STUDY BY MATCHING OF THE DEMOGRAPHIC IMPACT OF AN IUD PROGRAM

A Preliminary Report

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A most important question about the IUD program is how much it will contribute to the fertility decline in a population. An earlier report[1] of a co-author indicated that the fertility of the intrauterine contraceptive device (IUD) acceptors was 54 per cent higher than that of the average of the married women in Taiwan. The women were selected also in terms of recent births: their open intervals[2] averaged 21 months compared with 37 months for the average of the married women included in the KAP[3] survey sample. After the first acceptance, their fertility declined by about 76 per cent compared with only about a five per cent decline among the married women in general.

The comparison above, however, overestimates the impact of the IUD because the acceptors had been subjected to a higher demographic pressure and were also "selected" by a stronger motivation for family limitation. Their fertility would have declined more than married women in general even if there had been no IUD.

A strict "control group" study is not feasible, but one way to estimate the real demographic impact of the IUD is by "matching."

Taiwan is fortunate in having a unique household registration system from which can easily be obtained not only the names and addresses of married women but also their characteristics such as

age, level of education, number of live births and the date of each live birth. Moreover, the Taiwan Population Studies Center, through the coupon system, keeps a complete registry of IUD acceptors from the beginning of the program in January, 1964. From this registry the names of the acceptors and the dates of first acceptance of IUD can be obtained. Comparing these two sets of registers, one can identify the IUD acceptors and nonacceptors.

The IUD acceptors are then "matched" with the nonacceptors who have characteristics similar to acceptors at the time of first insertion, and the fertility rates of the "acceptors" before and after the first acceptance can be compared with the corresponding rates of the "matches." This study method suggests what the fertility of the IUD acceptors would have been without an IUD program.

A pilot study was undertaken in January, 1968. The present paper reports its results.

MATERIAL AND METHODS

Three townships (Chen) in Nantou County (Nantou, Tsao-tun and Ming-chien) and one in Taichung County (Wu-Feng) were selected for the pilot study. It was in Nantou County where a family planning program, designated as the "pre-pregnancy health" (PPH) program, using mainly the conventional contraceptive methods, (condoms and foam tablets), was started in 1959, before the beginning of the islandwide IUD program in 1964. It was also in Nantou where a study to evaluate the effect of the PPH program by "matching" was conducted in 1962 by the Taiwan Population Studies Center.[4]

The "acceptors" under the current study are the women who had accepted loop insertion before the end of 1966. Women who accepted the IUD after January, 1967, were not included.

It is known that, because of migration, the "matching" can never be complete. About ten per cent of the IUD acceptors probably will move out every year. To test the feasibility of the study, two villages in Nantou Township were taken, and the names of IUD acceptors were compared with the complete name list of the married

women in these villages. About 80 per cent of the IUD acceptors recruited from the villages from 1964 to 1966 could be identified. In January, 1968, a female worker was employed to visit the registration office of Nantou Township, and to copy all the names of married women 20–44 years old, as of the date of transcription, according to the administration; village (li) and section (lin).

The names of the acceptors on the IUD registry in the Taiwan Population Studies Center are also in order of administrative subdivisions. Dates of the first insertions are in the registry.

The next job is to compare these two sets of registries and to identify the names of the IUD acceptors from the complete name list of married women. If the name of an acceptor from the village specified cannot be found, the investigator will attempt to find the woman in another village within the township. No further effort is made to identify the name from other townships.

In copying the names, the dates of birth, level of education and dates of each live birth of the women are also copied.

From the date of the first insertion, the fertility of the women before and after the first acceptance can be calculated.

To minimize possible bias in estimating the fertility of the IUD acceptors before acceptance, who include more postpartum cases than average, the average fertility over three years before the first acceptance is taken.

All the information about the married women (both the IUD acceptors and nonacceptors), including age, number of live births, level of education, date of first insertion of loop and open interval is then punched onto computer cards.

The criteria of "matching" include age, education, open interval and number of live births as of the date of the first insertion. The following classifications are made:

A. Age at first insertion: below 30, 30–34, 35–39, and 40–44 (four groups).
B. Education: no formal, primary, junior high school and above (three groups).
C. Open interval: less than 6 months, 7–12 months, 13–24 months, 25 months and longer (four groups).

D. Number of live births: 1–2, 3, 4, 5, 6+ (five groups).

The "matching" was not by individual cases, but by groups. The total IUD acceptors in a township during 1964 to 1966 in each township were first sorted into three groups by year of acceptance: 1964, 1965 and 1966. The 1964 acceptors were then sorted into four age groups. Each of these groups was again sorted into three educational groups, each of the subgroups into four groups by open interval and, finally, each of them into five groups for number of live births, to make 240 small groups ($4 \times 3 \times 4 \times 5$).

The same grouping is done for the nonacceptors in the respective township.

To estimate the "open interval" of the nonacceptors, all the accceptors were assumed to have accepted the IUD on July 1 of the year. For each nonacceptor in the township, three "open intervals," each estimated from July 1, 1964, 1965, and 1966, respectively, were punched onto a computer card.

Any matched case that had a live birth within nine months from July 1 of the year was disqualified, because it is unlikely for the IUD acceptor to have a live birth within nine months following the insertion of the device.

The same process was carried out for the 1965 and 1966 IUD acceptors, and for the other townships.

RESULTS

"Rate of Response"

A total of 4,776 IUD acceptors were recruited from the study townships from 1964 to 1966. Available statistics suggest that about ten per cent of these would be reinserted cases. The estimated first acceptors, therefore, would be about 4,300 cases.

By comparing the names of IUD acceptors with the name list of married women, 3,181 IUD acceptors were identified. The "response rate" was about 74 per cent. The rest could not be identified, probably because of migration or because the addresses on the coupons were incomplete.

TABLE I. FERTILITY RATE OF IUD ACCEPTORS BEFORE THE FIRST ACCEPTANCE AND OF MARRIED WOMEN IN GENERAL BY YEAR OF ACCEPTANCE

Year of Acceptance	*Fertility Rate per 1,000*		
	*Acceptors**	*Married Women***	*Ratio*†
1964	384	266	144
1965	375	245	153
1966	387	235	165
Average	381	248	154

* Average of three years before the first acceptance of IUD.

** Three-year average fertility of the married women in general of the IUD acceptors. For instance, for comparison with the fertility of 1964 acceptors, the average fertility of the married women in general in the township in 1964, 1963, 1962, and 1961 was taken, with 1964 and 1961 rates being given half the weight.

† Married women = 100.

The Sample

The sample size, the number of IUD acceptors identified, was 463 for 1964, 1,434 for 1965, and 1,284 for 1966, totalling 3,181. An equal number of "matches" were selected from the nonacceptors for the comparison.

December 31, 1967, was the cut-off date. The average length of observation was 39.2 months for the 1964, 31.2 months for the 1965, and 18.4 months for the 1966 acceptors.

Fertility of IUD Acceptors as Compared with Married Women

Higher than average fertility of the IUD acceptors was found among the acceptors under the present study.

Table 1 indicates that, on the average, the fertility of the acceptors was 54 per cent higher than the corresponding fertility of the married women in general in the township. The difference was less (44 per cent) for the 1964 acceptors, compared with the 1966 acceptors (65 per cent). This might have been because, in 1966, a larger proportion of the married women were already protected by the IUD and other fertility control methods. The preinsertion total marital fertility rates of the acceptors did not decline with the more recent acceptance. In 1964, the rate was 384, which rose slightly to 387 in 1966 (all per 1,000). The program had been continuously recruiting highly fertile women to accept the IUD.

TABLE 2. FERTILITY RATES OF IUD ACCEPTORS AND MARRIED WOMEN IN GENERAL, BY AGE GROUP

Age Group	*Fertility Rate per 1,000*		*Ratio†*
	*Acceptors**	*Married Women***	
Below 30	513	394	130
30–34	378	230	165
35–39	243	112	216
40–44	185	50	368

* Average of three-year period before the first insertion.
** Average fertility rate of 1963–64 in the study townships.
† Married women = 100.

The difference of fertility between the IUD acceptors and the married women in general increased with age, as reported earlier.[1] For the younger age group of less than 29 years, the difference was 30 per cent, which increased to 116 per cent for women 35 to 39, and 268 per cent for those 40 to 44 years (Table 2).

Fertility of Acceptors and "Matches"

Because of the matching procedures, which take the number of previous live births into account, the preinsertion fertility rates of the acceptors and the corresponding fertility rates of the "matches" were about the same. This is important because one of the most serious and valid criticisms of some earlier work on the demographic impact of family planning program was on this point.

To compare the postinsertion fertility with the corresponding "after" fertility of the "matches," three indices are used:

1. Percentage decline of fertility before and after "acceptance."
2. Index of fertility decline of the acceptors against the "matches." The index is obtained by the following formula:

$$\text{Index} = \frac{A_1 \cdot \frac{M_2}{M_1} - A_2}{A_1 \cdot \frac{M_2}{M_1}} \times 100 = \frac{\text{Expected F.} - \text{Observed F.}}{\text{Expected F.}} \times 100$$

Where: A_1 = fertility rate of acceptors before first acceptance
A_2 = fertility rate of acceptors after first acceptance

M_1 = corresponding "before" fertility of "matches"
M_2 = corresponding "after" fertility of "matches"
F = fertility rate per 1,000

The term, "expected fertility" $(A_1 \cdot \frac{M_2}{M^1})$ assumes that the post-insertion fertility of the acceptors would have declined at the same rate as did the "matches" had they not accepted the IUD.

The index, therefore, is the percentage decline of this "expected" fertility caused by the IUD program, which may be regarded as the *net* effect of the IUD program. It has a maximum value of 100 if the postinsertion fertility rate becomes zero.

3. Births averted by insertion of 1,000 IUDs. This is obtained by the term $(A_1 \cdot \frac{M_2}{M_1} - A_2)$, which is the numerator of the formula above. This is the total effect of IUD acceptance, not only the effect of the actual use of IUD.

By year of first acceptance. On the average, the fertility of the acceptors declined from 381 before to 77 after the first acceptance, or a reduction of 80 per cent. The decline was less significant for the "matches": from 376 to 195, or a reduction of 48 per cent.

The decline of the acceptors was about 80 per cent (78 per cent to 82 per cent) regardless of the year of acceptance, whereas that of the "matches" was inversely correlated with the recency of acceptance, from 56 per cent for 1964 to 40 per cent for 1966 groups. Aging and increased demographic pressure felt probably were the causes of this difference.

Consequently, more births are averted by more recent acceptors: 158 births per 1,000 insertion for the 1966 acceptors, but only 99 for the 1964 ones. The "net" demographic effectiveness of the IUD will decrease gradually.

It has to be pointed out, however, that even among the 1964 acceptors, who accepted the device 39 months before the cut-off date on the average, and the majority of whom should have terminated its use, the "net" effectiveness was still at 99 per 1,000, or one birth averted a year per every ten IUD insertions. The hypothesis

TABLE 3. FERTILITY BEFORE AND AFTER FIRST ACCEPTANCE OF IUD, FERTILITY DECLINE AFTER ACCEPTANCE AND BIRTHS AVERTED, BY YEAR OF FIRST ACCEPTANCE

Year of First Acceptance	*Sample Size*	*Fertility Rate per 1,000*				*Fertility Decline*			*Births Averted per 1,000*
		Before		*After*		*Cases*	*Matches*	*Index*	
		Cases	*Matches*	*Cases**	*Matches*	%	%	%	
1964	463	384	390	70	172	82	56	58	99
1965	1,434	375	370	82	193	78	48	58	113
1966	1,284	387	377	74	227	81	40	68	158
Total	3,181	381	376	77	195	80	48	61	121

* Nine months were deducted from each case for calculation of postinsertion fertility because, when the loop was inserted, the woman was not pregnant. She could not have a live birth within the following nine months. The same deduction was made for the "matches" also because they were selected in a way that they could not have live births within nine months.

that the real effect of IUD would last much longer than the actual length of time when the device is in the uterus seems to be true.

On the average, 6.3 loops will prevent one live birth a year during the first year, beginning nine months after insertion. This number will increase to 8.8 loops during the second year, and about 10 loops during the third year, averaging 8.3 loops preventing one birth a year during the first three years after insertion.

The index of fertility of decline was 58 per cent for the 1964 and 1965 acceptors and 68 per cent for the 1966 cases. This index will be affected by both the values in the numerator and the denominator. The denominator ("expected" fertility) for the 1964 acceptors will be smaller because of more fertility decline by the "matches" (smaller value of M_2/M_1); therefore, a smaller actual value of the numerator ("expected"–observed fertility) will make the index appear larger. In other words, the "expected" fertility of the 1964 acceptors has been cut by 58 per cent because of the acceptance of IUD (see Table 3).

Although the "birth averted" by IUD insertion will decrease rather sharply year after year, the index of fertility decline may remain rather stable.

By number of live births. The percentage of fertility decline was higher for the women who had had more live births: 91 per cent for women with six or more, but steadily declining to 50 per cent for those with less than two live births. This is understandable

because the IUD stays in the uterus longer for women of higher parity, who are also more strongly motivated to keep their family size smaller.

A similar but much stronger trend was observed also among the "matches," which decreased from 70 per cent for women with six or more live births to only two per cent for these with less than two live births.

Consequently, more births were prevented among women of lower parity: 221 births per 1,000 insertions among women of less than two live births, which sharply decreased to 69 births for those with more than six live births.

The variation of the index of fertility decline was less remarkable, ranging from 49 per cent to 71 per cent, averaging 61 per cent.

Acceptors of lower parity tend to be more recent acceptors, and,

TABLE 4. FERTILITY BEFORE AND AFTER FIRST ACCEPTANCE OF IUD, FERTILITY DECLINE AFTER ACCEPTANCE AND BIRTHS AVERTED, BY NUMBER OF LIVE BIRTHS

Number of Live Births	*Sample Size*	*Fertility Rate per 1,000*				*Fertility Decline*			*Births Averaged per 1,000*
		Before		*After*		*Cases*	*Matches*	*Index*	
		Cases	*Matches*	*Cases*	*Matches*	*%*	*%*	*%*	
Less than 2	352	465	433	235	425	50	2	49	221
3	658	427	438	95	270	78	38	63	170
4	804	376	379	68	172	82	55	60	101
5	590	346	339	42	142	88	58	71	103
6 or more	777	336	321	32	97	91	70	69	69
Total	3,181	381	376	77	195	80	48	61	121

TABLE 5. FERTILITY BEFORE AND AFTER FIRST ACCEPTANCE OF IUD, FERTILITY DECLINE AFTER FIRST ACCEPTANCE AND BIRTHS AVERTED, BY WIFE'S CURRENT AGE

*Age Group**	*Sample Size*	*Birth Rate*				*Fertility Decline*			*Births Averted per 1,000*
		Before		*After*		*Cases*	*Matches*	*Index*	
		Cases	*Matches*	*Cases*	*Matches*	*%*	*%*	*%*	
Below 30	1,124	514	504	150	315	71	37	53	173
30–34	1,091	378	379	51	173	87	54	71	123
35–39	780	243	237	30	97	88	59	70	70
40–44	186	185	161	—	7	100	95	100	9
Total	3,181	381	376	77	195	80	48	61	121

* Age at last birthday, counted at the time of first insertion.

as shown previously, the IUD program should have had a higher impact on them. Although it probably is true that more births would be averted by acceptance at lower parity, the differential might not be so strong as it appears in Table 4 if other factors, such as the year of first acceptance, are standardized.

By age group. Because of a positive strong correlation between age and parity, the general trend indicated in Table 5 agrees fairly well with that of Table 4.

More births are prevented when the IUD is accepted by younger women: 173 births per 1,000 insertions for women of less than 30 years of age, which decreased sharply to only nine births by women 40 years old or over.

The index of fertility decline of 53 per cent among women of the youngest age group was significantly lower than that of the other higher age groups. Because the absolute fertility is higher the actual contribution of IUD in terms of births averted will be more among younger women.

Potter reported that the net number of births averted per IUD inserted is fairly similar among five-year age groups within the age range 20 to 39 years, though the most favorable combinations of potential fertility and retention of the device, from the standpoint of averting births, appear to coincide with the two intermediate age groups of 25 to 29 and 30 to 34 years.[9] The finding of the current study seems to conflict with his results. The difference is caused by the fact that, although the present study takes into account the total effect of the IUD program (including the program impact after termination of use of IUD), that of Potter included the effect of the IUD only during the time it was actually worn.

Although the IUD is relatively short-lived among younger women of lower parity, if the total effect (including the "after" effect) is considered, a definite advantage is found when younger women of lower parity are encouraged to accept the device. The IUD program should hereafter emphasize this particular point more, disregarding the higher termination rates among the younger women.

By level of education. Table 6 indicates that women with primary school education had had the highest preinsertion fertility rate

TABLE 6. FERTILITY BEFORE AND AFTER FIRST ACCEPTANCE OF IUD, FERTILITY DECLINE AFTER FIRST ACCEPTANCE AND BIRTHS AVERTED, BY WIFE'S EDUCATION

Education	Number of Cases	Birth Rate Before Cases	Before Matches	After Cases	After Matches	Fertility Decline Cases %	Matches %	Index %	Births Averted per 1,000
None	1,458	368	367	68	187	82	49	64	120
Primary	1,411	397	386	86	213	78	45	61	132
Junior high and above	312	371	367	81	152	78	59	48	71
Total	3,181	381	376	77	195	80	48	61	121

(397), higher than those without any formal education (368). This is rather unexpected and worth exploring further.

The IUD program seems to have had significantly higher impact on the women with lower education. The index of fertility decline was 64 per cent for the women without formal education, but only 48 per cent for those with junior high school education or above. The number of births averted per 1,000 insertions was 120 for women without formal education, 132 for those with primary, but only 71 for those with junior high school or above.

Women with higher education have had more choices of methods to control fertility in the absence of IUD. This suggests that, even if the IUD program did not exist, more women of higher education would have used other means to control fertility; but, for those with lower education, their fertility would have remained high. The IUD program has had a stronger demographic impact on the less-educated women, which is in line with the program objectives.

Because women of low education are the overwhelming majority in most of the countries where the need for family planning is pressing, this finding is important.

Discussion. Skepticism has been expressed by some demographers[5] that the reported hundreds of thousands of insertions of IUD in Taiwan and Korea may give only an illusion of success because:

1. The acceptors are mostly women of high parity who are too old to have many more children.
2. The programs are "skimming the cream." The acceptance

rates must fall when the small, highly motivated group of high parity is exhausted.

3. Discontinuation rates for the IUD's are so high as to mean little protection.
4. The net result is that few births are averted, and the IUD's do not help those who come into the program to prevent any substantial number of births.

To the questions above, evidence has been presented[6] based on the experience in Taiwan, that:

1. The program has reached a part of the population that could have many more births.
2. As time goes on, the program is reaching more rather than less of the relevant couples.
3. A substantial proportion of those entering the program are still practicing birth control and preventing many births some years after entering the program.
4. The acceptors are having many fewer births after than before entry into the program and many fewer than they might be expected to have.

Another fundamental question, however, has not been answered. The IUD acceptors are selected not only in terms of higher than average fertility, and with recent births, but also in terms of stronger than average motivation for family limitation. Their fertility would decline more than the married women in general even without the IUD program.

The question is valid and is critical in discussing the demographic impact of the IUD. Because of the stronger demographic pressure on them, if the IUD acceptors had used some other fertility control methods, including contraception, sterilization and induced abortion, in the absence of the IUD, the "net" program impact of the IUD would be minimized because the device would simply be "substituting" some other methods.

To answer the question is extremely difficult, and "matching" seems to be a feasible method.

Evaluation of the impact of a family planning program by

TABLE 7. FERTILITY OF ACCEPTORS AND "MATCHES" IN FAMILY PLANNING PROGRAM IN NANTOU TOWNSHIP

	Acceptors	*Matches*
Birth rate (per 100 person-years) in 5 years preceding entry into program	38.0	34.2
Birth rate (per 100 person-years) from entry into program to June 30, 1962	10.4	13.1
Per cent reduction	73	62

"matching" in Taiwan was first attempted by Takeshita in 1962.[4] The acceptors of a family planning program, mainly using conventional contraceptive methods (condom and foam tablets) in Nantou County were "matched" with the nonacceptors in the area. Of the total of 1,361 cases, 1,021 were successfully matched. The criteria of matching included wife's age, duration of marriage and number of living children and sons. It was further stipulated that the matching case should not have had a live birth within nine months of the corresponding case's entry into the program.

Comparison was made of the birth rate per 100 person years in five years before and after the entry into the program until June 30, 1962. The result is shown in Table 7.

Although the analysis above indicated that the program was "moderately" effective, the fact that the fertility of nonacceptors had also declined as much as 62 per cent caused some concern.

The concern seems to be particularly relevant in the case of an IUD program, in which much stronger motivation is needed for acceptance than for the conventional methods. In fact, under the current study, the fertility of the "matches" had declined as much as 48 per cent. Although the corresponding decline of the acceptors was higher, being 80 per cent, the "net" demographic impact of the IUD program seems to be less than the apparent before-after fertility decline among the acceptors.

It is true that the "matching" method underestimates the real program impact. In the first place, the fertility decline of the "matches," no doubt, was caused partly by the influence of the program activities. Moreover, it might be that the "matches" did not

accept the IUD because they had accepted some other method. The latter point, however, might be argued to the contrary; the "matches" being less motivated, so that they did not accept the IUD. It will, therefore, be of interest to follow-up interview the "matches" to find out their fertility control practice and when they started such practice. It will be of particular interest to know how many of them had been sterilized and to what extent induced abortion had been practiced.

Although the fertility decline among the "matches" has also been rather substantial, the demographic impact of the IUD program seems to be still apparent. As shown in Table 3, the fertility rates of the acceptors had been reduced by 58 to 68 per cent from the rates "expected" without an IUD program. From 99 to 158 live births would have been prevented by insertion of 1,000 IUD's, depending on the recency of acceptance.

Assuming that 1,000 IUD's were inserted at the beginning of a calendar year, about 40 births $(158 \times 3/12)$ would be prevented during the year considering that nine months will have to be deducted. Similarly, during the second calendar year, 136 births $(158 \times 6/12)+(113 \times 6/12)$, and during the third year 107 births $(113 \times 6/12)$ would be prevented. The number of births prevented during the first six months of the fourth year will be approximately 50 $(99 \times 6/12)$.

The number of births averted by insertion of one IUD, as calculated above, is lower than the estimated births averted as reported by Potter,[7] based on the data of the Taichung medical follow-up studies. Table 8 gives the related figures, which, however, are not comparable because, as mentioned earlier, the former includes the total effect of IUD program; the latter estimate of Potter considers the effect of the IUD only during the period in which it is actually worn.

The current estimate is also lower than a previous "guess" of Chow that "insertion of five loops would prevent one live birth a year for five years, or one loop inserted would eventually prevent one live birth."[8] Under the present study, about six loops are needed

TABLE 8. BIRTHS AVERTED PER IUD INSERTION BY YEAR FOLLOWING FIRST INSERTION

Report	*First Year*	*Second Year*	*Third Year*	*Fourth Year*	*Fifth Year*	*Sixth and Later*
Current study	0.040	0.136	0.107	0.050*		
Potter study**	0.036	0.196	0.143	0.089	0.053	0.083

* First six months only.
** First segment of IUD only.

TABLE 9. ESTIMATED NUMBER OF BIRTHS PREVENTED BY ISLANDWIDE IUD PROGRAM

Year	*Number of IUD Insertions*	*Number of Births Prevented*			
		1964	*1965*	*1966*	*1967*
1964	50,000		5,400	6,100	5,200
1965	100,000			10,800	12,200
1966	110,000				11,880
1967	120,000				
Total	380,000		5,400	16,900	29,280

TABLE 10. REGISTERED AND "ESTIMATED" LIVE BIRTHS IN TAIWAN, 1964–1967

	1964	*1965*	*1966*	*1967*
Registered annual live births	416,927	406,604	415,108	374,282
Additional births if no IUD		5,400	16,900	29,280
Estimated total live births if no IUD program	416,927	412,004	432,008	403,562

TABLE 11. REGISTERED AND "ESTIMATED" BIRTH RATES IN TAIWAN, 1964–1967

Crude Birth Rate	*1964*	*1965*	*1966*	*1967*
Registered	34.5	32.7	32.4	28.5
Estimated	34.5	33.1	33.7	30.7
$\frac{\text{Estimated}}{\text{Registered}} \times 100$	100.0	101.2	104.0	107.7

to prevent one birth during the first year, which requirement will increase to nine loops in the second and ten in the third year.

The estimate above, however, is not conclusive. A question that remains to be answered is how fast the effect of the IUD would decline and how long it takes before the effect disappears entirely. Women would reach menopause sooner or later, so that the impact of IUD cannot last indefinitely. A longer observation probably would clarify the problem further.

Table 9 shows the estimated number of annual live births prevented by the islandwide IUD program, with calculations based on the assumption above.

The estimated number of annual live births in the absence of the islandwide IUD program would have been as shown in Table 10.

The crude birth rates in the absence of the IUD program would have been as shown in Table 11. As can be seen, without the IUD program the crude birth rate of Taiwan during 1967 would have been 30.7, instead of 28.5, as observed, or about eight per cent higher than the observed rate.

Three significant points with respect to the IUD program must be pointed out.

1. Although the demographic impact of IUD is correlated negatively with age and parity of the acceptors, it is still substantial for women aged 30 to 34 who have had three to four live births, who are the mode of acceptance (Table 4 and 5). Had these women not accepted the IUD, they probably would have many more births.
2. The impact of the IUD program is much stronger for women with lower education, which is another important asset of the IUD.

The clinical effectiveness of the oral contraceptives exceeds that of the IUD; but because the former is more acceptable to the better educated, whose fertility would decline even without the pill, the "net" demographic impact of the pill program should be less than the IUD program. In other words, more "substitution" probably is true for the pill, which may in fact prevent fewer births than an-

ticipated, despite its higher clinical efficacy. This, however is simply a speculation, and actual studies are required for confirmation.

3. IUD retention must be improved. The "higher than anticipated" termination rate of IUD, however, may not be critical to the program, because the results of the current study suggest that many women will resort to some other fertility control methods, including induced abortion, after the IUD is terminated. What is most important is the acceptance of the basic idea of small family size, which is associated with IUD acceptance.

Another point that deserves some consideration is the problem of migration and its effect on the current study. It is known that migrants generally have different characteristics, particularly having lower fertility than nonmigrants. The IUD acceptors who move out of the area may have lower average fertility than those who remain. This bias tended to increase the pre- and post-insertion fertility of the acceptors.

At the same time, those women moving into the areas who form part of the pool for the "matches" would have lower than average fertility also. In addition, some of the women moving into the area may be IUD acceptors from other townships, but could not be identified by the current study procedures. The net effect of these factors would be to lower the relative fertility of the "matches," hence would probably somewhat underestimate the net impact of the IUD program.

The current study ignored one important point. As mentioned above, a significant impact of the IUD program is to facilitate the dissemination of the notion of family planning among the population in general. Regardless of whether women accept IUD's or not, the favorable aspect of a smaller family would be induced by the program effort. This indirect program impact is almost immeasurable at this stage, and is not taken into account in the present analysis. It probably is safe to say that the current study is an estimate of the minimum program impact of IUD. How great is the underestimate, however, is not known. It is true also that in some

countries, where "substitution" of other fertility control methods is less likely, the impact of the IUD program should be greater.

CONCLUSION AND SUMMARY

A pilot study to evaluate the demographic impact of an IUD program by "matching" was undertaken in four townships in central Taiwan.

The "matching" was done by age, education, open interval and number of live births to make the acceptors and "matches" nearly identical in characteristics and degree of demographic pressure.

The following points deserve special attention:

The present study confirmed a previous finding that the IUD acceptors are strongly selected in terms of higher than average fertility. On the average, the preinsertion fertility of the acceptors was 54 per cent higher than the corresponding fertility of the married women in general in the township.

The IUD program was able to bring down the fertility of the acceptors sharply: from 381 before to 77 after the first acceptance, or a reduction of 80 per cent.

On the other hand, the corresponding fertility among the "matches" has been quite impressive also: from 377 before to 195 after, or a reduction of 48 per cent.

Despite the above, the "net" demographic impact of the IUD program seems to be still apparent, although it seems to be lower than in some of the earlier studies because of a rather substantial fertility decline among the "matches." On the average, 159 live births would be prevented in a year during the first year, beginning nine months after the first insertion. The number of births averted would decrease to 113 during the second and 99 during the third year, all per 1,000 insertions.

The demographic impact of the IUD program, however, seems to last longer than might have been speculated because, among the earlier acceptors (1964), the "expected" fertility had been reduced

by 58 per cent, and 99 live births a year had been prevented by 1,000 first insertions.

The demographic impact of the IUD is greater among younger women of lower parity. This is somewhat contrary to what has been reported by Potter, who took into account only the period when the device was actually worn. The current study included the "after" effect of the IUD as well.

The impact, nevertheless, is still considerable among women 30 to 34 years of age, and with three to four live births, indicating that, had they not accepted the device, they would have had many more births.

The impact of the IUD is significantly greater among women of lower educational status. This is desirable and important: this group of women constitute the majority in areas where the need for family planning is most pressing. This also suggests that the "net" impact of the IUD may be greater than that of the pills because more pill users are women of higher education.

The "higher than anticipated" termination rate of IUD may not be critical to the program, because women frequently use some other fertility control methods after termination. The desirability of a small family is usually introduced when they are motivated to accept the IUD—which is more important.

It will be of interest to follow-up and interview the "matches" to find out why they had not accepted the IUD, and what had been their fertility control practice. A longer observation on a larger sample should be able to tell more about the real program impact of the IUD.

The curent study ignored the indirect program impact of enhancing the awareness of family planning among the population in general, thus encouraging more of them to practice fertility control, even though they might not have accepted the IUD.

The impact of IUD program varies from country to country, depending on the extent of fertility control practice. In countries

where "substitution" is less likely, the program impact should be greater.

The "nonresponse rate" of about 26 per cent is high enough to weaken somewhat the force of the results. An effort will be made to trace at least part of these women to see if their fertility behavior differs significantly from that of the "respondents."

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