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ABSTRACT

This report summarizes preliminary results of the Yale Project which is attempting to identify and document relationships between social and economic development and major physical and mental growth, and health deficiencies in Tunisian children. A total of 112 children aged 6-1/2 to 8-1/2 were examined physically and psychologically, and a social interview was carried out with the parents. In addition, the heights and weights of 81 parents and 34 older brothers were measured. The major hypothesis of the project regarding physical, mental, and health deficiencies was that there would be wide and significant differences between middle class and underprivileged in the following variables: height and other linear measures, weight and other mass measures, some physical function tests, health variables, skeletal maturity, performance on intelligence tests, and other aspects of physical development. These differences were then related to the following variables: nutrition, overcrowding and/or number of children in family, type of housing, general hygiene including medical care, education and general socioeconomic level of parents, and intrafamily relationships and family stimulation. Other areas of interest were comparable studies of Tunisian, American, and Italian middle class differences in nutrition "practices," and in examination of the effects of "positive stimulus" by economic and social development on the families of poorer classes. (CS)

A Preliminary Report

by

Harben Boutourline Young, M.D.
on behalf of the research group to the
Dean of Harvard University School of Public Health
and to the
Inter Faculty Committee on Research in North Africa

Some Relationships between Social and Economic Development and Physical and Mental Growth and Health in Tunis

Primary problems in most developing countries are population increase, inadequacy of existing agricultural resources for the growing population, lack of employment in the course of population shift from subsistence agriculture to urban life, and the prosecution and maintainance of an adequate level of education and health. Tunisia is no exception, although considerable efforts are being made for a break-through with attacks on all the problems mentioned. Perhaps the problem which has attracted most attention since independence is education. In the near future

every child should be assured of the first six years of primary school. The problems which are less easy of solution are those of food availability (some is dispersed in exports for hard currency), and steady employment (the growth of industry has not kept pace with urbanization), and the things that go with steady employment such as adequate housing and positive intra-family relationships. The effects of the current attack on the population problem have yet to be seen.

In regard to health, the W.H.O. team led by Dr. O. L. Christensen has had notable success with the BCG program, and the Ministry of Health likewise with the poliomyelitis vaccination program. Although there are established medical clinics and a free health service, the clinics are few and overcrowded in a country with only 400 doctors. The new medical school, whose first class will graduate in three years' time, will help to solve this problem.

It is likely that amongst the developing countries those that are less developed will have greater variability on some important human and environmental factors. In fact, the range of such variability, and the character of the frequency distribution on selected variables, may well serve as an index to the level of development of a society.

The interdependence of the major problems makes it imperative that research workers in developing countries should have available the resources offered by several disciplines. Many of the problems can only be solved by effective inter-disciplinary effort aimed at identifying and documenting the main areas of deficiency. Only after such identification may remedial action be taken and such preventive measures as appear appropriate be instituted.

Our hypotheses regarding the above-mentioned areas of deficiency were as follows:

1. There will be wide and significant differences between middle class and underprivileged in the following variables:-

   a. height and other linear measures
   b. weight and other mass measures (bone muscle, fat, etc.)
   c. some physical function tests
   d. health variables, including haemoglobin
   e. skeletal maturity
   f. performance on intelligence tests
   g. aspects of adjustment

These differences will be related, more or less closely, to the following environmental variables:-

   a. nutrition
   b. overcrowding and/or number of children in family
   c. type of housing
   d. general hygiene including medical care
   e. education and general socio-economic level of parents
   f. intra-family relationships and family stimulation

2. There will be differences in physical growth between the Tunis middle class and middle class American and Italian children because of differences in nutrition "practices", and number of children dependent on income.

3. Families of the poorer classes who have received "positive stimulus" by economic and social development will have children differing from those without "positive stimulus" in a number of health and growth variables, both physical and mental.

4. The differences noted in (3) may be related to sub-variables of "positive stimulus".

Another area of interest would be to compare heights of subjects with heights of older brothers and parents, and by comparison of the actual height of the children with their predicted height, it might be possible to make a crude evaluation of some differential environmental pressures on the subjects during the past seven years, the preceding three to seven years on their brothers, and between 25 and 40 years ago, when the parents were growing.

I now have to report on implementation of the proposals presented in December 1965 to the committee, supplemented by certain decisions taken on May 2, 1966. It is assumed that those present have seen these documents and therefore I shall not repeat what was then stated.

The proposals were carried through in almost their entirety. A total of 112 children aged $6\frac{1}{2}$ to $8\frac{1}{2}$ were examined physically and psychologically and a social interview was carried out with the parents (the observations occupied some five hours per subject). In addition we measured the heights and weights of 81 of the 82 parents at Djebel Djelloud and the heights and weights of 34 of the 35 older brothers. In this latter group X-rays of the left hand and wrist were taken and puberal maturity status

was assessed where this seemed appropriate. In addition, physical performance tests were carried out. As described in Appendix 3, a number of the observations were repeated for the purpose of checking reliability.

Because of logistic difficulties caused by summer holidays for some of the subjects, and University examinations undergone by our Tunisian assistants, 8 of the 112 psycho-social examinations were not completed. Of these, 4 were from the Sadiki College, 2 from Rue Charles de Gaulle and 2 from Djebel Djelloud. Two of the psychological examinations were not completed. Both of these are at Sadiki College.

Six of the eight missing psycho-social examinations have now been completed, together with the two missing psychological examinations, but these arrived too late for the analyses which we shall present.

Some notes on the variables are included in Appendix 1 and a description of the population is included in Appendix 2.

METHODS

Physical Growth

Twenty-five measurements of body length, breadth and depth to give an idea of body composition and proportion. The instruments used are widely accepted for use in international growth studies and their reliability, as that of the observer, was known. Size of testicles by comparison with standard, number of permanent teeth emerged.

X-ray of left hand and wrist, using Kodirex wrap around film. Tube 75 cm. vertically above head of 3rd metacarpal. Hand in standard position. Subject's testicles protected by lead screen. X-ray of soft tissues in a number of subjects.

Photography: Polaroid for identification attached to documents and another was given to subject to increase rapport. Somatotype precision photography carried at 4 metres distance. Subject in three st rd positions.

Medical History

Standard history. Reliability of many retrospective data such as birth weight, weight at 1 year, first steps and appearance of primary dentition is questionable. Also questionable is the use of non-medical personnel to gather much of the medical history. In general, the knowledge of disease and significance of symptoms in the Djebel Djelloud population was so scanty as to make history taking extremely difficult.

Health

Standard examination (using dictionary of terms and agreed indices where indicated) and including examination of the ear, nose and throat, teeth, visual acuity (with correction if possible), blood (for haemoglobin) using MRC photometer, and urine analysis.

Physical Function

1. Harvard Step: platform modified to height of 33 cm., $2\frac{1}{2}$ minute performance, 30 cycles/minute.

2. Dynamic flexibility*
3. Balance*
4. Hand dynamometer (Naragansett)*

Supplement 1: provided for direct measurement of height and weights of parents and older brothers (9 - 14), also school performance, maturational status, and physical function tests of older brothers

Aspects of Adjustment

Questionnaire on behaviour applied at interview with mothers. The questions were derived from a variety of questionnaires used by pediatricians and child psychologists in Western countries. This instrument should be refined and possibly supplemented by a greater degree of direct observation than the one item provided during the medical examination. Teachers have already been tried as additional sources but the large size of their classes apparently blocks their perception outside the field of instruction.

Performance on Intelligence Tests

We chose a set of measures which would minimise the influence of verbal skills and the cultural background of the subjects. Five tests were chosen. These were Kohs' Blocks, Figure Reconstruction, Porteus' Mazes, Raven's Progressive Matrices "47" and the Goodenough Draw-A-Man test. These procedures were modified during the course of trials to meet the degrees of retardation involved and to provide a satisfactory internal con-

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* Fleishman, E. A. The Structure and Measurement of Physical Fitness. Prentice-Hall, New Jersey, 1964.

sistency. The tests were applied jointly in training sessions, by our own personnel and Tunisian University student assistants in psychology, until the performance of our assistants was judged sufficiently dependable. Subsequent tests were applied by them with occasional controls by our own personnel.

School performance was obtained from the school records. The verbal judgments were placed in a hierarchy and a percentage figure assigned to each.

Psycho-Social Enquiry

We put together an instrument which contained basic elements of previous questionnaires which we have used, a few elements of the previous questionnaire used by Drs. Rolde and Goethals of Harvard, some suggestions made by Dr. Paul Sebag (Sociologist, University of Tunis), a great number of elements previously used by Dr. Richard Jessor (University of Colorado) in his tricultural study, a modification of Cantril's self anchoring device, and some new suggestions by Dr. Gino Tesi and other members of our group. These questionnaires, translated into French by Dr. Elizabeth Boutourline Young and into Arabic by a trarslator suggested by the AID mission, were applied by our own personnel with two university students in social psychology, Mr. Zaidi and Mr. Baccouche, until such time as it was judged they were proficient.

Supplement 2: a brief questionnaire on the total family income and particulars of the grandparents' occupation, place of origin and those who might know the family there.

Supplement 3: a brief questionnaire on basic socio-economic items prior to the psycho-social enquiry in numbers 101 - 128 (for speeding up analysis).

Supplements 2 and 3: are being used also for reliability checking on the items concerned.

Nutrition

In the lack of a nutrition worker to measure overall calorie and specific food intake, we decided to obtain a measure of animal protein intake, controlling this by a record of what the child ate the day before. It was assumed that below a certain level of animal protein intake there would be a correlation with overall calorie intake.

In Appendix 3, we have made some notes on reliability and validity of instruments.

The mean age of the Djebel Djelloud sample was 7.5 years and that of the Sadiki sample 7.7 years.

Analysis of Tunis Data and Description of Variables Used

The medical psychological and sociological variables were treated differently according to their having parametric or non-parametric characteristics.

The medical and psychological data underwent a preliminary analysis comprising 106 variables. The means, standard deviations and standard errors were calculated. For each variable the subjects were divided into age groups with a range of 6 months for each group, in order to follow the characteristics of change through time. For each age group means and standard deviations were calculated, and also the mean age was calculated in order to control for possible deviations from labelled age in each group. For purposes of comparison, the Djebel Djelloud and the Sadiki samples were analysed separately.

A program of intercorrelation was made on 20 medical variables which appeared particularly indicative on the basis of the previous analysis: these were age, weight, height, sitting height, chest circumference, chest depth, chest width, arm circumference, calf circumference, humeral bicondyle, femoral bicondyle, triceps, biceps, supracrestal, external and internal calf subcutaneous tissue, dynamometer, blood pressure, skeletal age and haemoglobin.

In order to identify further the most useful variables, correlations analyses were made.

a. between the subcutaneous tissue measurement;
b. between the three age indicators (chronological age, skeletal age and number of permanent teeth emerged);
c. between the indicators of thoracic size (chest circumference, chest depth, chest width and "thoracic index");
d. between indicators of socio-economic condition;

These smaller matrices are to be seen in Appendix 4.

Perusal of Appendix 4 will make clear for example, how the most appropriate subcutaneous tissue measurements were chosen for further analyses, the usefulness and meaning of the two variables "skeletal age" and "number of permanent teeth present", and the way of arriving at the formulation of the secondary somatic variables "thoracic index" and its usefulness, and the formulation of three indices of socio-economic condition, one of which stands out as superior in this particular research situation.

Appendix 4 - page 35

A program of intercorrelations was made between the six psychological tests.

A program of item analysis was made for all the areas covered by the items of the social questionnaire.

A program of intercorrelations was made on the 52 variables listed below:

1. Age
2. Weight
3. Bicondyle humerus
4. Bicondyle femur
5. Height
6. Chest circumference
7. Arm circumference
8. Triceps
9. Biceps
10. Supracrestal
11. Dynamometer
12. Number permanent teeth
13. Skeletal age
14. Haemoglobin
15. Deviation of actual height from expected height for chronological age
16. Thoracic index obtained from depth and width measurements
17. Fat free arm circumference
18. Animal protein content of diet
19. Psychological tests - Kohs' blocks, our adaptation
20. Psychological tests - Kohs' blocks, first part, W.I.S.C.

21. Psychological tests - Kohs' blocks, second part, W.I.S.C.
22. Psychological tests - Mazes
23. Psychological tests - Figure Reconstruction
24. Psychological tests - Progressive Matrices 47
25. Psychological tests - Goodenough Draw-A-Man
26. Number of children in family
27. Reason for coming to Tunis
28. Time in Tunis
29. Radio ownership
30. Educational level of father
31. Father's occupation
32. Unemployment
33. Distribution of income
34. " "
35. " "
36. " "
37. " "
38. " "
39. Relation between total additional expenditure and money spent on food
40. Relation between total additional expenditure and saving
41. Income
42. Socio-economic index based on type of housing, level of education, occupation and income
43. Freedom item N° 2 (page 4 questionnaire)

44. Index of Freedom (items 1 - 4, page 4 questionnaire)
45. Present position on social ladder
46. Difference between positions on social ladder now and in five years
47. Internal versus external control index (from items 1 - 8, pages 5 - 6 questionnaire)
48. Future expectations (from realistic to vague)
49. Index of religious practices (from items 1 - 6, page 7 questionnaire)
50. N° trips to town per year
51. Listening to radio
52. Newspaper - reading in Arabic and French

The observations arising from these programs suggested a further selection of variables, and transformations to be used for some of them. We thus obtained 38 variables, taken from the medical and anthropometric examinations, from the psychological tests administered to the subjects and from the social interview data. This condensed matrix is presented in the next section under "results".

RESULTS

Physical Growth

We have broken these measures down into:

a. linear, e.g. height, leg length, etc.
b. body mass, e.g. weight, chest depth and width, chest circumference, arm circumference, etc.

c. component "bone" of body mass, e.g. femoral and humerus bicondyle

d. component "fat" of body mass, e.g. 7 fat measurements

e. skeletal age and dental age

For future work of this kind it will be possible to select much fewer, but similarly representative, measurements.

Tables 1 (a), (b), (c), (d) and (e) present the means, standard deviations and significance levels of the differences between the 82 subjects at Djebel Djelloud and the 20 subjects at the Sadiki College, plus 4 relatively well off subjects from Rue Charles de Gaulle, that is 24 in all.

Significant differences are seen in:

Linear Measurements: Table 1 (a)

Height

Sitting Height

Leg Length

Arm Length

Body Mass Measurements: Table 1 (b)

Weight

Biacromial I

Biacromial II

Chest Width

Chest Circumference I

Bicrestal

Arm Circumference

Leg Circumference

Cranial Width

Table 1 (a)

Linear Measurements

	Height		Sitting Height		Leg Length		Arm Length	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Djebel Djelloud n 82	116.3	5.5	61.7	2.6	68.1	4.3	35.6	2.2
	t = 4.78		t = 4.17		t = 4.65		t = 4.86	
	Significant		Significant		Significant		Significant	
	P < .001		P < .001		P < .001		P < .001	
Sadiki n 24	121.8	4.8	63.8	2.1	72.3	3.7	38.1	2.3

Table I (b)

Body Mass Measurements

	Weight		Biacromial I		Biacromial II		Chest Depth		Chest Width		Chest Circum. I	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Djebel Djelloud n 82	20.3	2.3	26.8	1.9	25.2	2.1	14.2	0.7	18.7	1.0	57.9	2.7
	t = 4.23		t = 3.79		t = 3.64		t = 1.93		t = 3.31		t = 3.47	
	Significant		Significant		Significant		Not Significant		Significant		Significant	
	P < .001		P < .001		P < .001				P < .01		P < .001	
Sadiki n 24	22.5	2.2	28.0	1.3	26.6	1.3	14.5	0.7	19.3	0.8	60.4	3.1

	Bicrestal		Arm circ.		Leg circ.		Cranial width		Cranial length	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Djebel Djelloud n 82	18.9	1.2	15.5	1.3	22.7	1.6	13.9	0.6	18.1	0.6
	t = 5.29		t = 4.05		t = 4.55		t = 4.49		t = 0.45	
	Significant		Significant		Significant		Significant		Not Significant	
	P < .001		P < .001		P < .001		P < .001			
Sadiki n 24	20.0	0.8	16.5	1.0	24.0	1.2	14.3	0.4	18.2	0.6

Table 1 (c) Bone - Table 1 (d) Fat

	(c)				(d)			
	Humeral Bicondyle		Femoral Bicondyle		Triceps		Biceps	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Djebel Djelloud n 82	4.8	0.3	7.4	0.4	6.7	1.6	3.7	0.9
	t = 6.32		t = 3.09		t = 3.24		t = 1.99	
	Significant		Significant		Significant		Significant	
	P < .001		P < .01		P < .01		P < .05	
Sadiki n 24	5.1	0.1	7.7	0.4	8.0	1.9	4.2	1.0

	Subscapular		Supracrestal		Lateral Thorax		Calf I External		Calf II Internal	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Djebel Djelloud n 82	3.9	0.8	3.8	0.8	3.2	0.6	8.0	1.9	6.9	1.8
	t = 1.90		t = 1.12		t = 0.98		t = 1.61		t = 3.41	
	Not Significant		Not Significant		Not Significant		Not Significant		Significant	
									P < .001	
Sadiki n 24	4.3	0.9	4.2	1.5	3.3	0.6	8.9	2.3	8.5	2.0

Similar comparisons were made with log. transformed data for the triceps, biceps and the internal calf. The levels of significance were the same.

Table 1 (c)

Skeletal Age and Dental Age

	Skeletal Age		N° permanent teeth present	
	Mean	SD	Mean	SD
Djebel Djelloud n 82	5.9	1.1	7.2	3.0
	t = 4.61		t = 1.12	
	Significant		Not Significant	
	P < .001			
Sadiki n 24	7.0	1.0	8.0	3.0

Bone: Table 1 (c) — Humeral Bicondyle

Femoral Bicondyle

Fat: Table 1 (d) — Triceps

Biceps

Calf II

Skeletal Age and Dental Age: Table 1 (e)

Skeletal Age

Differences which approach the 5% level and which presumably would be significant if the more privileged sample had been larger are:

Body Mass Measurements: Table 1 (b)

Chest Depth

Fat: Table 1 (d) — Subscapular

Calf I

Thus hypotheses, 1 (a), (b) and (e) are supported.*

It is of interest to compare the height and weight data with U.S. norms. See Figures 1 and 2. It may be seen that the Sadiki College boys are below the U.S. norms provided by Meredith. The skeletal age data have already been discussed.** This supports the first part of hypothesis 2,*** although the cause needs further investigation. Table 5 shows that the Sadiki College boys ingest a mean of about 23 grams of animal protein per day versus 8.5 for the Djebel Djelloud group, although there is a wide frequency distribution.

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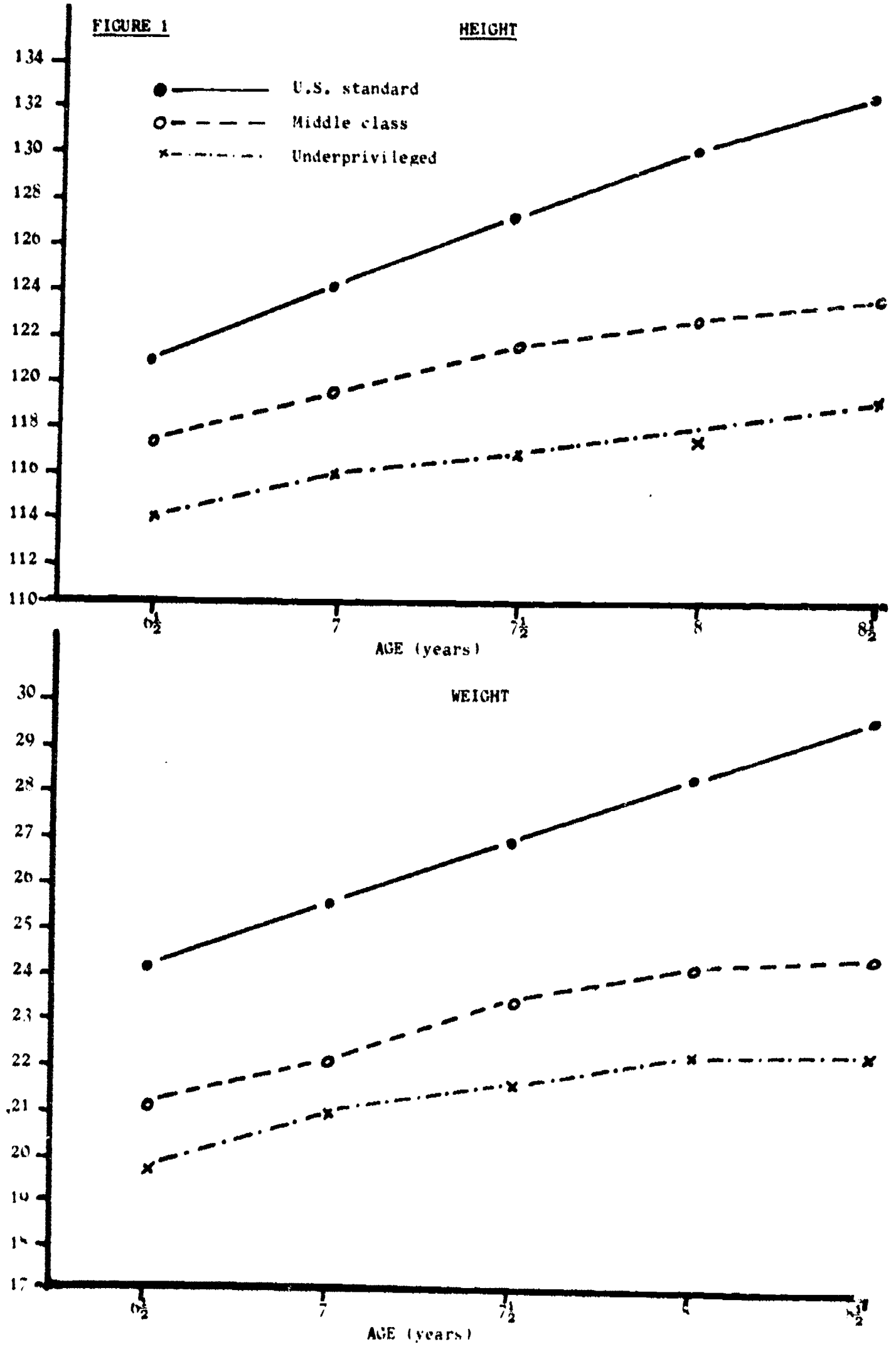
* See page 3

** See "Some Somatic and Psychological Observations on Young Children in a Poor Suburb of a North African City". Elizabeth Boutourline Young, Gino Tesi, Richard Jessor, Harben Boutourline Young. Presented at Annual Meeting of International Children's Centre, Stockholm, 19-24 June, 1966.

*** See page 3

FIGURE 1



Physical Function

Table 2 compares the results on the four physical function tests.

a. Harvard Step

b. Dynamometer

c. Dynamic Flexibility

d. Balance

It is seen in all four tests that the children from the privileged group were superior. The differences were significant for (b), (c) and (d). (a) fell just short of the 5% level.

The results of (d) should be accepted with caution as the children wore a variety of foot gear, ill fitting in many cases.

Some support is thus given to hypothesis 1 (c).*

Body Health Variables

In the Djebel Djelloud group there were more orthopaedic defects and they were judged substantially worse in muscle tone and mass as also in "general condition". There was more skin infection. There were no differences in the systolic or diastolic blood pressures. The heart rate was moderately less in the Sadiki sample. There was substantially more upper and lower respiratory infection with accompanying enlargement of the cervical lymph glands. There was also more middle ear disease in the Djebel Djelloud group. There was, however, less caries of temporary teeth in this sample offset by a little more caries of the permanent teeth and a moderate amount of gingivitis which was not seen at all in the Sadiki sample. There were more visual defects at Djebel Djelloud. There was substantially more albuminuria. A mean difference of almost 1 gm in haemoglobin level was significant at the 5% level.

As a genetic reassurance there was practically no difference in the colour of the iris.

Some of the less unreliable items in the medical history have been tabulated (Table 2b) for the two groups, Djebel Djelloud and Sadiki. There are marked differences in deaths of children. Seventy-five per cent of the Sadiki families have never lost a child against forty-one per cent of the less privileged group. Thirteen per cent of this latter group have lost four or five children. Forty-five per cent of the Sadiki group children are born in hospital against twenty-four per cent of the less privileged. There is no history of tuberculosis in the Sadiki families against twenty-one per cent in Djebel Djelloud.

Over-all support is thus given to hypothesis 1 (d).*

Although the custom of swaddling in the first months is not greatly different, it continues longer in the less privileged.

Breast feeding is also universally practised but continued much longer in the Djebel Djelloud group, forty-three per cent of whom are still suckling for one to two years against none of the Sadiki.

Similarly, carbohydrates and proteins are initiated much earlier in the Sadiki infants. For example, forty-four per cent of the Djebel Djelloud children initiate extra animal protein after 18 months as compared to only five per cent of the Sadiki.

Similar observations may be made for the different prevalence of respiratory infections and gastroenteritis between the two groups (Table 2c).

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* See page 3

Table 2

Tests of Physical Function

	Harvard Step									
	Pulse before 30 secs.		After total 3 x 30 secs.		Dynamometer		Dynamic Flexibility		Balance	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
n	81		80		82		80		80	
Djebel Djelloud	46.2	6.1	151.5	20.3	19.3	5.8	8.8	2.5	2.3	1.9
	t = 1.10 Not Significant		t = 1.96 Not Significant		t = 2.38 Significant P = .02		t = 3.08 Significant P < .01		t = 3.39 Significant P < .01	
Sadiki	44.5	5.7	140.8	21.0	21.8	4.2	10.5	2.2	6.4	5.9
n	18		18		24		24		24	

Table 2 (b)

Comparison of Items in Medical History

		Deaths of Children					Birth at		Tuberculosis History in Family Members
		0	1	2	3	4&5	Hospital	House	
Djebel Djelloud	%	41	22	20	4	13	24	76	21
Sadiki	%	75	10	15	0	0	45	55	0

		Swaddling (months)			Breast-Feeding (months)				Initiation Carbohydrates & Proteins				
		1-6	6-9	9-12	1-6	7-12	12-18	19-24	1-6	7-12	13-18	19-24	24
Djebel Djelloud	%	86	11	3	11	46	23	20	5	55	23	22	0 Ch.
									0	21	20	44	15 Prot.
Sadiki	%	95	5	0	45	55	0	0	30	55	10	5	0 Ch.
									30	55	10	5	0 Prot.

Table 2 (c)

		Respiratory Infections				
		Few	Frequent 1st Year	Frequent to present	Severe	Confirmed T.B.
Djebel Djelloud	%	47	3	36	11	3
Sadiki	%	95	0	5	0	0

		Gastroenteritis				
		None	Single Episode	To 3 years	Frequent to present	Frequent & Severe (blood in faeces)
Djebel Djelloud	%	34	11	8	46	1
Sadiki	%	60	40	0	0	0

Psychological Testing

Table 3 presents the data for the four available tests in the two groups.

Significant differences are seen in respect of Kohs' Blocks, the Mazes and the Goodenough "Draw-A-Man" Test. No significant difference is seen for Raven's Progressive Matrices or for Figure Reconstruction.

Hypothesis 1 (f) is thus in part confirmed.*

Table 3 also shows the greater sensitivity of the North African modified form of Kohs' Blocks as compared to the U.S. version.

Aspects of Adjustment

Table 4 tabulates the results in % of Yes for the variables in the two groups.

It is seen that in the Djebel Djelloud group there is moderate increase of difficulties in respect of items 4, 15 and 16 (all concerned with self expression and communication) while the Sadiki boys are described as more "nervous" and "restless". On the other hand the Djebel Djelloud group appear as more "timid" and have more "control problems". As these results may be confounded with social class attitudes, we have not calculated any levels of significance.

Specific Environmental Variables

Table 5 (a) and (b) presents the percentage distributions for type of housing, general socio economic condition and then a comparison of animal protein, family income and number of children per family. We do not have sufficient information to provide a measure of intra-family dynamics although it was our impression that in the poorest families there was much apathy, more marked in the parents.

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* See page 3

Table 3

Results of Psychological Testing

	KOHS' BLOCKS													
	W.I.S.C.													
	11-20		ABC		1-10		Mazes		Figure Reconstruction		Progressive Matrices 47		Goodenough	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Djebel Djelloud n 80	42.1	16.4	12.5	6.5	4.3	4.8	26.8	6.1	22.0	8.2	15.3	4.4	9.4	4.4
	t = 5.41 Significant P < .001		t = 2.86 Significant P < .01		t = 1.66 Not Significant		t = 3.07 Significant P < .01		t = 0.73 Not Significant		t = 0.77 Not Significant		t = 4.66 Significant P < .001	
Sadiki n 20	53.5	5.2	15.5	3.4	6.5	5.7	31.1	5.9	23.4	7.8	16.0	3.7	15.7	5.9

Table 4

Answers to Behaviour Questionnaire

% answering "yes"

Item	Thumb sucking	Nail biting	Speech difficul-ties	"Nervous"	"Restless"	"Timid"	Control Problems	Attention drawing	Writing difficul-ties	Reading difficul ties
Djebel Djelloud n = 80	9	15	23	58	46	60	26	24	28	19
Sadiki n = 19	16	0	16	74	63	26	18	21	21	10

Table 5 (a)

		1	2	3	4	5	6	7	8	9
Djebel Djelloud	HOUSE %	18	10	35	24	5	8	–	–	–
Sadiki		–	–	5	5	5	5	25	50	5
Djebel Djelloud	Social Economic Condition %	5	14	23	28	20	7	3	–	–
Sadiki		–	–	–	–	–	–	5	10	85

Table 5 (b)

	Consumption Animal Protein		Income Father		Nº of children living	
	Mean	SD	Mean	SD	Mean	SD
Djebel Djelloud n 80	8.5	7.3	25.7	27.0	5.0	2.1
Sadiki n 24	23.2	7.5	126.4	62.0	5.6	2.9

Unit of Measurement: g./day dinars (1D = $2)

There are wide differences between the groups.

The Condensed Correlation Matrix - Djebel Djelloud and Sadiki - Table 6

At the end of the section on methodology we described how it was possible, by a series of progressive evaluations, to reduce the number of elements for a correlations program embracing somatic psychological and social variables.

The results of this correlations program comprising 38 variables are presented in Table 6. This table shows the subjects from Djebel Djelloud in the lower triangle and those from Sadiki College in the upper. Because of the small number of subjects in the Sadiki sample, a high level of correlation was necessary in order to obtain significance. We have, therefore, included those correlations which approached the 5% level, clearly marking these as being merely indicative. On the Djebel Djelloud side, only significant correlations have been presented.

This correlation matrix is worthy of study, as it contains not only a number of expected relationships, but also some provocative findings.

The correlation between chronological age (1) and skeletal age (2) is rather low (.38). Chronological age has lower correlations with most somatic variables. Skeletal age appears to be a better indicator of physical growth.

The variables expressing body mass have good intercorrelations as expected.

Transverse section of the thorax obtained from an approximation of the surface of an ellipse based on chest width and depth measurements $S = \frac{D}{2} \cdot \frac{W}{2} \pi$ presents high correlations with most of the other anthropometric measurements.

The bicondyle femoral measurement appears as a suitable representative of bone closely resembling, but having higher correlation than, the humeral measurement. The fat free arm and calf circumference, representing bone and muscle, are well correlated with other body mass measures and the hand dynamometer performance is, as expected, more highly correlated with fat free arm circumference than with total arm circumference.

CORRELATION

variable	1	2	3	4	5	6	7	8	9	10
1 Age	.	25°	36°	.	35°	.	.	39°	.	.
2 Skeletal age	38	.	30°	.	37°	.	.	30°	.	25°
3 Height	36	56	.	69	67	43	62	53	.	.
4 Actual height v. expected height	.	35	54	.	63	40	52	39	47	31°
5 Weight	34	55	81	46	.	30°	36°	41	38°	30°
6 Bicondyle humerus	.	44	49	30	69	.	59	.	.	.
7 Bicondyle femur	33	57	72	39	76	68	.	.	.	.
8 Chest circumference	28	47	58	37	71	60	69	.	27°	68
9 Thoracic index	40	39	55	47	63	50	56	78	.	.
10 Arm circumference	.	.	22	.	45	48	47	35	30	.
11 Fat free arm circumference	.	25	31	X	46	52	53	35	.	92
12 Calf circumference	.	40	51	.	72	55	66	51	42	78
13 Fat free calf circumference	27	39	56	X	68	53	63	45	34	64
14 Supracrestal	.	28	.	.	33	27	28	27	24	34
15 Dynamometer	33	34	58	42	65	59	56	65	56	37
16 Kohs cubes 11-20	.	.	25	.	26	.	23	.	.	.
17 Mazes	31	.	26	.	31	.	25	22	.	.
18 Figure Reconstruction	.	.	.	.	27	.	.	X	.	.
19 Progressive Matrices 47	.	.	24	.	28	.	31	28	.	27
20 Goodenough	.	.	.	.	33	.	25	X	.	.
21 Protein intake	.	.	.	.	.	26	.	.	.	28
22 Income	.	.	.	.	.	.	.	.	.	.
23 Type of house	.	.	.	.	.	.	.	.	.	.
24 No. rooms	.	.	.	.	.	.	.	.	.	24
25 No. people in family	.	.	.	.	.	.	.	.	.	.
26 Index rooms/persons	.	.	.		.	.	.	.	.	25
27 Father's educational level	.	.	.	.	DJ.		DJ.		.	.
28 Father's occupation	.	-30	.						.	.
29 Unemployment	.	.	.	.	.	.	.	.	.	.
30 Socio economic index	.	.	.	.	.	.	.	.	.	.
31 Perceived position on social scale	.	.	.	.	.	23	.	.	.	27
32 Future expectations	.	.	-27	22	-32	-37	-31	-21	.	-26
33 Index of control	.	.	30	.	23	.	.	.	.	.
34 Index of religious practices	.	.	33	.	31	.	28	23	.	.
35 Index of mass communication	.	.	.	.	.	.	.	.	.	.
36 No. trips to town	.	.	.	.	.	.	.	.	.	.
37 Radio listening	.	.	.	.	.	.	.	.	.	25
38 Newspaper reading	.	.	.	.	.	.	.	.	.	.

TUNIS

LATIONS OF SELECTED VARIABLES

8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	3
39°	.	.	33°	41°	39	.	.	.	35°	.	.	36°	28°	.	.	.	.	.	.	.	.	.	
30°	.	25°	.	31°	.	39	.	.	.	..	.	46	36°	.	.	.	.	.	.	.	.	.	
53	.	.	26°	31°	30°	.	.	.	33°	.	.	41	31	32°	.	35°	.	.	.	.	.	.	
39	47	31°	.	31°	.	.	.	.	.	X	44	X	.	.	.	.	.	.	.	.	.	.	
° 41	38°	30°	42	52	40	34°	.	.	38°	.	28°	42	37°	25°	.	36°	.	.	.	.	.	.	
.	.	.	.	.	.	.	.	.	28°	.	.	42	25°	31°	.	33°	.	.	.	.	.		
.	.	.	30°	33°	27°	.	.	.	33°	.	26°	36°	25°	34°	.	42	.	.	.	.	.		
.	27°	68	32°	35°	27°	.	.	.	40	.	.	43	30°	27°	.	33°	.	.	.	.	.		
78	.	.	.	.	.	.	.	.	34°	.	.	.	.	.	.	.	.	.	.	.	.		
35	30	.	39°	65	25°	.	.	28°	35°	.	.	42°	31°	28°	.	37°	.	.	.	.	.	.	
35	.	92	.	32°	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
51	42	78	74	.	33°	.	.	.	31°	.	.	41°	34°	28°	.	33°	.	.	.	.	.	.	
45	34	64	77	89	.	.	37°	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
27	24	34	.	37	.	.	.	27°	37°	.	.	35°	34°	26°	.	32°	.	.	.	.	.	.	
65	56	37	46	44	.	.	.	36°	.	.	33°	.	.	.	-33°	.	.	.	-34°	-34°	.	.	
.	.	.	.	.	.	.	23	.	.	26°	33°	36°	27°	28°	.	.	.	33°	.	.	.	.	
22	.	.	.	.	.	.	.	47	.	45	41	33°	.	27°	.	28°	.	.	.	.	.	.	
X	.	.	.	.	.	.	.	64	48	.	46	37°	.	.	.	.	.	.	.	.	.	.	
28	.	27	29	27	.	.	24	44	45	35	.	.	.	.	.	.	.	.	.	.	.	.	
X	.	.	.	26	.	.	.	37	23	46	32	.	.	.	.	.	.	.	.	.	.	.	
.	.	28	22	26	.	.	.	23	.	21	.	23	.	41	.	.	.	58	.	.	.	40	
.	.	.	.	.	.	.	.	38	.	31	.	.	60	.	37°	58	30°	77	34°	35°	.	79	
.	.	.	.	.	.	.	.	25	.	.	.	.	51	58	.	.	-35°	73	38°	38°	.	39	
.	.	24	25	.	.	.	.	.	.	.	.	.	57	48	57	.	53	91	.	.	.	56	
.	.	.	.	.	.	.	.	.	.	.	.	.	.	25	.	25	.	64	-44	-40	.	31°	
.	.	25	.	.	.	.	.	.	.	.	.	.	62	45	57	96	.	.	70	69	.	.	
J.	.	.	.	.	.	.	.	.	.	.	26	.	36	33	31	.	.	.	.	72	.	38°	
.	.	.	.	.	.	.	.	39	.	32	.	33	55	64	28	30	.	32	37	.	.	35°	
.	.	.	.	.	.	.	.	.	.	.	.	.	-32	-41	.	.	.	.	.	-56	.	.	
.	.	.	.	.	.	.	.	39	.	32	.	25	68	82	72	52	24	43	60	76	-34	.	
.	.	27	.	25	.	.	.	24	.	22	.	.	43	40	30	23	.	.	.	40	.	45	
1 -21	.	-26	-23	-33	.	.	-35	-32	.	.	.	-28	-36	-47	-34	.	.	.	-41	-36	33	-33	-
.	.	.	23	.	.	.	.	.	.	.	.	.	.	.	31	.	.	.	38	.	.	33	
23	.	.	.	25	.	.	.	.	34	.	26	.	.	.	.	.	40	.	27	.	-27	.	
.	.	.	.	.	.	.	.	.	.	.	.	.	24	.	.	.	30	.	40	24	.	21°	
.	.	.	.	.	.	.	.	.	.	.	.	.	21	.	.	.	30	.	37	23	.	24	
.	.	25	.	.	.	.	.	33	.	23	25	.	44	45	35	30	.	25	38	27	-24	35	
.	.	.	.	.	.	.	.	27	.	.	.	.	26	25	.	.	22	.	74	.	.	26	

° Not significant

X Not tested

ED VARIABLES

Table 6

17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38
35°	.	.	36°	28°	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
.	..	.	46	36°	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
33°	.	.	41	31°	32°	.	35°	.	.	.	.	.	.	.	.	27	.	.	.	.	.
.	X	44	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
38°	.	28°	42	37°	25°	.	36°	.	.	.	.	.	.	.	.	.	.	.	.	.	.
28°	.	.	42	25°	31°	.	33°	.	.	.	.	.	.	.	.	.	.	.	.	.	.
33°	.	26°	36°	25°	34°	.	42	.	.	.	.	.	.	**SADIKI**					.	.	.
40	.	.	43	30°	27°	.	33°	.	.	.	.	.	.						.	.	.
34°	.	.	.	.	.	.	.	.	.	.	.	.	.						.	.	.
35°	.	.	42°	31°	28°	.	37°	.	.	.	.	.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
31°	.	.	41°	34°	28°	.	33°	.	.	.	.	.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
37°	.	.	35°	34°	26°	.	32°	.	.	.	.	.	.	.	.	.	.	.	.	.	.
.	.	33°	.	.	.	-33°	.	.	.	-34°	-34°	.	.	.	.	.	.	.	.	.	.
.	26°	33°	36°	27°	28°	.	.	.	33°	.	.	.	.	.	.	42	.	.	.	.	.
.	45	41	33°	.	27°	.	28°	.	.	.	.	.	.	.	.	.	.	.	.	.	.
48	.	46	37°	.	.	.	.	.	.	.	.	.	.	.	.	30°	.	.	.	.	.
45	35	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
23	46	32	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
.	21	.	23	.	41	.	.	.	58	.	.	.	40	.	.	-38°	-46	.	.	.	.
.	31	.	.	60	.	37°	58	30°	77	34°	35°	.	79	.	.	.	.	.	.	.	.
.	.	.	.	51	58	.	.	-35°	73	38°	38°	.	39	.	.	.	-67	-68	.	.	.
.	.	.	.	57	48	57	.	53	91	.	.	.	56	.	.	29°	.	-47	.	.	.
.	.	.	.	.	25	.	25	.	64	-44	-40	.	31°	.	.	40	37°	37°	.	.	.
.	.	.	.	62	45	57	96	.	.	70	69	.	.	.	-59	.	.	.	.	.	.
.	.	26	.	36	33	31	.	.	.	.	72	.	38°	56	.	.	.	.	.	.	.
.	32	.	33	55	64	28	30	.	32	37	.	.	35°	50	.	.	.	.	.	.	.
.	.	.	.	-32	-41	.	.	.	.	.	-56	.	.	.	.	.	.	.	.	.	.
.	32	.	25	68	82	72	52	24	43	60	76	-34	.	58	-56	.	.	.	.	.	.
.	22	.	.	43	40	30	23	.	.	.	40	.	45	.	.	.	.	.	.	.	.
.	.	.	-28	-36	-47	-34	.	.	.	-41	-36	33	-33	-34	.	.	.	.	.	.	.
.	.	.	.	.	.	31	.	.	.	38	.	.	33	.	-23	.	.	.	.	.	.
4	.	26	.	.	.	.	.	40	.	27	.	-27	.	.	.	29	.	.	.	.	.
.	.	.	.	24	.	.	.	30	.	40	24	.	21°	.	.	.	.	.	.	.	.
.	.	.	.	21	.	.	.	30	.	37	23	.	24	.	.	.	29	77	.	.	.
.	23	25	.	44	45	35	30	.	25	38	27	-24	35	36	.	28	26	29	35	.	.
.	.	.	.	26	25	.	.	22	.	74	.	.	26	.	-23	37	33	32	36	34	.

significant

tested

Actual height versus the expected U.S. height for the chronological age (4) was obtained, as a measure of approach to height potential, by a formula which gave progressively higher values to the variable as the U.S. standard was approached. This variable (4) has good correlation with all somatic variables except fat free arm and calf circumferences and the subcutaneous tissue.

Relationships between Somatic and Psychological Variables

Although age is correlated only with mazes, the body mass measurements in Djebel Djelloud and in particular weight, bicondyle of the femur, height and fat free calf circumference are correlated positively with performance on the intelligence tests. Physical function, as represented by the dynamometer test, is also correlated significantly with two of the tests. There was satisfactory intercorrelation between the intelligence tests.

Animal protein content of diet (21) has low and frequently not significant correlations with anthropometric and psychological variables, perhaps because of generally low consumption, (the mean of animal protein consumption for the Djebel Djelloud group is 8 grams/day with only 7 subjects consuming 20 or over) but is highly correlated with income (22) and socio economic index (30), and with many attitudinal variables such as perceived present position on social ladder (31) and elements of communication (36, 37, 38). There is also a correlation with future expectations (32). This might be interpreted as an effort on the part of the community to improve the nutrition of its children but that such striving, constantly impeded by the lack of resources, cannot be reflected in actual improvement of health and growth.

With better social conditions (see the Sadiki group) the influence of content of animal protein in the diet (21) appears in correlations with anthropometric measurements especially weight (5), height (3) and skeletal age (2).

The preceding analysis of such socio economic variables as level of education and occupation of father, family income and type of house, indicated the possibility of working out an index of socio economic class. The variable thus obtained (30) (see Appendix 4, page 36) has practically the same correlations as family income (22) and father's occupation (28). It has interesting correlations with performance on three of the psychological tests of our battery (16, 18, 20). This battery, as was mentioned before in the Stockholm report, contains tests which are among the most culture free in existence. These correlations therefore, may reflect the impact of social conditions on performance and mental level in this very underprivileged group. In the Sadiki boys there is no correlation between the index and mental performance although there is significant relationship between income and two of the tests.

The performance on tests is also positively correlated with some social attitudes like perceived position on social scale (31), index of religious practices (34), future expectations (32) and important elements of mass communication like radio listening (37), reading of newspapers (38).

Index of socio economic class (30) is correlated with attitudes and namely index of internal versus external control (33), future expectations (32) which become less and less realistic as socio economic status goes down, and perceived position on social scale (31). Good correlations also exist between this variable (30) with access to means of communication (35, 36, 37, 38).

Index of religious practices (34) is correlated with index of internal versus external control (33). That is the more religiously observant appear to perceive themselves as capable of controlling the environment. From this one might argue conversely that when the individual gives up hope of shaping his own life he also extends his hopelessness to the point of abandoning any kind of religious faith. Such a hypothesis is supported by the negative correlation between index of religious practices (34) and length of unemployment (29).

Future expectations (from realistic to vague) (32) is negatively correlated with all the factors of social class, that is, educational level and occupation (27, 28), income (22), type of house (23) and index of social class (30), with perceived present position on social scale (31), with index of internal versus external control (33) and with radio listening (37). This expresses the incapacity of the most underprivileged people to perceive both their future and their present status in a realistic manner.

On the Sadiki side of the matrix many of the anthropometric variables observed for Djebel Djelloud remain valid, but the results are obviously more difficult to interpret given the small size of this group. One of the most important points to be made is that here the factors of social class are no longer correlated with performance on psychological tests, which serves to underline the culture free character of these tests.

We have seen substantial support of the first two groups of provisional hypotheses (see page 3).

On the other hand there has been much less support for hypothesis 3 (page 4). In the poorer area protein intake was correlated with a few somatic variables but little else was seen. This is in contrast to the many positive relationships between social variables (protein intake, number of rooms, family income) and somatic variables in the middle class groups. In contrast there are more relationships between social factors and mental performance in the Djebel Djelloud group. These findings underly the need for further study.

In regard to the last matter referred to in our list of hypotheses, that is, the use of physical measurements in family members in order to obtain a measure of environmental pressures over periods of many years, we were able to examine 34 of the 35 older brothers in the 9 - 14 age range at Djebel Djelloud. The measures have been described on page 4.

On the basis of the parents' heights and the age of the child, we calculated the expected height by means of the Fels prediction sheet kindly supplied by Dr. Stanley Garn. The mean parental height was in many cases lower than 163 cm, the lowest point on the Fels scale. We therefore extrapolated on a curve, and so the prediction of those subjects where the mid-parent height was below 160 cm can only be accepted with much caution.

On the basis of the skeletal age and the actual height of the subjects and their brothers, we predicted the adult expected height by means of the tables of Bayley and Pinneau. Here again a number of the subjects had skeletal ages of less than 6, the lowest point on the scale. These extrapolations must also be regarded with caution, especially as in any case predictions are less accurate on this end of the scale. It should also be noted* that where there is marked retardation in skeletal age there is not an equivalent diminution in linear growth. Thus the basis of the predictions, that is the hi h correlation between skeletal age and the percentage of mature height attained, is eroded. This resulted in absurd predictions of more than 180 cm in some cases. Therefore in the impressions which we shall present we shall mostly include only those subjects within 1½ years of the standard skeletal age.

We are now recording impressions and not formal analyses of this data, which have still to be processed.

Skeletal Age in Brothers and Socio-economic Conditions

In general, the brothers were similar in degree of retardation in skeletal age.

Example: Case N° 12 (aged 6.6) had two brothers examined aged 11.5 and 15.0. The skeletal age of the three was 5.0, 9.0 and 12.5. The two elder brothers are thus

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* See Stockholm Paper - reference page 15

retarded 2.5 years and our subject 1.6 years. The family has five children and the father earns 100 D a month in a kiosk in France. Half of this comes back to the family. The housing is one of the best to be found in Djebel Djelloud but the children currently ingest only 9.0 grams of animal protein daily. The economic situation of this family has improved. At the birth of our subject the father was earning less. The children's paternal grandfather was described as doing no work. Perhaps he was a small landowner in Kalaat Es Senam (Kef). Despite the apparent economic improvement for this family over the past 40 years, our subject's predicted height is 3.0 cm less than his father's actual height and those of the brothers are also both less. Our subject falls 5 cm short of his own predicted present height and 12.1 cm short of the U.S. standard. The 11½ year old brother fell 9.5 cm short of his predicted height and 19.7 cm short of the U.S. standard. The oldest brother fell 19.8 cm behind the predicted and 27.8 cm behind the U.S. standard. It should be noted that these wide divergencies are explained to some extent in delay of puberal development. The oldest brother was running about one year behind the U.S. average.

The three boys are doing equally mediocrily at school, all being at the 45%-50% level. All did better than the average on the physical equilibrium test. They all did less well than the average on the Harvard Step test and two of them did less well than the average on the Dynamometer test.

Subjects N° 13 and N° 18 are brothers, the only ones amongst the subjects. There are five other children in the family. These boys aged 7.6 and 8.6 respectively, have skeletal ages of 5.0 and 5.1. The younger is retarded 12.6 cm on his predicted height and 22.6 cm behind the U.S. standard. The older is 7.2 cm behind his predicted height and 17.2 cm behind the U.S. standard. They are both severely retarded in physical growth. The father earns 15 D ($ 30) a month as an unskilled labourer (he has

since got a steady job and now earns 30 D), and although they also live in a relatively satisfactory house the animal protein intake is only 1 gram/day. In all the four physical performance tests they were well below the average although they are doing fairly well in school (75% and 65% respectively). Eight years ago the father earned less. He was an agricultural labourer until 1963. The paternal grandfather was also an agricultural labourer at Gabes. We should be surprised if either of these boys reach the father's height (166 cm).

It is difficult to resist the impression that although the recent economic improvement, as seen (subject 12) in the differences between our subject and his older brothers, appears to have an effect, there is still a gap to be bridged between now and 40 years ago in terms of food available per head. Such a hypothesis is advanced cautiously as we know nothing, for example, of infantile and child mortality of that time in Kef from which the family originally came and selection by survival might be sufficient to explain the trend. There is also the whole question of adequacy of breast feeding and nutrition in post weaning periods still to be properly explored. Our present data are retrospective.

Subject N° 119 and his older brother are the only children in their family. The father sends back 45 D monthly from his earnings as a crane driver (France) and he has had a steady job of this kind for seven or eight years. Although this family has about the same income and individual animal protein intake as family N° 12, the boys are outstanding in exceeding the U.S. standards in both skeletal age and height. Their physical performance test results are all superior; such a family is worthy of study in depth although one favourable factor (two children only) is already apparent. The paternal grandfather was a day labourer at Tataouine (Medenine).

Conclusions

Research of this kind is practicable in Tunisia. In the present study a number of hypotheses have received substantial support. A number of new hypotheses have been generated. Much work remains to be done on the identification and assessment of key environmental variables. It is hoped that this, together with other planned work, will eventually point to practical social measures which may carry the average citizen of a developing country much nearer to his potential.

Co-operation with Tunisian Academic Circles

We were introduced to Professor Paul Sebag, Lecturer in Sociology at Tunis University, by Dr. Edward Rolde, and to Dr. Carmel Camilleri, Professor of Social Psychology (now at Tours University) by Dr. David Kinsey, and they have both been of considerable help to us. Dr. Camilleri has provided for us two senior students (M. Zaidi and M. Baccouche) for the psycho-social questionnaire, and both Dr. Sebag and Dr. Camilleri attended many sessions in which ideas were exchanged and advice sought. Dr. Jacques Wittwer (Professor of Psychology) was also of inestimable help in providing students for the application of psychological tests, in discussing problems of intelligence testing in Tunisian children and in introducing us socially to many University professors and other Tunisian intellectuals.

Links with Tunisian Government Circles

Through Dr. Edward Rolde we met M. Fathi Zouhir, then Minister of Health and now Chief of Protocol. Through the U.S. Ambassador, Mr. Francis Russel, we met M. Mongi Slim, then Minister at the Presidency and now Minister of Justice, and we have since kept him informed by a meeting, together with Dean Snyder, in May 1966. We have also been in touch with M. Ounais formerly Chef du Cabinet of M. Mongi Slim.

Experience in Italy suggests that such links with influential and experienced leaders is of the utmost importance in carrying through a research program. So far we have not had the opportunity of meeting the Minister of Education or the Minister of Planning or their closest collaborators and we feel that this would be of value.

Relationships with the school head-masters and their immediate inspectors have been most cordial.

Links with Local Party and Administrative Offices

Through Dr. Edward Rolde we met M. Beji M'Barek, administrative director of the municipality at Dubosville and responsible for Djebel Djelloud. Some two months ago M. Beji left his post and is now Chef de Bureau of the municipality.

Officers of the U.S. AID mission have been most helpful.

Appendix I

The dependent variables chosen in December were all observed with these exceptions: an audiometer not used as one was not available; skin tuberculin test was not used as all the children had received BCG. We still do not have adequate information on vital statistics. A census was being carried out in spring 1966, so it appeared better to wait for these figures to be made available rather than use information based on the preceding census of 1956. We did not measure intelligence in the older brothers as a complete new battery of tests would have been needed, but instead obtained their scholastic performance. We did not measure persistence or attention span directly.

Although the headmasters and teachers were most co-operative and helpful they were unable to answer the individual behavior questionnaire on the children and instead called the mothers to the school. We then decided to handle this ourselves directly with the mothers. We did not estimate total calorie intake as there was no nutrition worker available but we obtained a measure of animal protein intake with the assumption that below a certain level this is correlated with total calorie intake. We did not apply the "Twenty Questions" of Dr. A. Leighton's questionnaire as we hoped that Dr. Leighton might well be involved himself with work in Tunis and it seemed preferable that the application of the questionnaire should be supervised by him, and modified by him, if necessary, for Tunisian culture. Following consultation with Dr. Leighton this instrument is now being applied to a sub-sample of our subjects.

The Moreno type socio metric device was not used, as it would have needed considerable modification for our population.

Otherwise the December and January proposals were carried through in full.

Appendix II

The Population

The subjects at Djebel Djelloud, all male and aged from $6\frac{1}{2}$ to $8\frac{1}{2}$, were drawn from two major primary schools of the area, that in Rue du 3 Aout and that in Rue la Cagna (E.P.M.). There is in the area another primary school to which a proportion of the children may go. Most of the children came from the first grade but in order to control in some measure the relationships between degree of poverty and age of school entry we chose about one third of the children from second grade classes. The great proportion of the subjects came from the urban districts of Djebel Djelloud (60%), Djeb el Karrouba (16%) and el Affrane (16%) in which the number of registered families were 1889, 1070 and 449 respectively. At an average of 8 persons per family this gives a source population of 25-30.000. In addition, a few children came from bordering areas such as Dubosville, Sidi Fathalla and Kabaria (8% of the sample).

Although official information is that all children go to primary school, in fact a small proportion, which appears to be rather more than 5%, do not attend. We therefore added to our sample a sufficient number of children not attending school in order to obtain a representative population in this respect.

The number of male children attending the first grade classes at the two major elementary schools was 609. Forty-eight of these became our subjects; to this number must be added 25 children from the second classes, 2 children from the other schools in the area and 7 children not attending school to make up the total of 82 children in 81 families (two were brothers).

The subjects at Rue Charles de Gaulle were from the old European area of the city now occupied by the middle classes of Tunis but there are interspersed areas of poverty. The ten subjects came from the first two grades.

There were 20 subjects from the first and second grades of the Sadiki College (Annex) which traditionally prepares the leaders of the country. The children were all from upper and middle class families. In the total sample of 112 children there does not appear to be any French or Italian admixture.

The population at Djebel Djelloud were largely immigrant, and most of the fathers of our subjects were born outside Tunis as were some of the subjects themselves. The other two groups were largely from Tunis.

Appendix III

Validity and other notes on instruments

Physical Growth

The methods for evaluation of physical growth and health (including bone age) have an accepted validity. A number of the physical growth measures may be condensed, at a saving in time of about six minutes*, to give practically the same information. Some extra items (e.g. stool examinations) may be indicated, but these would require personnel and equipment not available at present.

Physical Function

The Harvard Step test shows only moderate variability between the well and poorly nourished. This may not be an appropriate method in its present form. Dynamic flexibility shows more than moderate variability and it is probably worth trying a little longer with strict adherence to correct application. Balance and dynamometer appear to discriminate satisfactorily between the well and poorly nourished.

Aspects of Adjustment

Some of the items used are not appropriate. For example (First Questionnaire) Question Nº 9 - "Is he easily wounded in his feelings?" is answered in the affirmative by almost all families. Such an answer apparently has social value in Tunisian culture. The following items appear more suitable: 4, 5, 8, 10, 11, 16 and 17. Although as previously stated these questions may be confounded by social class attitudes.

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* More than the six minutes saved at examination, one avoids costly and time-consuming analysis.

Mazes

Discriminates between the extremes but is not related to socio-economic condition within Djebel Djelloud. It is related both to the size and the age of the child.

Performance on Intelligence Tests

Kohs' Blocks in its present much modified form discriminates satisfactorily between the extremes used and also within the sector of Djebel Djelloud.

Figure Reconstruction does not discriminate between the extremes but within Djebel Djelloud is correlated with socio-economic condition.

Nutrition

The reasonable correlation of animal protein intake with the socio-economic variables suggests that the instrument may be appropriate for the time being. There is, however, evidence that with Djebel Djelloud there is little relationship between growth deficiency and present consumption. Obviously we must obtain some measure of past consumption especially during the second-third year of life.

Reliability of Instruments

Physical growth and health. This has already been referred to (see Boutourline Young, H., Modern Problems of Pediatrics, Vol. 7).

Physical Function

43 repeats on dynamometer	r = .90
10 repeats on dynamic flexibility	r = .70
22 repeats on balance	r not significant
20 repeats on Harvard Step	r = .89

Photography

Checks of 10 body heights with height derived from photograph. r = .96

X-ray

Plates judged by 2 independent observers. On 112 observations: r = .95

Mental Health

This questionnaire needs to be tried out further, perhaps in a simplified form because it is our impression that many of the items are not understood by the parents belonging to lower income groups.

Psychological Tests

It is proposed that the battery will be re-applied to series 1 - 20.

Psycho-Social

M. Baccouche, M. Zaidi and our own personnel. Fifteen repeats at intervals of 1 - 3 months from initial enquiry.

We have chosen provisionally 9 items:

	1. Index	r = .60
	2. Index	r = .65
Variables	3. Index	r = .80
44 - 49	4. Index	r = .85
(see page 11)	5. Index	Complete agreement
	6. Index	Complete agreement
Item 42	7. House	One disagreement in 80 families
Item 31	8. Occupation	One disagreement only in 80 families
Item 41	9. Income	r = .70

Nutrition

In 20% of the Djebel Djelloud sample the enquiry was repeated after an interval of 3 - 6 months. Total daily animal protein consumption was compared ($r = .72$).

Appendix IV (a)

Correlations of subcutaneous tissue measurements with some anthropometric variables

	Triceps	Biceps	Supra-crestal	Calf (int.)	Calf (ext.)
Triceps	-	.58	.51	.59	.64
Biceps	.58	-	.58	.53	.61
Supracrestal	.51	.58	-	.49	.54
Calf (ext.)	.59	.53	.49	-	.71
Calf (int.)	.64	.61	.54	.71	-
Weight	N.S.	N.S.	.33	N.S.	N.S.
Bicondyle humerus	N.S.	N.S.	.27	N.S.	N.S.
bicondyle femur	N.S.	N.S.	.28	N.S.	N.S.
Chest Circumference	N.S.	N.S.	.27	N.S.	N.S.
Ellipse	N.S.	N.S.	.24	N.S.	N.S.
Arm circumference	. 27	.24	.34	N.S.	.27
Calf circumference	N.S.	N.S.	.37	N.S.	.29

From the above correlation matrix it is readily apparent that supracrestal fat is the most indicative measurement in multivariate analysis.

Appendix IV (b)

Subcutaneous Tissue - Sadiki

	Triceps	Biceps	Supra-crestal	Calf (1)	Calf (2)
Triceps	-	.77	.66	.46	.61
Biceps	.77	-	.61	N.S.	.56
Supracrestal	.66	.61	-	.38	.51
Calf (1)	.46	N.S.	.38	-	.50
Calf (2)	.61	.56	.51	.50	-

Appendix IV (b)

Age Indicators

Correlations with selected variables of body mass

	Chronological Age	Skeletal Age	N° permanent teeth
Chronological Age	-	.38	.44
Skeletal Age	.38	-	.44
N° permanent teeth	.44	.44	-
Height	.36	.56	.49
Weight	.34	.55	.47
Bicondyle (1)	N.S.	.44	.29
Bicondyle (2)	.33	.57	.34
Supracrestal	N.S.	.38	N.S.

Skeletal age has the highest correlations with the selected anthropometric measurements. This justifies the continued use of this complex measure. The N° of permanent teeth has practically the same correlations as chronological age. Therefore the use of this variable may substitute for chronological age when accurate information is not obtainable on this latter point. Of the two bicondylar measurements, the second has higher correlations and will therefore be used also in the future.

Appendix IV (c)

Index of Socio-economic position

We considered the following socio-economic factors:-

Total family income

Occupation of head of household

Educational level of head of household

Type of house

N° of rooms occupied by the family

Unemployment in months in the last year of the head of household

The number of persons living with the head of household was also noted in connection with availability of space in the house and of probable allotment of family resources.

Three indexes of social position were prepared, based on the first four factors mentioned above.

The first was obtained by the addition of the scores assigned to occupation, educational level and type of house plus spare root of total family income divided by two. With this method income presents roughly the same trend and the same variability as the other factors.

The second index is based on the same elements, but with different weighting, and on logarithmic function of family income.

The third index gives the same weighting to all the factors previously transformed so that S.D. = 1, and Mean = 0.

For the purpose of evaluating these indexes of socio-economic position we have used an external criterion, that is, use of mass communication media. As a further check we also considered a crowding index based on N° of rooms divided by a logarithmic function of the N° of persons.

	Index I	Index II	Index III
Total family income	.80	.81	.82
Occupation	.84	.77	.76
Education level	.56	.58	.60
Type of house	.52	x	.72
Nº of rooms	x	x	.52
Nº of persons	x	x	.24
Crowding index	x	x	.43
Radio listening	x	N.S.	.35
Newspaper reading French	x	N.S.	.29
Newspaper reading Arabic	x		.24
Nº trips to town	x	N.S.	.24
Cinema	x	N.S.	.24
Index of mass communication	x	x	.21
Unemployment	x	-.39	-.34
Index of control	x	.52	.33
Protein intake	x	.66	.68
Perceived position social scale	x	.43	.45
Index of religious practices	x	N.S.	N.S.
Future expectations	x	-.48	-.33
Kohs' blocks, our adaptation	x	.34	.39
Figure reconstruction	x	.24	.32
Goodenough	x	x	.25

x Not calculated

Index II and Index III have fairly similar correlations with some independent variables, but Index III is more significantly correlated with some important elements of mass communication.

Furthermore from a conceptual point of view Index III appears more suited to an investigation where interest is centered on the effects of the various components of social position on child development, while Index II based on different weightings for each component of social class, gives a more precise definition of social hierarchy, but for our purposes such exact positioning of an individual on a scale is far less important than the recognition of the social factors, the relative importance of which, in terms of impact on the child, cannot be differentially determined.

Another advantage of Index III is that it does not require a preparatory phase of research, and may be adapted to studies of restricted sectors of social hierarchy.

Appendix IV (d)

Thoracic indexes

Chest circumference has been generally used as an indicator of chest development. At the suggestion of Prof. V. Correnti we have added two measurements, respectively of chest width and depth taken at the level of the nipple. From these two measurements we have constructed an empirical thoracic index:

$$T.I. = \frac{(\frac{D}{2})^2 + (\frac{D}{2})^2}{2} X$$

which represents an approximation of a transverse section of the thorax at the level of the nipple.

The use of this index is justified by the fact that it is based on two very simple measurements, easy to take and little subject to error.

Members of the field research group were: Dr. Elizabeth Boutourline Young, Dr. Gino Tesi, Dr. Richard Jessor and Dr. Harben Boutourline Young.

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