completed on March 16. Therefore we are happy to be able to present some preliminary reports at 12 months, just two weeks after data collection was terminated at this age. This work has been done by desk computer, therefore the variables are limited, although we believe well chosen.

III. The Longitudinal Study

A. Design in Detail

The original design approved by Study Section and NICHD was of five groups of small children from impoverished social groups in five different "poor" areas of the City of Tunis. The study was exclusively urban and interventional in nature in order to test hypotheses deriving from the cross-sectional study.

These hypotheses were as follows:

1. Malnutrition, synergistic with infection, contributes in large part to the demonstrated gross social class differences in mental and physical growth and physical health.

2. Cultural malnutrition (see cross-sectional study) as represented by parent-child interaction and other socio-cultural factors play a part to be measured in the above differences.

It was important that ethnic and possible genetic differences should be taken into account.

In the two-year period between approval by Study Section and funding, a good deal of thought was given as to how the design might be improved. The few large scale longitudinal studies of this kind do not effectively randomise subjects amongst areas but it was felt important to do this. The experiment was not taking place in an institutional or other easily controlled environment but in a natural situation.

The interventional factors were nutritional supplements of three types and pediatric care. A control group, not in contact with physicians of the research, would depend upon Tunisian local resources, both socio-cultural and medical.

An initial problem in the improved design was that of randomization. This was possible and was effected in four areas (with 3 types of supplementation but 4 groups, as one of the "local product" supplementation groups would move up to a low cost effective North African weaning food at approximately one year after first supplementation). In each of these four impoverished areas there are now approximately 25% of each of the four supplemented groups. All have received pediatric care. What was not possible in a human experiment was

randomization of Group 5 amongst the four areas. This would have meant attendance of Group 5 (receiving pediatric care but no supplementation) at the same centers where their neighbours and perhaps relatives were receiving both benefits. Accomodation is hard to find in these areas and a doubling of centers (apart from cost) was not feasible. Therefore, for reasons which were not only humane but also sprang from common sense, it was decided to concentrated Group 5 in one of the impoverished areas and to encourage the sociological section to convince the research group that no substantial socioeconomic differences existed between the areas. This was the assumption of the initial staff sociologist and subsequently also a senior sociologist from that Department of the University of Tunis. Apart from this, to return to the matter of common sense, it is clear that resentments and hostilities engendered by obviously different treatments in the same centers would have interfered more with the good conduct of the work than the necessary risk which was taken.

Group 6 (receiving neither medical care nor supplementation) was randomized through the five areas. A few extra subjects in Group 6 were brought into the Group 5 area in the final two weeks of the intake (November 29, 1971 - March 23, 1972) but some of these were lost. In any case those who remain (about 15) have been tagged.

Thus the work began with about 600 subjects from poor families born in the three maternity centers (where 90% of such infants are now born) and examined between 24-72 hours of birth. The first 24 hours was avoided because of birth trauma and 72 hours as the limit imposed because many women leave the hospital even at 2 days.

The supplements (4 groups and 3 types of supplements) look alike and have the same texture. They are very different in composition as No. 1 is made of egg and milk with some sorghum, No. 2 is superamine (the North African UNICEF sponsored weaning food*, and No. 3 is from local cereals and pulses such as might be made by any impoverished mother for her child.

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*A mixture of cereals plus 10% skimmed milk and fortified with vitamins.

Thus the mothers and children do not have any idea of the nutritional value of their supplement nor do the observers at the central office know to which group a supplemented child may belong. Every effort is made to ensure that the observers do not know the identity of Groups 5 and 6.

It was planned that routine physical examinations would take place 4, 8, 12, 18, 24 and 30 months of age. Testing with the Bayley Scale would take place at 6, 12, 18, and 24 months of age, all at the central office.

Vaccinations with B.C.G. were carried out at birth and observations subsequently made for positive tuberculin reactions.

Inoculation against DTP and Polio was performed between 4 and 8 months.

Measles and German Measles vaccination is just being completed for all subjects. The Institute of Microbiology, University of Florence (Professors Davoli and Urbano) have cultured the measles virus and it has been found to be satisfactorily viable. This was important as we seemed to have fewer vaccination reactions than those described elsewhere.

As before, on-going pediatric care was afforded at the feeding centers or transportation arranged to the central office where such clinical care could be provided on days when there was no clinic. Records were kept and have been partially transformed into precoded morbidity forms.

B. Logistics

Losses in Group 6 are now available. A number of infants were never traced to their stated addresses and have not been taken into consideration.

Losses in Group 6 have been as follows:

Deaths	4
Change of residence outside the area	5
Refusal to participate	0
Eliminated for medical reasons . . .	4
Total Losses	13

C. Personnel

The total number is still just above 80.

The foreign national personnel are the same with the exception of Mr. Thomas Dahr, who will return to Sweden at the end of March. Arrangements have been made to transfer his duties in an orderly manner and Mr. Dahr has been most helpful. Programming in Tunis will be assumed by Mr. Bouktir (Tunisian) and a colleague (French). Programming too complex for a 54K machine will be handled in Pisa by Mr. Capelli under the direction of Dr. G. Tesi and participation by Dr. Young.

We regret greatly the departure for Paris (for personal reasons) of Madame Frances Burki Jumel. Those trained to take her place are doing an adequate job.

D. Notes on Sections

(1) Biomedics

Routine medical examinations are proceeding smoothly as also are the clinics for the care of sick children. Microelectrophoresis (Miss Kathy Thorn) commenced during the course of the 12 month examination and thus in addition to total plasma proteins we have albumin, globulin, the A/G ratio and the globulin fractions (Alpha 1, Alpha 2, Beta and Gamma).

One double hemoglobin is done each day by Mr. Dali and reliabilities on 35 doubles have been calculated as follows:

Mean Hb	Mean Diff.	Smeas	% Mean Value
10.9 g.%	0.35 g.%	0.29	2.7%

This is acceptable.

A chamber for thalassemia detection will be inserted in the electrophoresis system in the near future.

A further set of anthropometric reliabilities for males by Mr. Kamoun on repeat examinations by himself has now been analysed with the results shown on Table 1.

(2) Sociology

The entire questionnaire (previously pretested) has now been applied to more than half of the families.

The questionnaire to the father is applied by an experienced interviewer who has supervised a number of interviews with men conducted by the Sociology assistants. This reporter has attended some home interviews and has been impressed by the intelligence and empathy of the interviewer as well as by the frankness and clarity of replies to the individual questions.

The questionnaire to the mother and that which concerns both parents is applied by the sociology assistants in collaboration with the home visitors in Nutrition.

Those who have copies of the questionnaires may appreciate the dynamic issues which are explored. Of course, there are a number of questions related to social class and welfare which are routine and necessary.

(3) Psychology

Reliability A further 50 subjects examined by one tester under concealed observation by the other two testers gave a r = 1.0 on almost 80% of the subjects. The overall observed reliabilities appear to be acceptable.

The psychological team remains essentially the same, except that one voluntary worker (4th year University student in psychology) has come on the team as a half-time paid research assistant to replace Mlle. Micheleff (full-time) who resigned to pursue her studies in London.

Mrs. Rabhi, M.A. (Psychology) has written a first draft on mother-infant relationships within the research.

(4) Nutrition

The 10 home visitors of this section have been collaborating closely with the Sociological Section. Their close connection with the families has been of inestimable value in obtaining replies that are honest and sincere.

In the meantime, Nutrition Survey 7/4 (7 day survey of family expenditure on food) is well underway and is scheduled to be completed by April 30, 1973.

The almost 30% of new pregnancy incidence in the mothers of our 12 months old babies has raised obstacles to the attendance of the mothers at the feeding centers. An expectant mother in, say, the 6th month of pregnancy has difficulty in bringing by foot to the center our subject who cannot yet walk. To meet this situation a series of motivational meetings have been held and these have been well attended by the mothers. In addition food is being collected by other brothers and sisters and taken to their homes. Discreet enquiries of these siblings has failed to reveal a single case where the food was eaten by other than our subject.

Miss Almrin has compiled records of total food intake both individual (with variations) and by groups since supplementation began at 4 months of age. Secondary analysis by food intake will commence in the month of April. Total amounts eaten between 4 and 12 months of age by an individual child vary from more than 40 kg. to just a few kgs.

(5) Programming and Analysis

Reference has been made to the transfer of Tunis programming to Mr. Bouktir and his colleague.

As previously reported all available transverse data is now in Pisa and copies are also available in Tunis. The transverse study will be fully analysed in Pisa during the spring and summer.

Preliminary Results (Males Only)

Table 2 presents comparability of the groups at birth. There are no important group differences on the variables.

Table 3 presents comparability of the groups at 12 months on the Bayley Motor-Mental Scales. Although no differences are seen on the mental scales, in the motor area there are consistently higher group scores in all five experimental groups when each is compared with Control Group 6. These differences reach the 5% level of significance when Groups 1 and 5 are compared with Control Group 6. The results are most

encouraging and it is of interest to compare them with the results of the transverse study up to 12 months (Table 4). Here we see the first male differences between the privileged and the underprivileged appearing at 12 months. Therefore it would appear that a combination of medical care and nutrition do have notable influence upon sensory motor abilities even by the age of 12 months.

The motor score results correspond closely to those of the cross-sectional study (Table 4) and it would appear that almost half of the score differences between privileged and underprivileged has been made up.

The mental score results are a little lower than those of the cross-sectional study.

When the raw scores of the longitudinal study are converted into standardized scores it is seen that in the mental scale the Tunisian underprivileged is slightly higher than the American norm, while in the motor scale the Tunisian underprivileged is slightly lower. A more detailed discussion of this finding will be made after further analysis including the females.

We have chosen 3 somatic variables: body length, body weight and head circumference. There are no differences in respect of head circumference, although there are consistent group differences in body length and weight in favor of all experimental groups.

The results are presented in Table 5, and it is seen for body length that the 5% level of significance is reached in Groups 3, 4, and 5 respectively when they are compared with Group 6. Group 1 just falls short of the level.

When the results at 18 months become available it should be possible to calculate how long it may be before the variables regarded as most important will reach the 5% levels.

These first results are most interesting and provocative, therefore it is to be hoped that financial support may be obtained for the necessary third year in order to conclude the experiment, the results of

which may be not only of benefit to the Tunisian people but also to many others in developing countries.

IV. Addendum

Since the last annual report there are three further publications from the Tunis research. These are:

Emergence of Deciduous Teeth in Tunisian Children in Relation to Sex and Social Class
M. Bambach, R. Saracci and H. Boutourline Young
"Human Biology" (in press)

Relationships between Socio-Economic Conditions and Physical and Mental Growth and Health in a Developing Country in North Africa
H. Boutourline Young
Proceedings VI International Scientific Meeting, International Epidemiological Association, pp. 798-808
Savremena Administracija, Belgrade, 1973
Edited by A. Michael Davies

Social Class and Impairment of Growth and Health: The Tunisian Case
H. Boutourline Young
In Book "Whither Tunisia", Edited by J. Simmons and R. Stone (in press)

TABLE 1

ANTHROPOMETRIC RELIABILITIES*

12 MONTH EXAMINATIONS - 33 DOUBLES BY KAMOUN (Anthropometric)

	MEAN	MEAN DIFF.	Smeas	% MEAN VALUE
Arm Circumference	13.59	0.02	0.26	1.94
Calf Circumference	16.74	0.06	0.23	1.37
Chest Circumference I	43.86	0.05	0.22	0.51
Chest Circumference II	44.69	0.05	0.31	0.69
Head Circumference	44.52	0.05	0.21	0.47
Femur Bycondyle Diameter	4.82	0.01	0.10	2.12
Bi-Iliac Diameter	11.70	0.04	0.20	1.70
Head Bi-Parietal Diameter	12.14	0.02	0.05	0.38
Head Length Diameter	15.70	0.03	0.07	0.44
Chest Width Diameter	14.78	0.01	0.22	1.51
Chest Depth Diameter	12.60	0.05	0.20	1.59
Bideltoid Diameter	19.37	0.10	0.27	1.38
Biacromial Diameter	16.37	0.09	0.34	2.07
Skinfold Biceps	4.00	0.03	0.22	5.39
Skinfold Triceps	7.04	0.03	0.38	5.34
Skinfold Ext. Calf	9.30	0.12	0.35	3.81
Skinfold Int. Calf	9.83	0.01	0.42	4.26
Skinfold Supra-Iliac	6.33	0.04	0.32	5.11
Skinfold Subscap	6.10	0.14	0.26	4.19
Weight	8.35	0.001	0.01	0.12
Length	71.44	0.07	0.29	0.41
Crown Rump	46.01	0.09	0.23	0.51

*All measurements are expressed in cm. except the six skinfolds expressed in mm. and the weight in kg.

TABLE

COMPARABILITY OF GROUPS AT BIRTH (MALES)
6 SELECTED VARIABLES:
FARR CLINICAL, HEIGHT, WEIGHT,
HEAD CIRCUMFERENCE, NEUROLOGICAL, AGE*

VARIABLES		Farr Clinical (weeks gestation)	Height	Weight	Head Circumference	Neurological (weeks gestation)	A... (weeks
GROUP 1	Number	43	44	44	44	44	44
	Mean	40.3	49.7	3.058	34.2	39.5	36.8
GROUP 2	Number	44	43	43	43	44	44
	Mean	40.3	49.9	3.071	34.3	39.7	35.4
GROUP 3	Number	44	44	44	44	44	44
	Mean	39.9	49.0	3.084	34.5	39.6	40.0
GROUP 4	Number	44	44	44	44	44	44
	Mean	40.1	50.0	3.045	34.3	39.5	36.0
GROUP 5	Number	46	46	46	46	46	46
	Mean	40.3	49.9	3.054	34.2	39.7	36.8
GROUP 6	Number	42	42	42	42	42	42
	Mean	40.3	50.1	3.045	34.5	39.6	36.5

* The weights have been measured at approximately 36 hours and therefore are not newborn weights. According to the investigations ... should be added to weight to make it newborn.

TABLE

COMPARISON OF EXPERIMENTAL (GROUP 1 THROUGH 5) WITH CONTROL (GROUP 6) ON MALE INFANTS AT 12 MONTHS OF AGE

PSYCHOLOGICAL TESTS: BAYLEY MOTOR (RAW SCORES)

	Total	No.	Mean	SD	E - 6 "t"	E - - "p"
GROUP 1	1784	39	45.7	3.4	2.29	< .05
GROUP 2	1814	40	45.4	3.8	1.73	< .10 > .05
GROUP 3	1834	41	44.6	3.5	0.71	< .50 > .40
GROUP 4	1721	38	45.3	3.6	1.62	< .20 > .10
GROUP 5	1880	41	45.9	3.5	2.57	< .02
GROUP 6	1728	39	44.1	2.8		

PSYCHOLOGICAL TESTS: BAYLEY MENTAL (RAW SCORES)

	Total	No.	Mean	SD
GROUP 1	4004	39	102.7	9.7
GROUP 2	4128	40	103.2	4.2
GROUP 3	4222	41	103.0	4.0
GROUP 4	3928	38	103.4	5.1
GROUP 5	4276	41	104.1	3.8
GROUP 6	4036	39	103.5	4.8

TABLE (a)

BAYLEY TEST PERFORMANCE - MALES
2 - 12 MONTHS (RAW SCORES)

BAYLEY MOTOR

Class Description	No.	X	S.D.	t	p
2 Months					
Underprivileged	28	11.86	2.05	1.79	N.S.
Privileged	28	12.75	1.71		
4 Months					
Underprivileged	32	18.75	2.37	.02	N.S.
Privileged	31	18.74	2.19		
6 Months					
Underprivileged	34	26.68	2.13	1.67	N.S.
Privileged	34	27.62	2.62		
8 Months					
Underprivileged	31	36.77	4.06	.66	N.S.
Privileged	37	37.43	4.19		
10 Months					
Underprivileged	34	43.41	3.69	.41	N.S.
Privileged	40	43.13	2.24		
12 Months					
Underprivileged	33	44.85	3.98	2.34	$< .05$
Privileged	41	46.88	3.53		

TABLE (b)

BAYLEY TEST PERFORMANCE - MALES
2 - 12 MONTHS (RAW SCORES)

BAYLEY MENTAL

Class Description	No.	X	S.D.	t	p
2 Months					
Underprivileged	28	26.89	2.39	.74	N.S.
Privileged	28	27.50	3.72		
4 Months					
Underprivileged	32	47.94	4.20	.81	N.S.
Privileged	31	48.87	5.03		
6 Months					
Underprivileged	34	71.62	4.99	1.42	N.S.
Privileged	34	73.12	3.72		
8 Months					
Underprivileged	31	86.26	4.61	1.14	N.S.
Privileged	37	87.41	3.77		
10 Months					
Underprivileged	34	93.03	6.23	1.75	N.S.
Privileged	40	95.18	4.33		
12 Months					
Underprivileged	33	104.09	4.89	2.82	<.01
Privileged	41	107.63	5.85		

TABLE

COMPARISON OF EXPERIMENTAL (GROUP 1 THROUGH 5) WITH CONTROL (GROUP 6) INFANTS AT 12 MONTHS OF AGE

ANTHROPOMETRICS: BODY LENGTH, WEIGHT, AND HEAD CIRCUMFERENCE

E = experimental

HEIGHT (cm.)

	Total	No.	Mean	SD	E - 6"t"	E - 6 "p"
GROUP 1	30,601	42	72.9	2.5	1.98	<.10>.05
GROUP 2	30,511	42	72.6	2.9	1.29	<.20>.10
GROUP 3	30.739	42	73.2	2.7	2.18	<.05
GROUP 4	30.641	42	73.0	1.6	2.32	<.05
GROUP 5	31,450	43	73.1	2.1	2.20	<.05
GROUP 6	27,977	39	71.7	3.2		

WEIGHT (km.)

	Total	No.	Mean	SD	E - 6"t"	E - 6 "p"
GROUP 1	382,900	42	9.117	.990	1.09	<.30>.20
GROUP 2	384,225	42	9.148	1.350	1.03	<.40>.30
GROUP 3	387,580	42	9.223	1.150	1.45	<.20>.10
GROUP 4	381,570	42	9.085	.750	1.03	<.40>.30
GROUP 5	394,260	43	9.122	.910	1.27	<.30>.20
GROUP 6	346,610	39	8.889	910		

CRANIAL CIRCUMFERENCE (cm.)

	Total	No.	Mean	SD
GROUP 1	19,115	42	45.5	1.3
GROUP 2	19,220	42	45.8	1.6
GROUP 3	19,157	42	45.6	1.2
GROUP 4	19,206	42	45.7	1.4
GROUP 5	19,644	43	45.6	1.2
GROUP 6	17,862	39	45.8	1.4

ADDENDUM:

The weights and heights (Table 6) of one year old male subjects from the earlier transverse study are now being analyzed for future publication. It is interesting to note that these figures obtained (from male underprivileged infants visited once at one year of age) closely approximate those of Group 6 (Control) in the longitudinal study at the same age level. One might assume from this comparison that a possible "Hawthorne" effect, because of extra attention to the control group, was negligible. On the other hand experimental Group 5 is significantly greater in body length ($p = .02$) than the cross-sectional underprivileged classes. Similarly, experimental Groups 3 ($p < .02$) and 4 ($p = .025$) from the underprivileged classes are significantly greater, and Group 1 is almost significant ($p = .06$), in body length than the underprivileged of the same age in the cross-sectional study. All experimental groups reach the body length of the privileged classes.

As experimental Group 5 received pediatric care only (without supervised supplementation, but with advice upon nutrition education) these preliminary results lend support to the view that a comprehensive approach is required for family health. (L.J. Casazza and Cicely D. Williams, Lancet i, 712-714, 1973). Of course, supporting evidence at the 18 month point is still required.

TABLE 6

MALE INFANTS AGED 12 MONTHS
CROSS-SECTIONAL STUDY

Height (cm.)

Group 1 (Underprivileged)			Group 2 (Middle)			Group 3 (Privileged)		
No.	Mean	SD	No.	Mean	SD	No.	Mean	SD
35	71.39	4.20	27	71.80	2.94	39	72.63	3.04

t ratios	1 : 2	.43 N.S.
	2 : 3	1.11 p<30>20
	1 : 3	1.47 p<20>10

Weight (kg)

Group 1 (Underprivileged)			Group 2 (Middle)			Group 3 (Privileged)		
No.	Mean	SD	No.	Mean	SD	No.	Mean	SD
35	8.97	1.19	27	9.49	1.57	39	9.70	1.17

t ratios	1 : 2	1.49 <.20>.10
	2 : 3	.62 N.S.
	1 : 3	2.66 <.01