

# INTERRELATIONSHIPS BETWEEN ANEMIA AND FERTILITY

## PATTERNS IN RURAL EGYPTIAN WOMEN

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### INTRODUCTION

The hypothesis that malnutrition interferes with reproductive function has been verified by several reports. In Europe, studies done during famines following world wars, revealed two major findings: (a) secondary amenorrhea in women was associated with food shortage, and was reversed when food becomes available<sup>(1)</sup>; (b) delay in pubertal development in girls was related to failure to achieve the critical body size to trigger adolescence<sup>(1,2)</sup>.

In developing countries several studies on chronic protein-energy malnutrition and other specific nutritional deficiencies pointed the relation between malnutrition and disorders of sexual functions. Hypogonadism in adult men was observed in association with chronic protein-energy malnutrition and iron deficiency anemia<sup>(3,4)</sup>. In premenopausal women, vitamin B12 produce infertility, which occur before the appear-

ance of symptoms of pernicious anemia, and can be reversed by treatment<sup>(5)</sup>. In men pernicious anemia was observed to produce sperm abnormalities<sup>(6)</sup>. Iron and zinc deficiency were reported to produce hypogonadism and sexual infantilism<sup>(7-12)</sup>

Malnutrition in lactating women was reported to prolong the period of postpartum infertility<sup>(13-16)</sup>. In rural Guatemala, the period of postpartum infertility was reported to be significantly decreased with dietary supplementation during pregnancy<sup>(17)</sup>. In Bangladesh, Chen et.al.<sup>(13)</sup>, report on a seasonal trend in termination of postpartum lactational amenorrhea occurring most frequently following major rice harvest, due to improved nutritional status during increased food availability.

Socio-cultural and environmental factors influence reproductive behaviour particularly in rural communities, where most people reside. This influence is exerted through, the esteemed value of large family size, marriage at young age, the high risk of infant and child deaths, leading to high parity. High parity on the other hand is one of the important factors affecting maternal health and nutritional status.

The aim of this study is to investigate the relation of malnutrition as indexed by hemoglobin levels and anthropometry and the fertility of rural women.

### METHODOLOGY

The area of the study included two close-by villages in Beheira Governorate. At each village a unified health unit was available as a study station. The two villages were conveniently reached by motor traffic. The population of the two villages was homogeneous regarding their socio-economic level, they were mostly illiterate, engaged in agriculture, and living under poor sanitary conditions, which are the common features in rural life.

The sample included 500 eligible women (married women aged 15-45 years). The women were randomly selected and were interviewed at homes using a preplanned questionnaire. They were asked to report to the health unit for hemoglobin determination and anthropometric measurements. Reporting to the health unit was incomplete, so that complete fertility and nutritional data were obtained for only 357 women.

Fertility data included, age, age at marriage, duration of married life, numbers of pregnancies, abortions, stillbirths, living children and dead children. Anthropometric measurements included, heights and weights. Local reference standards for weight percentiles and weight for height percentiles were used<sup>(18)</sup>. Body index<sup>(18)</sup> was calculated using

the following formula:

$$\frac{\text{Weight}}{\text{Height}} \quad 2 \times 1000$$

Hemoglobin was estimated calorimetrically<sup>(19)</sup>. Identification of the level of anemia followed was that of WHO (1968)<sup>(2)</sup>, where 12 gm. of hemoglobin is the lower limit of the normal level in nonpregnant women. The degree of anemia was classified, mild anemia at 10-11 gm., moderate anemia at 6-10 gm., and severe anemia at less than 6 gm. of hemoglobin<sup>(21)</sup>.

## RESULTS

### General Characteristics of the Study Sample:

#### Age Structure and Duration of Married Life:

As presented in Table I, 40.9% of the total women were in the optimum child bearing age, (20-30 years), 6.2% and 14.8% were at the two extremes of reproductive life (15-less than 20 and 40-45 years). The mean age was 30.5 years. Around 60% of the women were married at the age of 15-19 years and 50% were married for less than 5-10 years. The mean duration of married life was 10.96 years for the total group.



### Nutritional Status:

#### Hemoglobin Levels:

The frequency distribution curve of hemoglobin in the studied population was shifted to the left indicating a high prevalence of anemia (Degree of skewness - 0.21) (Fig. I). The mean hemoglobin was 10.4 gms. for the total group, ranging between 9.7 at age less than 20 years and 11.1 gms. at age group 40-45 years as presented in Table II. Normal hemoglobin level was maintained by 30.2% of the total sample and anemia of various degrees was diagnosed in 70% of the total sample. Mild and moderate degrees of anemia were more prevalent than severe anemia at all age groups, and severe anemia was more prevalent at age group 30-39 years (Table III and Fig. II).

#### Anthropometric Measurements:

The mean body weights ranged between 62-64 Kgs., mean heights ranged between 158-163 cm. and mean body index ranged between 2.31-2.85 (Table II). Table IV and Fig. III, show the frequency distribution of the studied women by hemoglobin levels and weight percentiles and weight for height percentiles. Weight percentiles and degree of anemia showed a bimodal distribution, while the weight for height percentiles and degree of anemia showed a normal distribution, with a shift to the left indicating prevalence of underweight for height. The underweight for height follow the same pattern

of distribution of the anemia.

### Fertility Patterns:

#### General Fertility Performance at the time of the Study:

(Table I)

The proportion of the pregnant women at the time of the study was 9.8% and were distributed at all ages, with the highest frequency at the youngest age group. The distribution of pregnant women according to the duration of married life was bimodal, the two peaks were at early and late married life.

The proportion of nulligravid women at the time of the study was 13.4%, most of them were young and married for less than 5 to 5 years.

#### Fertility Pattern and Age: (Table V)

### Gravidity:

The pattern of pregnancy experience in the total group showed that they had on the average 3.6 previous pregnancies (excluding reported pregnancies at the time of the study). The highest average of pregnancies was 6.7 attained at the age of 40-45 years.

Pregnancy Interval:

The mean pregnancy interval was 2.14 years ranging between an average of 0.86-2.98 years at different age groups.

Parity:

The number of live births was on the average 3.27. The age specific parity ranged between an average of 0.64-5.77 with the highest average at the age 40-45 years.

Abortions:

Abortion experience in the total group was on the average 0.22. The age specific mean abortions ranged between a mean of 0.18-0.59. The highest means were at both ends of fertile years.

Mean Still Births:

The mean still births was 0.07 in the total group, ranging between 0.03-0.11 and showing the same trend as abortions regarding age distributions.

Total Child Losses:

Child death experiences was highest at the age group 40-45 years, which was on the average 0.75. The mean total child lossess in all the group was 0.36.

Family Size:

The number of living children was on the average 2.8 for the total group. The mean number of living children ranged between 0.64-4.1 with the highest mean at age 40-45 years.

Fertility Pattern and Duration of Married Life: (Table VI)

The table shows that the mean reproductive activity increases with increase in years of married life. At 20 years of married life, the mean numbers of pregnancies was 7.20, mean live births was 6.50 and mean numbers of living was 5.64. Pregnancy wastage and child deaths were highest 0.69 and 0.97 respectively. The mean duration of married life was 10.69 years, where around 50% of this reproductive capacity was achieved (4.33 pregnancies and 3.98 live births on the average). Reproduction at early years of married life and at late years was associated with high proportion of pregnancy wastage and child mortality as presented in Table VIII.

At duration of married life less than 5 years and 20 years, the percentages of live births were 85.8 and 91.0 respectively, percentages of pregnancy wastage were 13.2 and 9.8, respectively and percentages of total child losses were 9.9 and 12.10 respectively. The differences between

these values were not statistically significant.

Fertility Pattern and Hemoglobin Levels (Table VII):

The table shows that anemia tends to reduce fertility at all ages. The mean gravidity was lower in the anemic group compared to the normal (6.0 in anemic group at age 40-45 years compared to 6.7 in the normal group at the same age), the difference between normal and anemic mean numbers of pregnancies was not significant at any age group. The mean pregnancy interval in the total anemic group was 2.65 years compared to 2.11 years in normal group, the difference was significant at  $p = < 0.05$ . The same trend was observed for the different age groups but the difference was not significant.

The mean parity was higher in the total normal group compared to the anemic 3.44 and 3.27 respectively. Age specific parity was higher for normal group than anemic group, the difference was not significant.

The mean family size was higher in normal than in anemic women, 3.18 and 2.7 for all ages respectively. At age 40-45 years mean family size in normal women was statistically higher than that for anemic women, 5.8 and 3.0

respectively ( at  $p = < 0.05$ ). The hypofertility in anemic women was also demonstrated by the data presented in table VIII. In anemic women the percent live births was 92.7 compared to 94.4 in the normal. Pregnancy wastage was 10. in anemic women compared to 5.8% in the normal and total child losses was 11.3% in anemic compared to 10.8 in the normal (the differences were not statistically significant.

### DISCUSSION

This report together with several other reports from studies in developing countries (22,23) indicate that the average number of live births range between 6 to 7 children at the age of completed fertility. Although this is far below the maximum average of 11 to 12 children (2), yet it results in a rapid rate of population growth, due to decreased mortality. It is estimated that the rate of population growth in the Middle East is 2.9 - 3.0, which is three times that of the Western World (24).

A well nourished couple who do not practice contraception would be able to attain the maximum numbers of children by the end of the reproductive life, under favourable socio-environmental conditions. Undernutrition, contraceptive abortion, biological variations in pregnancy interval, late

marriage and venereal disease, tend to reduce this maximum number, to the advantage of developing countries. Venereal disease and other infections reported by WHO (25) to be involved in sterility and hypofertility in Sub-Saharan Africa. Undernutrition affects reproductive ability by shortening the duration of reproductive life span and by reducing its efficiency. Undernourished females has menarche later and menopause earlier than does well nourished females (26). Undernutrition reduces reproductive efficiency through, reduction in energy reserves and tissue vitality as a result of anemia and other specific nutritional deficiency. As it is well known that malnutrition is a multifactorial syndrome, and that anemia is one of its multiple features, it is difficult to conclude whether anemia per se predisposes to hypofertility or there exists a common demonstrator for both anemia and hypofertility within the complex of malnutrition.

Socio-cultural and environmental factors, influences, reproductive behaviour particularly in rural communities. The influence is exerted through the esteemed value of the large family size, marriage at young age, the high risk of infant and child deaths. Young newly married women living in rural extended families, are often under social pressure to prove their biological capability by child birth. Their early marriages place the child bearing years in the period of

incomplete sexual maturation, the outcome would be unfavourable, ranging from sterility to high risks of abortions and still births.

The mean age at marriage was 20.6 years which is optimum for reproduction, (although a great proportion was married under 20 years of age). However, to the advantage of this community the mean duration of married life was somewhat short (10.69 years). It is commonly known that duration of married life and age at marriage can be measures of the numbers of years during which women are exposed to the risk of pregnancy. Exposure to pregnancy, is directly related to fertility, which increases with the increase of duration of married life and the decrease of age at marriage.

The mean pregnancy interval observed in the study, was around 2-3 years; which is close to that observed in Punjab India (27). Older women tend to have longer pregnancy intervals than younger women, and anemic women tend to have longer pregnancy interval than normal women. Prolongation of pregnancy interval may be due to missed abortions (as often occurs in the first two months of pregnancy), natural infertility influenced by lactation and anemia. The prolongation of pregnancy interval by age, may be related to the physiological increase of duration of postpartum amenorrhea with age(28).



A relationship between anthropometric measurements and reproductive capacity was reported by several workers. Loss of body weight by 10-15% which amounts to a loss of about 30% of body fat, or putting on excess body fat result in amenorrhea and disturbance in menstrual cycle (30,31). Such type of relationships could not be established in this study. A tendency towards underweight for height as evidenced by lower body index incomparison with local standard average (18), was observed indicating undernutrition. The impact of underweight on fertility pattern could not be evaluated in this study, further investigation in this area are suggested.

### SUMMARY

The population covered in this study included rural females in the child bearing age (15-45). The discription of health and nutritional status as measured by weight, height, body index, and hemoglobin levels were given.

Interrelationship between reproductive performance, gravidity, pregnancy outcome, pregnancy interval family size and child mortality, and nutritional status, age, age at marriage, duration of married life were evaluated.

Frequency distribution curve of hemoglobin in the studied population was shifted to the left indicating a high prevalence of anemia. The degree of anemia varied with age and anemia in general was a major factor affecting fertility pattern.

Anemic women experienced lower mean gravidity, particularly at older ages, higher percentage of still births and reported abortions and a longer pregnancy interval compared to nonanemic.

The population of non-fertile women was higher in the anemic group, indicating that anemia not only affect pregnancy

outcome, but also, the ability to conceive.

The data indicated that interaction between nutritional state, environmental conditions and fertility performance is the major determinant of human reproduction.

Table 1. Distribution of Women According to Duration of Married Life, Age and Age at Marriage and the State of Reproduction at the Time of Study.

Years	Duration of Married Life						
	5	5-	10-	15-	20-	All	
Total Women	No.	99	81	66	53	58	357
	%	27.7	22.7	18.5	14.8	16.2	100
Gravid	No.	13	9	4	4	5	35
	%	31.1	11.1	6.1	7.5	8.6	9.8
Nulligravid	No.	35	10	3	-	-	48
	%	35.4	12.3	4.5	-	-	13.4

Years	Age					
	20	20-	30-	40-45	All	
Total women	No.	22	146	136	53	357
	%	6.2	40.9	38.1	14.8	100
Gravid	No.	4	10	18	3	35
	%	18.2	6.8	13.2	5.7	9.8
Nulligravid	No.	7	35	5	1	48
	%	31.2	24.0	3.7	1.9	13.4

Years	Age at Marriage				
	20	20-	30-	All	
Total women	No.	223	122	12	357
	%	62.5	34.2	3.3	100

Table 11. Mean (X), Standard Deviation (S) of Hemoglobin in gm %, Body weight in Kg., Height in Cm. and Body Index by Age.

		<u>Age in Years</u>				
		<u>20</u>	<u>20-</u>	<u>30-</u>	<u>40-45</u>	<u>All</u>
Hemoglobin in gm.	(X)	9.7	10.4	10.0	11.1	10.4
	(S)	2.5	2.86	2.98	2.81	2.9
Body weight in Kg.	(X)	62	63	61	64	
	(S)	6.17	8.23	9.15	9.9	
Height in Cm.	(X)	158	162	162	163	
	(S)	8.4	7.8	6.9	8.2	
Body Index	(X)	2.36	2.31	2.85	2.37	
	(S)	0.29	0.34	0.30	0.44	

Table 111. Frequency Distribution of Women by Age and Hemoglobin Levels.

Hemoglobin levels		Age in Years				
		20-	20-	30-	40-45	All ages
Normal	No.	4	45	38	21	108
	%	18.4	30.8	27.9	39.6	30.2
Mild anemia	No.	10	48	53	13	124
	%	45.9	39.0	39.0	24.5	34.3
Moderate anemia	No.	8	47	38	18	101
	%	36.4	32.2	27.9	34.0	31.09
Severe anemia	No.	-	6	7	1	14
	%	-	4.1	5.1	1.9	3.92
Total No. of Women		22	146	136	53	357

Table IV- Frequency Distribution of Normal and Anemic Women According to Weight and Weight/Height percentiles.

Percentiles																				
3rd			10th			25th			50th			75th			90th			97th		

Table V- Fertility Patterns by Age.

Fertility	Age in Years									
	20		20-		30-		40-45		All ages	
	X	S	X	S	X	S	X	S	X	S
Gravidity	0.86	(0.81)	2.2	(1.8)	4.4	(2.30)	6.7	(2.5)	3.6	(2.7)
Pregnancy Interval.	0.8.6	(0.83)	2.29	(1.44)	2.98	(1.31)	2.74	(1.23)	2.14	(1.41)
Parity	0.64	(0.74)	1.97	(1.73)	4.01	(2.21)	5.77	(2.49)	3.27	(2.5)
Abortions	0.5.9	(0.83)	0.18	(0.58)	0.25	(0.73)	0.51	(0.73)	0.22	(0.62)
Still Birth	0.09	(0.43)	0.03	(0.18)	0.08	(0.32)	0.11	(0.32)	0.07	(0.27)
Total child losses	0.05	(0.12)	0.17	(0.45)	0.49	(1.06)	0.75	(1.16)	0.36	(0.76)
Family size	0.64	(0.73)	1.60	(1.45)	3.5	(2.04)	4.1	(2.9)	2.8	(2.2)

Note: Mean (X)  
Standard deviation (S)



Table VI - Fertility Pattern by Duration of Married Life.

Fertility	Duration of Married Life in Years									
	5		5-		10-		15-		20-	
	X	S	X	S	X	S	X	S	X	S
Grauidity	1.20	(1.22)	2.50	(1.57)	4.33	(1.90)	5.40	(2.05)	7.20	(1.87)
Parity	0.97	(1.23)	2.36	(1.47)	3.98	(1.78)	5.16	(1.73)	6.50	(2.04)
Pregnancy wastage	0.14	(0.06)	0.21	(0.72)	0.29	(0.69)	0.32	(1.01)	0.69	(1.48)
Total child losses	0.02	(0.2)	0.12	(0.4)	0.42	(0.8)	0.70	(1.15)	0.97	(1.46)
Family size	0.89	(1.12)	2.25	(1.44)	3.56	(1.62)	4.72	(1.67)	5.64	(2.24)

Note : Mean (X)  
Standard deviation (S)

Table VII . Fertility Pattern by Age and Hemoglobin Levels.

	Age in Years									
	20		30		40-45		All ages			
	X	S	X	S	X	S	X	S	X	S
<u>Gravidity</u>										
Normal	0.76	(0.50)	1.91	(1.65)	4.92	(2.48)	6.71	(2.43)	3.67	(2.81)
Anemic	0.88	(0.93)	2.28	(1.93)	4.42	(2.18)	6.00	(2.92)	3.47	(2.52)
t-test	0.224		1.019		1.154		0.903		1.33	
<u>Pregnancy Interval in Years</u>										
Normal	1.51	--	2.23	(1.36)	2.82	(1.44)	3.31	(1.12)	2.11	(1.40)
Anemic	1.44	(0.90)	2.29	(1.48)	3.04	(1.26)	3.22	(1.25)	2.65	(1.43)
t-test	0.1709		0.2302		0.8773		0.3262		3.315	
<u>Parity:</u>										
Normal	0.72	(0.50)	1.73	(1.62)	4.13	(2.22)	6.32	(2.39)	3.44	(2.68)
Anemic	0.53	(0.72)	2.06	(1.22)	4.16	(2.08)	5.84	(2.40)	3.27	(0.45)
t-test	0.632		1.060		0.074		0.728		0.585	
<u>Family size</u>										
Normal	1.07	(1.23)	1.62	(1.51)	3.8	(2.02)	5.81	(2.25)	3.18	(2.46)
Anemic	0.53	(0.72)	1.87	(1.65)	3.85	(1.98)	3.00	(2.70)	2.70	(2.16)
t-test	1.25		0.812		0.131		3.99		1.84	

Note: Total No. of Normal women = 108

Total No. of Anemic women = 249

\* Significant at P 0.05

Table VIII- Pregnancy Outcome According to Hemoglobin Levels and Duration of Married Life

Hemoglobin levels:		Pregnancy		Live Still		Abortions		Preg.		Child	
				births		births		wastage		losses	
		No.	%								
Normal		412		389	7	17		24		42	
				94.4	1.7	4.1		5.8		10.8	
Anemic		860		797	16	71		87		90	
				92.7	1.9	8.3		10.1		11.3	
Duration of Marriage:											
Less than 5 years		No.	%								
		106		91	2	12		14		9	
				858	1.9	11.3		13.2		9.9	
5-9		No.	%								
		198		191	5	12		17		10	
				96.5	2.5	6.1		8.6		5.2	
10-14		No.	%								
		274		260	2	17		19		27	
				94.9	0.7	6.2		6.9		10.4	
15-19		No.	%								
		283		270	7	10		17		33	
				95.4	2.5	3.5		5.0		12.2	
20+		No.	%								
		411		374	6	34		40		53	
				91.0	1.5	8.2		9.8		14.2	
All ages		No.	%								
		1272		1186	23	88		111		132	
				93.2	1.8	6.9		8.7		11.3	

\* Excluding a total number of 35 pregnancies at the time of the study.

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