Births and Induced Abortions Averted by The Sterilization Achievement of The Korean National Family Planning Program

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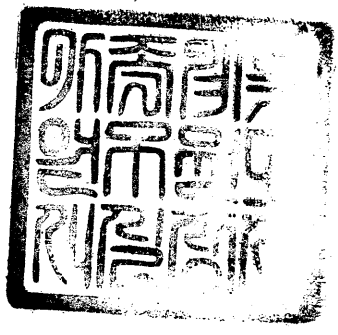

The Korean Institute for Family Planning (KIFP) was established by Law 2270 in 1970. KIFP has two major functions. The first function is to carry out research and evaluation for the national family planning program. The second function is to provide training programs for family planning workers. KIFP has contributed to the maximum possible extent in the performance of its policy-oriented research activities.

The views and interpretation of the paper are those of authors, and shall not be construed as an official opinion of the Institute.

Preface

Since 1962 when the government adopted family planning activities as part of the economic and social development program, a great decrease in the birth rate due to the distribution of various contraceptives has been observed.

With the exception of 1964, the yearly achievement of sterilization (vasectomy alone) never exceeded 20,000 before 1972, the year tuballigation was introduced as a program method. The number of sterilization acceptors (vasectomy and tuballigation) began to rise in 1973 and reached 235,000 in 1977. The present paper will estimate the births averted by the government sterilization program. It will also discuss the characteristics of acceptors, government-paid fees for acceptors, achievement by year, and projections of births and induced abortions averted through the government sterilization program. This information should be useful for planning the government's contraceptives distribution policy. We hope that this paper will be utilized by both researchers and decision-makers.

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Contents

Births and Induced Abortions Averted by The Sterilization Achievement of The Korean National Family Planning Program

by

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This report is a revision of a paper entitled "Demographic Effect of the Sterilization," which was presented by the first author at a sterilization seminar held in May 1978.

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Introduction

The fertility of Korean women declined sharply during the 1960's and 1970's. The crude birth rate (CBR) fell from an estimated 43 births in 1960 to 24 births in 1976 (Park et al., 1978); during the same period total fertility fell from approximately 6.0 births to 3.5 births per woman. This fertility decline was associated with social modernization, and increasing use of both contraception and abortion.

Assessing the interreationships among these developments and their impact on fertility is a complex task. Most observers agree that a large portion of the fertility decline can be attributed to factors outside the national family planning program, but that the speed of the decline is due in large part to program activities. For example, Watson (1971) estimated that 40 percent of the fertility reduction during the first ten years of program activity was due to the rising age at first marriage, 23 percent to the increased use of induced abortion, and that 37 percent of the fertility reduction could be attributed to family planning. Using the projection technique, Koh & Nichols (1977) estimated that 45 percent of the total number of births averted between 1960 and 1975 could be credited to the family planning program. The purpose of the present paper will be to measure the impact of the sterilization program alone using a new variation of the births averted methodology.

Vasectomy was introduced as a national family planning program method in 1962, the first year of program operation. Designated physicians were trained by the program and reimbursed for the operations they performed. Throughout the years, the national program has remained the major source of vasectomies, performing approximately 3.5 operations for every one operation accomplished by the

private sector (Kim, et al., 1972, p. 159). Female sterilization (tuballigation) did not become a popular method until laparoscopes were imported in 1976 under the auspice of the government. The first tuballigations were performed by the private sector, which continued to be the major source of the operation until 1976. Tuballigation was introduced as a program method in 1972 and proved immediately successful. The major obstacle limiting acceptance of the method was the shortage of laparoscopes, which were located primarily in urban areas. This situation should be relieved considerably when 95 new laparoscopes are introduced into the rural areas in 1979, with the financial support of the United Nations Fund for Population Activities (UNFPA).

I. DATA SOURCES

The primary data sources for the present study include service statistics such as monthly reports and acceptors coupons, and fertility and mortality data taken from national surveys. At the end of every month, the 202 health centers located throughout the nation send routine data on personnel, registration, performance and inventory-supply of contraceptives to the 11 provincial headquarters, where they are summarized. Both the summaries and the original reports are forwarded to the KIFP. In addition, coupons are filled out by the field worker for each sterilization, IUD and menstrual regulation acceptors she recruits. This coupon indicates the recruiter and the doctor involved and provides information on demographic characteristics of the acceptor including age, number of living children, education, and number of induced abortions experienced. The fertility data come from national fertility and family planning surveys conducted by the KIFP at frequent intervals. Mortality and nuptiality data have been taken from the national census reports published by the Bureau of Statistics, Economic Planning Board.

II. ACHIEVEMENT OF STERILIZATION

The sterilization achievement of the government program amounts to 624,079 over 15 years (1962-1977). Table 1 shows sterilization achievement by year and method.

Table 1. Sterilization Achievement by Year and Method

Year	Total	Vasectomy	Tubal-ligation
1962-1966	82,332	82,332	–
1962	3,413	3,413	–
1963	19,866	19,866	–
1964	26,256	26,256	–
1965	12,855	12,855	–
1966	19,942	19,942	–
1967-1971	87,024	87,024	–
1967	19,677	19,677	–
1968	15,988	15,988	–
1969	15,457	15,457	–
1970	17,321	17,321	–
1971	18,581	18,581	–
1972-1976	219,550	156,049	63,501
1972	19,679	16,396	3,283
1973	24,489	19,696	4,793
1974	37,368	32,020	5,348
1975	57,588	43,056	14,532
1976	80,426	44,881	35,545
1977-1981			
1977	235,173	53,746	181,427
1978	(230,320)	(36,922)	(193,398)
Total*	624,079	379,151	244,928

* Excludes the 1978 achievement.

Table 2. Government-Paid Fees for Sterilization*

Unit : Won

Year	Vasectomy			Tuballigation		
	Physician	Acceptor	Field Worker	Physician	Acceptor	Field Worker
1962	Unknown					
1963						
1964						
1965	500	—	—	—	—	—
1966	900	800	100	—	—	—
1967	900	800	100	—	—	—
1968	900	800	100	—	—	—
1969	900	800	—	—	—	—
1970	1,000	800	100	—	—	—
1971	1,000	800	100	—	—	—
1972	1,800	—	150	—	—	—
1973	2,500	—	300	—	—	—
1974	2,500	—	300	—	—	—
1975	3,500	—	300	—	—	—
1976	3,644	—	350	5,000	—	350
1977	5,000	—	350	15,000	3,000**	350
1978	6,000	—	400	15,000	3,000**	400

* Based on the current year.

** Only for the poor.

During the first decade of vasectomy in Korea, vasectomy achievement peaked at 26,256 in 1964. Between 1965 and 1973 vasectomy achievement fluctuated between 12,000 and 20,000. In 1974, vasectomy achievement began to increase again, from 32,000 operations in 1974 to 53,746 in 1977. The target for 1978 was about 60,000. One reason for the increase is the larger service-providing capacity of the program.

Tuballigation was introduced into the government program in 1972, and that year 3,283 operations were performed. Tuballigation achievement has risen every year, reaching 181,427 in 1977, 60 times higher than in 1972. The original target for 1978 was 160,000, but real achievement exceeded the original target, partly because the government increased the budget allocation to meet the unexpectedly high demand.

Until 1976 female sterilization was ground together with vasectomy under a single sterilization target and physicians received the same fee for tuballigation as for vasectomy. Since the actual cost of the tuballigation was approximately three times higher than for vasectomy and patients had to pay the remaining charges themselves, many women could not afford to be sterilized. In 1977 vasectomy and tuballigation were given separate targets and the physician's payment for tuballigation was tripled. The immediate effect was that three times as many women were sterilized in 1977 as had been sterilized in the previous 5 years combined. Table 2 presents the fees paid by the government for vasectomy and tuballigation by year.

Private sterilization is not rare any more. Thus, the total effect of sterilization on fertility, population increase rate and induced abortions extends beyond the government program.

III. SOCIO-DEMOGRAPHIC TRENDS AMONG STERILIZATION ACCEPTORS

Table 3 presents the mean age and number of living children of sterilization acceptors from 1962.

Table 3. Demographic Characteristics of Sterilization Acceptors by Year

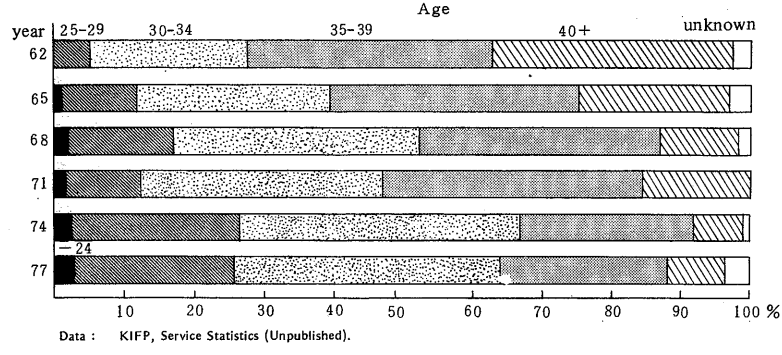
Year	Mean Age		Mean Number of Living Children	
	Vasectomy*	Tuballigation	Vasectomy*	Tuballigation
1962	38.1	–	–	–
1967	36.2	–	4.0	–
1970	35.7	–	4.4	–
1971	34.9	–	4.2	–
1972	33.7	35.4	3.8	3.8
1973	33.8	35.3	3.7	3.8
1974	32.5	34.5	3.3	3.6
1975	32.6	34.0	3.1	3.7
1976	32.8	33.5	3.0	3.3
1977	32.5	33.0	2.9	3.6

Data : KIFP, Service Statistics (Unpublished).

* Wives of acceptor.

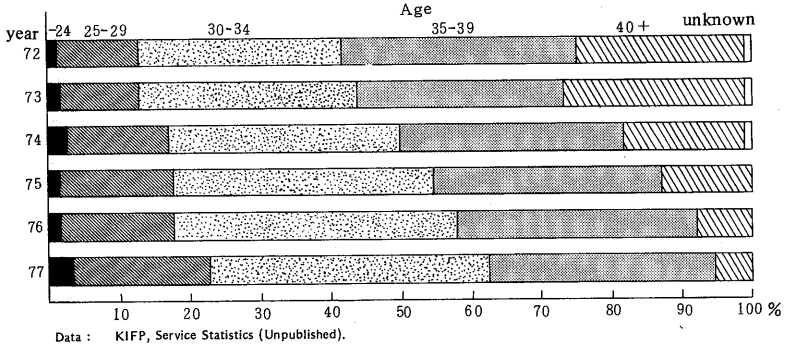
The mean age of wives of vasectomy acceptors was 38.1 in 1962 and it was 32.5 in 1977, which increased the period of protection 5-6 years over a 15 year span. The mean number of living children decreased from 4 in 1967 to 2.9 in 1977. In the case of tuballigation acceptors, mean age and number of living children are a little higher than vasectomy acceptors. This indicates that tuballigation acceptors as a group have higher fertility than vasectomy acceptors. Figures 1, 2, 3, 4 show the changing trend in the age and number of living children of sterilization acceptors.

Figure 1. Chaging Trend of Age of Acceptors: Vasectomy



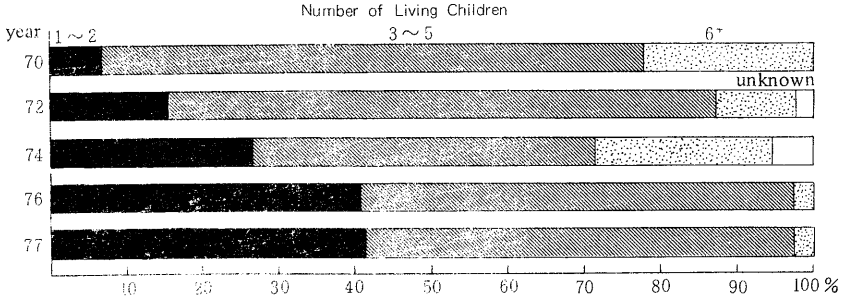
Data : KIFP, Service Statistics (Unpublished).

Figure 2. Changing Trend of Age of Acceptors: Tuballigation



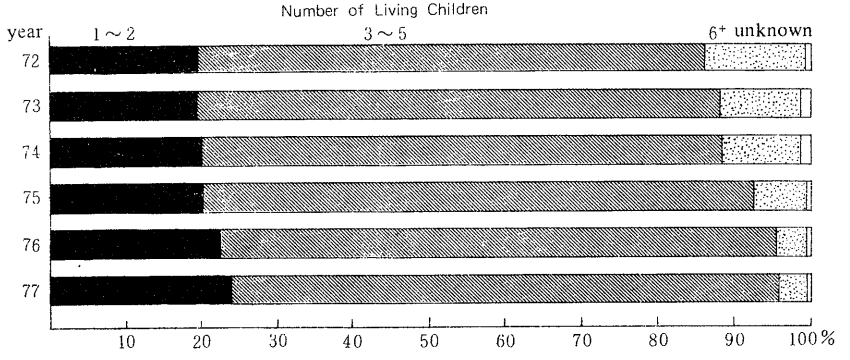
Data : KIFP, Service Statistics (Unpublished).

Figure 3. Changing Trend of Mean Number of Living Children: Vasectomy



Data: KIFP, Service Statistics (Unpublished).

Figure 4. Changing Trend of Mean Number of Living Children: Tuballigation



Data : KIFP, Service Statistics (Unpublished).

One factor contributing to the higher fertility of tuballigation acceptors is the wives' educational background. It is well known that fertility levels are inversely related to educational attainment. In the early 1970's the educational backgrounds of vasectomy and tuballigation acceptors were equivalent; 56% of the wives of vasectomy acceptors and 50% of the tuballigation acceptors had only an elementary school education. By 1977 only 25% of the wives of vasectomy acceptors had only an elementary school education and

almost half had a high school education or better. Elementary school continued to be the modal educational level of tuballigation acceptors in 1977. This difference in educational backgrounds between vasectomy and tuballigation acceptors may simply mean that vasectomy acceptors are being drawn from a more select background. Tuballigation has become by far the more popular of the two methods, and in 1977 acceptors of tuballigation outnumbered vasectomy acceptors by a margin of more than 3 to 1. Figure 5, 6 illustrate the change in educational backgrounds of vasectomy acceptors and acceptors of tuballigation.

Figure 5. Education Level of Wives: Vasectomy

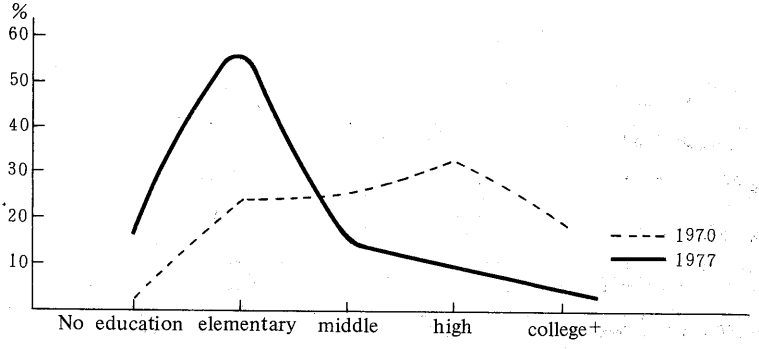
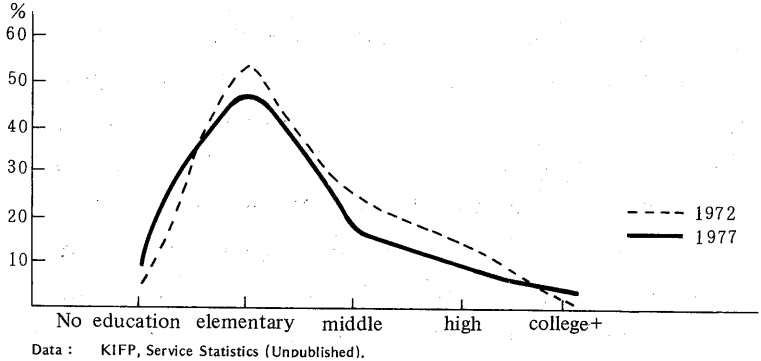


Figure 6. Education Level of Wives: Tuballigation



Data : KIFP, Service Statistics (Unpublished).

In addition to sterilization program, menstrual regulation (early abortion) was introduced as a government method in 1975 and now accounts for approximately 10% of all induced abortions performed each year. Table 4 shows the demographic characteristics of those who accepted menstrual regulation (M.R.) under the government program.

Table 4. Demographic Characteristics of Acceptors of Menstrual Regulation by Year

Year	Mean Age	Mean Number of Living Childran
1975	33.86	3.65
1976	33.24	3.40
1977	33.70	3.60

Data: KIFP, Service Statistics (Unpublished).

As Table 4 indicates, the mean age and number of living childern of acceptors of menstrual regulation is much higher than those of sterilization acceptors. Therefore we suggest that many menstrual regulation user would accept female sterilization if it were offered post-abortally. In Chapter VI we will discuss the interrelationship between induced abortion and sterilization acceptance.

IV. STERILIZATION USERS AMONG ELIGIBLE COUPLES

According to the family planning evaluation survey in 1976, 36% of all eligible women in Korea were using temporary methods of contraception and another 8% were sterilized.

Table 5. Practice Rate by Method

Method	1966	1971	1973	1976	1978
IUD	9%	7%	8%	11%	9.6%
Sterilization	2	3	5	8	16.6
Pill	1	7	8	8	6.6
Condom	3	3	6	6	5.8
Others	5	4	9	11	10.5
Total	20	26	36	44	49.1

Data: KIFP, "Current Status and Problems of Family Planning Program in Korea", 1977.
KIFP, "Family Planning Practice Survey" (Unpublished), 1979.

As Table 5 shows, the sterilization rate has increased every year. Data for 1976 indicate that approximately 400 thousand of 5 million eligible couples were sterilization users and that among these users, 240 thousand were government-supported acceptors. An additional 160 thousand were private sterilization acceptors. The total number of government-paid acceptors was 388,906 as of September 1976, but about 150,000 acceptors had dropped out of the eligible population because of age, death or divorce.

Table 6 shows the difference in sterilization use by age between Korea and Taiwan. In 1973, 12% of eligible Taiwanese women in the 30-34 age range were users of sterilization. In Korea only 7% of this group were users. This may be due to the fact that the tubal-

ligation boom happened earlier in Taiwan than in Korea. Soon, however the rate in Korea will be higher than that in Taiwan, aided by rapid adoption of new sterilization techniques especially tubal-ligation.

Table 6. Sterilization Use by Age in Korea and Taiwan

Age	Korea				Taiwan			
	1967	1968	1971	1973	1965	1967	1970	1973
-24	—	—	—	—	—	—	1%	1%
25-29	1%	1%	1%	5%	3%	2%	3	6
30-34	2	3	3	7	6	8	9	12
35-39	5	5	6	10	9	11	15	15
40-44	3	3	5	6	—	—	—	—

Data: John A. Ross & Kap Suk Koh, "Transition to the Small Family: A Comparision of 1964-1973 Time Trends in Korea and Taiwan," Population Change in the Pacific Region. Vancouver : Canada, 1975.

The use of male and female sterilization as a method of contraception seems very similar in the United States and Korea. In 1973, male and female sterilization users accounted for 11.2% and 12.3% respectively, of those couples contracepting in the United States (People, 1977), and in Korea in 1976 male and female sterilization users accounted for 9.2% and 9.0% respectively, of the total contraceptors (KIFP, 1977). Although the total rate of contraceptive practice was higher in the United States than in Korea, the relative popularity of two methods of sterilization was roughly the same.

In recent years, female sterilization seems to be achieving greater popularity than male sterilization. In 1977 three times as many Korean women as men were sterilized through the government

program, and in 1978 the ratio had risen to five times as many women as men. Singapore has also experienced an imbalance between male and female sterilization acceptors; during the period 1970-75 women acceptors outnumbered men 24 to 1. If we apply Singapore's 1970-75 total sterilization acceptance rate (number of acceptors/number of eligible women) to our projections for the size of the eligible population in Korea, we estimate that 830,000 sterilizations can be possible through the government program for the years 1976-81.

V. METHODOLOGY FOR COMPUTING BIRTHS AVERTED

Since sterilization provides life-time contraceptive protection, the births averted by a sterilization operation is equal to the woman's remaining fertility, adjusted for spontaneous sterilization and dissolution of marriage. Gorosh & Wolfers (1977) provide the following method of computing births averted.

$$1.1 \quad E_i(\text{total}) = \frac{2.5\, E_i (1-S_i)\sqrt{(P'_{i\text{-}i+5} \cdot P''_{i+5\text{-}i+10})}}{1000\,(1-S_i)} + \frac{5 \sum_{j=i+5}^{j=48+} E_j\,(1-S_j)(P'_{j\text{-}j+5} \cdot P''_{j+5\text{-}j+10})}{1000(1-S_i)}$$

where

$E_i(\text{total})$ = total expected fertility of a woman age i

E_i = expected fertility rate for age i

S_i = probability of accidental or spontaneous sterilization

$P'_{i\text{-}i+5}$ = probability of woman's surviving from age i to age i+5

$P''_{i+5\text{-}i+10}$ = probability of man's surviving from age i+5 to age i+10

This formulation of expected fertility makes two explicit assumptions: (1) that all acceptors are fertile at the time of acceptance, and (2) that the survival probabilities for successive 5-year intervals are mutually independent. Later in this section we will present a model for computing births averted on yearly basis, which differs from the Gorosh & Wolfers formulation on both points.

To compute the number of births averted by a group of women all sterilized the same year at the same age, we simply multiply expected fertility by the number of women in the group. Summing across all ages in a given cohort (year of sterilization) we compute births averted for a single cohort; summing again across cohorts we compute births averted by a group of cohorts. Thus,

$$1.2 \qquad BA = \sum_{c=1962}^{c=1977} \sum_{i=1}^{i=6} E_{ci}\,(\text{total}) \cdot N_{ci}$$

where

BA = total number of births averted

c = calendar year of acceptance cohort

i = age of acceptor expressed as a 5-year range

1 = 20-24 2 = 25-29 3 = 30-34

4 = 35-39 5 = 40-44 6 = 45-49

N_{ci} = number of acceptors age i in acceptance cohort c

While this formula gives us a life-time measure of births averted, it does not allow us to estimate how many births will be averted in any single calendar interval. The latter estimate would be of great practical value to program managers, who need to know both short and long-term program impact.

To compute the number of births averted during a 1-year period, we must estimate the number of couples who were protected by sterilization the year before and their expected fertility.

We begin with an acceptance cohort c divided into 5-year age groups i.

1.3 $C = \sum_{i=1}^{i=6} N_{ci}$

We set July 1 as the acceptance date for all sterilizations performed in any given year and assume that all acceptors survive to the end of the year. Therefore the number of couples protected during the first year is equal to half the number of acceptors.

1.4 $PC_{1ci} = N_{ci}/2$

where PC_{1ci} = protected couples in year 1 for cohort C, age i

We make the assumption that acceptors are equally distributed within 5-year age groups, so that every succeeding year a constant fraction F_{ci} proceeds to the next 5-year age group.

1.5 $F_{ci} = N_{ci}/5$

The probability of surviving through the next year is computed as the fifth root of the joint 5-year survival rates of husband and wife.

1.6 $P_i = (P'_{i-i+5} \cdot P''_{i+5-i+10})^{\frac{1}{5}}$

Therefore the number of couples protected during the second year is a function of the number remaining from the first year plus those entering from the immediately proceeding age group.

1.7 $PC_{2ci} = (4 \cdot F_{ci}) \cdot (P_i) + (F_{c(i-1)}) \cdot (P_{i-1})$

The general formula for year n for n greater than 1 and less than 6

1.8 $PC_{nci} = (6-n)F_{ci} \cdot (P_i^{n-1}) + (n-1)F_{c(i-1)} \cdot (P_{i-1}^{n-1})$

By year 6 (and years 11, 16 etc.) the entire age group has progressed to the next age.

$$1.9 \qquad PC_{6c(i+1)} = N_{ci} \cdot P_i^5$$

We can recompute the aging fraction and follow step 1.8 again for the next 4 years, and so on until the youngest acceptors pass age 49.

It should be pointed out that in this procedure survival probabilities for different 5-year intervals are not independent. The Gorosh & Wolfers formulation can be modified to produce the same result.

$$1.10 \qquad E_i(\text{total}) = \frac{2.5E_i(1-S_i)\sqrt{(P'_{i-i+5} \cdot P''_{i+5-i+10})}}{1000\,(1-S_i)} + \frac{5\sum_{j=i+5}^{j=48+} E_j(1-S_j)\sqrt{(P'_{j-j+5} \cdot P''_{j+5-j+10})} \cdot (P'_{j-j+5} \cdot P''_{j+5-j+10})}{1000(1-S_i)}$$

To calculate the total number of protected couples in age group j during calendar year y we sum across cohorts.

$$1.11 \qquad PC_{yj} = \sum_{c=1962}^{c=1977} PC_{ycj}$$

The second point of departure from the Gorosh & Wolfers model is the calculation of expected fertility. Gorosh & Wolfers assume that all acceptors are fertile at time of acceptance. In their formulation,

$$1.12 \qquad E_i = \frac{B_{i+2} \cdot (3-N_{i+2})}{3(1-S_i)}$$

where

B_{i+2} = ASMFR for the age group (i+2)

N_{i+2} = proportion of births for age group (i+2) that are first births

We assume that sterilization acceptors are randomly drawn from their age group rather than being completely fertile at acceptance. To compensate for natural sterility we multiply by the proportion who are fertile at age i $(1-S_i)$. We also simplify the formulation by using fertility rates for age group i rather than age group (i+2).

$$1.13 \quad E'_i = \frac{B_i \cdot (3-N_i)}{3}$$

By not making the fertility assumption we no longer have to adjust for sterility. The number of births averted during calendar year y+1 becomes;

$$1.14 \quad BA_{y+1} = \sum_{c=1962}^{c=2006} \sum_{j=1}^{j=6} \frac{PC_{ycj} \cdot E'_{cj}}{1000}$$

Selection of fertility estimates

Previous methods of computing life-time estimates of births averted using SCYP method have adopted a static approach: they predict future fertility from the age-specific fertility rates prevailing at the time of acceptance. This approach implicitly assumes that fertility will not change appreciably during the period of protection. The validity of the static assumption is questionable in a situation where fertility rates are changing rapidly and where the life-expectancy of the method extends over many years. These are precisely the circumstances surrounding acceptance of sterilization in Korea during the period 1962-1977.

An alternative to the static approach might be to adopt a moving strategy, that is, to update the fertility rates when computing expected fertility 5, 10, 15 or 20 years after acceptance. This approach penalizes the early sterilization acceptor since she contributes to the denominator but not the numerator of the new fertility rate, and the problem becomes greater as more and more couples are sterilized. (This is similar to the well-known paradox that as contraception in a population increases, each new acceptance averts fewer births).

In addition to the theoretical issues posed by the static vs. moving models, we are faced with a practical problem. The purpose of the new method is to predict births averted during yearly intervals, without regard to the acceptance cohort of the protected couples. This requires some kind of moving technique. As a compromise between the static and moving approaches we will "update" our fertility estimates obtained through various surveys and graduated over the period from 1962 through 1976, however the expected fertility rates for 1977 and subsequent years were used from assumed rates shown in Table 7.

VI. RESULTS

Births and Induced Abortions Averted Under Government Program

We will now estimate the total number of births averted by the achievement of the government sterilization program during the years 1962-1977. Since the youngest of these acceptors will reach menopause in the year 2006, we will estimate the births already averted between 1962-1977 and predict the births to be averted in the years to come.

We will present our findings in two ways. First, we will present the life-time births averted estimates for each cohort of vasectomy acceptors and each cohort of tuballigation acceptors. Using the moving approach, we will derive these estimates by our new projection method. These estimates will increase across cohorts as more and younger acceptors were recruited.

Second we will estimate the number of protected couples by year for the cumulative government sterilization program achievement. Using the moving approach, we will derive the number of births averted calendar periods. These figures will decline over time as acceptors drop out of the population at risk.

We will follow the procedures outlined in the previous section, using the following data:

Acceptors: The number of yearly acceptors of vasectomy and tuballigation by 5-year age groups was taken from the health centers' service statistics reports (coupons). To correct for over-reporting and falsification, we multiplied the reported vasectomy performance by .94 and the reported tuballigation performance by .98.

Expected fertility: From 1962 to 1975, ASMFR's were derived from the result of 1975 census and 1976 ASMFR was derived from the report of national fertility survey conducted in 1976. Age-specific sterility rates were taken from the Report in 1971 Fertility Abortion Survey (December, 1973), and same set of estimates was used throughout. An estimate of the proportion of live births at each age range that were first births was not available for Korea; 1975 estimate from Taiwan was used throughout. Table 7 presents potential fertility age-specific rates used in the computations.

Table 7. Potential Fertility Rates by Age and Year

	Age Range					
	20-24			25-29		
Year	ASMFR	E_i	$Ei(1-S_i)$	ASMFR	E_i	$E_i(1-S_i)$
1962	.482	.409	.409	.331	.310	.308
1963	.499	.424	.424	.329	.308	.307
1964	.469	.398	.398	.330	.309	.308
1965	.490	.416	.416	.336	.314	.313
1966	.524	.445	.445	.351	.329	.327
1967	.480	.407	.407	.345	.323	.322
1968	.503	.427	.427	.361	.338	.337
1969	.470	.399	.399	.359	.336	.334
1970	.529	.449	.449	.360	.336	.335
1971	.562	.477	.477	.369	.346	.344
1972	.522	.443	.443	.359	.336	.335
1973	.517	.439	.439	.353	.330	.329
1974	.508	.431	.431	.349	.327	.325
1975	.506	.430	.430	.321	.300	.299
1976	.488	.414	.414	.320	.299	.298
1977	.470	.399	.399	.319	.299	.297
1978	.468	.397	.397	.316	.295	.294
1979	.465	.394	.394	.312	.292	.291
1980	.462	.392	.392	.310	.290	.289
1981	.462	.392	.392	.307	.287	.286
1982	.459	.390	.390	.302	.282	.281
1983	.454	.385	.385	.298	.279	.278
1984	.451	.383	.383	.294	.275	.274
1985	.422	.358	.358	.275	.258	.257
1986	.392	.333	.333	.257	.240	.240
1987	.390	.331	.331	.254	.237	.236
1988	.384	.326	.326	.250	.234	.233
1989	.382	.324	.324	.247	.231	.230
1990	.352	.299	.299	.247	.231	.230
1991	.320	.271	.271	.247	.231	.230

Table 7. (Continued)

	Age Range					
	30-34			35-39		
Year	ASMFR	E_i	$E_i(1-S_i)$	ASMFR	E_i	$E_i(1-S_i)$
1962	.278	.274	.271	.218	.221	.214
1963	.294	.289	.286	.212	.214	.208
1964	.269	.264	.261	.197	.199	.193
1965	.263	.259	.256	.189	.190	.185
1966	.264	.260	.257	.177	.179	.173
1967	.249	.245	.243	.154	.155	.151
1968	.243	.239	.236	.157	.158	.154
1969	.249	.244	.242	.164	.165	.161
1970	.235	.231	.229	.146	.147	.143
1971	.242	.238	.236	.139	.140	.136
1972	.235	.231	.229	.133	.135	.131
1973	.213	.210	.208	.111	.112	.109
1974	.191	.188	.186	.101	.102	.099
1975	.165	.162	.160	.081	.081	.079
1976	.153	.150	.149	.064	.065	.063
1977	.141	.139	.137	.058	.058	.057
1978	.133	.131	.130	.053	.053	.052
1979	.125	.123	.122	.047	.048	.046
1980	.119	.117	.116	.043	.043	.042
1981	.111	.109	.108	.039	.039	.038
1982	.104	.102	.101	.024	.024	.023
1983	.095	.094	.093	.030	.030	.029
1984	.088	.086	.086	.026	.026	.025
1985	.084	.082	.082	.024	.024	.023
1986	.079	.078	.077	.022	.022	.021
1987	.075	.074	.073	.019	.019	.019
1988	.071	.070	.069	.018	.018	.018
1989	.067	.066	.065	.016	.016	.016
1990	.067	.066	.065	.016	.016	.016
1991	.067	.066	.065	.016	.016	.016

Table 7. (Continued)

	Age Range					
	40-44			45-49		
Year	ASMFR	E_i	$E_i(1-S_i)$	ASMFR	E_i	$E_i(1-S_i)$
1962	.111	.150	.109	.016	.056	.014
1963	.110	.148	.107	.019	.068	.017
1964	.100	.135	.098	.016	.055	.014
1965	.086	.116	.084	.016	.055	.014
1966	.084	.114	.082	.015	.052	.013
1967	.076	.102	.074	.015	.051	.013
1968	.076	.104	.075	.014	.049	.013
1969	.078	.104	.075	.010	.034	.009
1970	.062	.083	.060	.010	.034	.009
1971	.058	.078	.056	.008	.029	.007
1972	.055	.074	.053	.008	.027	.007
1973	.045	.060	.043	.006	.021	.005
1974	.036	.048	.035	.006	.020	.005
1975	.030	.040	.029	.005	.017	.004
1976	.025	.033	.024	.003	.011	.003
1977	.019	.026	.019	.001	.005	.001
1978	.017	.023	.017	.001	.005	.001
1979	.015	.020	.014	.001	.005	.001
1980	.013	.017	.023	.001	.005	.001
1981	.010	.014	.010	.001	.005	.001
1982	.009	.012	.009	–	.002	.001
1983	.007	.009	.007	–	.002	.001
1984	.006	.008	.006	–	.002	.001
1985	.005	.006	.004	–	–	–
1986	.005	.006	.004	–	–	–
1987	.005	.006	.004	–	–	–
1988	.003	.005	.003	–	–	–
1989	.003	.005	.003	–	–	–
1990	.002	.003	.002	–	–	–
1991	.002	.003	.002	–	–	–

Survival probabilities: Five-year survival probabilities for men and women were taken from a model life table, level 20 of west. The same rates were used throughout.

Estimation of Protected Couples by Acceptance Cohort

The first step of the analysis was to estimate age-specific PC's for each year beginning with the year of acceptance. These estimates will be used in deriving both the life-time and yearly estimates of births averted. For the purpose of illustration, Table 8 presents estimated PC's by year for the 1962 vasectomy cohort.

Similar analyses were performed for the remaining acceptance cohorts.

Estimation of Life-time Births Averted

Estimates of life-time births averted for each acceptance cohort were derived by the SCYP method and the PC projection method. Table 9, 10 present these results. As can be seen, the PC projection method produces consistently lower estimates of births averted than the SCYP method. This is because the PC method does not assume 100% fertility among acceptors and because survival probabilities in subsequent 5-year intervals are contingent on earlier survival rates. The reason for adopting the latter assumption is obvious: a person who died in the first 5-year interval cannot survive the second 5-year interval.

We also believe that there is a good reason for not making the assumption that all sterilization acceptors are fertile at the time of acceptance. First of all, fecundity is difficult to determine, especially during the period immediately following the termination of a pregnancy. Many Korean women obtain post-partum or post-abortal sterilization; so the fertility of these acceptors is unknown.

Table 8. Projection of Impact of 1962 Government Vasectomy Achievement: Estimated Protected Couples (PC) by Year, 1962-1991

Year	Age Range						
	20-24	25-29	30-34	35-39	40-44	45-49	Total
Original acceptors	3	174	792	1,294	860	290	3,413
1962	2	82	372	608	404	137	1,605
1963	2	131	624	1,111	879	373	3,120
1964	1	99	505	1,009	949	472	3,036
1965	–	66	388	910	1,020	568	2,953
1966	–	34	273	813	1,090	663	2,874
1967	–	3	160	719	1,160	755	2,797
1968	–	2	127	601	1,058	820	2,608
1969	–	2	96	486	959	886	2,429
1970	–	1	64	373	865	952	2,255
1971	–	1	33	263	773	1,018	2,088
1972	–	–	3	154	686	1,083	1,926
1973	–	–	2	123	572	985	1,682
1974	–	–	2	92	461	891	1,446
1975	–	–	1	62	353	803	1,219
1976	–	–	1	32	249	719	1,001
1977	–	–	–	3	147	640	790
1978	–	–	–	2	117	531	650
1979	–	–	–	2	87	426	515
1980	–	–	–	1	58	326	385
1981	–	–	–	1	30	230	261
1982	–	–	–	–	3	137	140
1983	–	–	–	–	2	109	110
1984	–	–	–	–	2	80	82
1985	–	–	–	–	1	53	54
1986	–	–	–	–	–	27	27
1987	–	–	–	–	–	2	2

Table 8. (Continued)

Year	Age Range						
	20-24	25-29	30-34	35-39	40-44	45-49	Total
1988	–	–	–	–	–	2	2
1989	–	–	–	–	–	1	1
1990	–	–	–	–	–	1	1
1991	–	–	–	–	–	0	0
Total	8	421	2,651	7,365	11,925	13,689	36,059

Table 9. Estimated Number of Births Averted by Vasectomy Cohorts, 1962-1977

Acceptance Cohort	(1) Number of Acceptors	Births Averted (2) (a) SCYP Method	(b) Projection Method	B.A./Acceptor (1/2b)
1962	3,413	4,096.485	3,057.177	0.896
1963	19,866	32,525.585	16,816.111	0.846
1964	26,256	38,554.677	20,925.181	0.797
1965	12,855	21,258.035	12,345.139	0.960
1966	19,942	31,988.966	18,055.718	0.905
1967	19,677	28,988.866	16,799.447	0.854
1968	15,988	27,905.118	15,794.041	0.988
1969	15,457	29,117.302	15,935.188	1.031
1970	17,321	21,934.722	11,722.433	0.677
1971	18,581	24,437.207	12,658.049	0.681
1972	16,396	24,153.156	12,113.481	0.739
1973	19,696	23,970.148	12,423.053	0.631
1974	32,020	42,655.136	23,280.698	0.727
1975	43,056	47,964.053	28,548.892	0.663
1976	44,881	43,641.137	28,034.862	0.625
1977	53,746	47,257.971	32,221.663	0.600
Total	379,151	490,448.564	280,731.133	0.740

Table 10. Estimated Number of Births Averted by Tubal-ligation Cohrots: 1972-1977

Acceptance Cohort	(1) Number of Acceptors	Births Averted (2) (a) SCYP Method	(b) Projection Method	B.A./Acceptor (1/2b)
1972	3,283	4,130.901	1,994.612	0.608
1973	4,793	5,147.299	2,595.771	0.542
1974	5,348	5,987.885	3,158.402	0.591
1975	14,532	14,045.149	8,055.839	0.554
1976	35,545	30,309.024	18,865.634	0.531
1977	181,427	150,623.725	101,525.271	0.560
Total	244,928	210,243.983	136,195.529	0.556

Second fieldworkers are under great pressure to achieve their acceptance targets. It is doubtful that a menstrual history is taken from every potential tuballigation acceptor to eliminate those who appear to be menopausal or naturally sterile. Third, anecdotal evidence suggests that husbands often do not discuss their vasectomies with their wives until after the operation has been performed. It is very unlikely that the wife's menstrual history is reviewed prior to the husband's vasectomy operation.

Examination of Table 9, 10 suggest that the discrepancy between the SCYP and PC estimates is decreasing over time. The fertility assumption of the SCYP method is most critical when acceptors are relatively old and expected fertility in the older ranges is relatively high. As the over-30 fertility rates approach zero, the differences between the SCYP and PC methods will disappear.

Estimation of Yearly Births Averted

Table 11, 12 present the year-by-year estimates of protected couples (PC) by age group for the 1962-77 cohorts combined. The increase in PC's through 1978 reflects new acceptors; since the last cohort entered in 1977, the number of PC's after 1978 declines as old acceptors leave because of aging and death. By the year 2006 the last of the 1977 cohort has existed.

Table 11. Projection of Impact of 1962-1977 Government Vasectomy Achievement: Estimated Protected Couples (PC) by Year, 1962-2006

	Age Range						
Year	20-24	25-29	30-34	35-39	40-44	45-49	Total
1962	2	82	372	608	404	137	1,605
1963	12	607	2,790	4,650	3,232	1,167	12,458
1964	29	1,489	6,999	12,155	9,175	3,693	33,540
1965	81	2,280	9,917	17,577	14,334	6,488	50,677
1966	175	3,191	12,278	21,627	18,431	8,948	64,650
1967	265	4,073	14,866	26,570	23,775	11,959	81,508
1968	378	4,841	16,789	30,343	28,782	14,957	96,090
1969	507	5,853	18,927	32,610	32,461	17,574	107,932
1970	541	6,032	20,948	35,668	35,866	20,457	119,512
1971	511	5,705	22,415	39,418	39,891	24,116	132,056
1972	549	6,023	23,721	41,974	43,230	28,029	143,526
1973	560	6,635	25,411	44,323	46,037	31,962	154,928
1974	808	9,454	29,825	48,146	49,110	35,523	172,866
1975	1,330	14,943	37,954	54,642	53,321	38,646	200,836
1976	1,829	20,507	47,429	62,979	58,434	42,664	233,842
1977	2,400	25,703	58,696	72,863	64,248	46,519	270,429
1978	2,244	23,841	60,658	78,903	69,457	49,723	284,826
1979	1,423	16,442	53,235	78,108	71,972	52,440	273,620

Table 11. (Continued)

Year	Age Range						
	20-24	25-29	30-34	35-39	40-44	45-49	Total
1980	757	10,298	46,072	75,773	73,806	55,564	262,270
1981	278	5,794	38,700	71,880	74,797	58,710	250,159
1982	–	3,035	30,946	66,509	75,215	61,671	237,376
1983	–	2,190	23,148	58,482	75,174	64,843	223,837
1984	–	1,388	15,953	51,323	74,410	67,171	210,245
1985	–	738	9,990	44,420	72,168	68,858	196,174
1986	–	271	5,623	37,311	68,431	69,763	181,399
1987	–	–	2,950	29,826	63,283	70,132	166,191
1988	–	–	2,125	22,273	55,605	70,099	150,102
1989	–	–	1,346	15,333	48,794	69,376	134,849
1990	–	–	715	9,598	42,236	67,257	119,806
1991	–	–	262	5,406	35,474	63,732	104,874
1992	–	–	–	2,843	28,338	58,886	90,067
1993	–	–	–	2,044	21,105	51,680	74,829
1994	–	–	–	1,292	14,503	45,344	61,139
1995	–	–	–	685	9,073	39,256	49,014
1996	–	–	–	250	5,117	32,966	38,333
1997	–	–	–	–	2,701	26,307	29,008
1998	–	–	–	–	1,935	19,506	21,441
1999	–	–	–	–	1,219	13,366	14,585
2000	–	–	–	–	644	8,353	8,997
2001	–	–	–	–	235	4,721	4,956
2002	–	–	–	–	–	2,507	2,507
2003	–	–	–	–	–	1,786	1,786
2004	–	–	–	–	–	1,120	1,120
2005	–	–	–	–	–	589	589
2006	–	–	–	–	–	214	214
Total	14,679	181,415	641,060	1,198,412	1,506,423	1,528,779	5,070,768

Table 12. Projection of Impact of 1972-1977 Government Tubal-ligation Achievement: Estimated Protected Couples (PC) by Year. 1972-2006

Year	Age Range						
	20-24	25-29	30-34	35-39	40-44	45-49	Total
1972	16	193	467	563	322	49	1,610
1973	49	572	1,546	1,876	1,200	273	5,516
1974	111	1,045	2,895	3,417	2,270	628	10,366
1975	221	2,301	5,939	6,481	3,837	1,157	19,936
1976	464	5,540	14,563	14,723	6,706	2,149	44,145
1977	2,479	23,891	54,747	49,775	15,333	3,542	149,767
1978	3,479	33,215	79,986	81,247	32,044	6,456	236,427
1979	2,541	25,372	69,480	83,881	43,685	9,097	234,056
1980	1,633	17,720	59,221	86,296	55,000	11,698	231,568
1981	768	10,534	49,266	88,028	65,689	14,536	228,821
1982	—	4,335	40,114	87,636	74,844	18,761	225,690
1983	—	3,398	32,276	77,129	77,433	30,112	220,348
1984	—	2,479	24,626	66,935	79,929	41,042	215,011
1985	—	1,592	17,184	57,041	82,239	51,589	209,645
1986	—	748	10,215	47,489	83,909	61,478	203,839
1987	—	—	4,218	38,735	83,529	69,885	196,367
1988	—	—	3,301	31,099	73,345	72,247	179,992
1989	—	—	2,406	23,682	63,558	74,555	164,201
1990	—	—	1,542	16,501	54,150	76,720	148,913
1991	—	—	724	9,808	45,140	78,301	133,973
1992	—	—	—	4,073	36,915	77,937	118,925
1993	—	—	—	3,180	29,532	68,183	100,895
1994	—	—	—	2,312	22,418	58,948	83,678
1995	—	—	—	1,478	15,585	50,203	67,266
1996	—	—	—	692	9,262	41,936	51,890
1997	—	—	—	—	3,883	34,438	38,321

Total 12. (Continued)

Year	Age Range						
	20-24	25-29	30-34	35-39	40-44	45-49	Total
1998	–	–	–	–	3,019	27,392	30,411
1999	–	–	–	–	2,186	20,687	22,873
2000	–	–	–	–	1,392	14,329	15,721
2001	–	–	–	–	650	8,515	9,165
2002	–	–	–	–	–	3,623	3,623
2003	–	–	–	–	–	2,799	2,799
2004	–	–	–	–	–	2,013	2,013
2005	–	–	–	–	–	1,274	1,274
2006	–	–	–	–	–	591	591
Total	11,761	132,935	474,716	884,077	1,069,004	1,037,143	3,609,636

The yearly births averted depends on the number and age distribution of the PC's. Table 13 presents the year-by-year estimates of births averted for the 1962-77 cohorts combined. These estimates were derived by updating expected fertility at every year.

Over a 45-year period the acceptance of vasectomy and tubal-ligation from the government program between 1962-1977 will avert approximately 417 thousand births. When we divide the number of births averted by the number of sterilization acceptors, we find that across cohorts, one sterilization operation will avert about 0.67 birth. This ratio appears to have declined somewhat in more recent years as the impact of accepting sterilization at younger ages is more than offset by declining expected fertility rates.

Table 13. Estimated Number of Births Averted Each Year by 1962-1977 Government Sterilization Achievement

Year	Type of Sterilization		Both methods
	Vasectomy	Tuballigation	
1962	302.741	–	302.741
1963	2,322.067	–	2,322.067
1964	5,601.044	–	5,601.044
1965	7,832.712	–	7,832.712
1966	9,645.792	–	9,645.792
1962-66	25,704.356	–	25,704.356
1967	10,958.526	–	10,958.526
1968	12,809.437	–	12,809.437
1969	14,613.176	–	14,613.176
1970	14,496.992	–	14,496.992
1971	15,244.506	–	15,244.506
1967-71	68,122.637	–	68,122.637
1972	15,679.208	269.704	15,948.912
1973	14,731.115	789.937	15,521.052
1974	15,630.780	1,346.995	16,977.775
1975	17,130.209	2,361.161	19,491.370
1976	19,433.114	5,107.771	24,540.885
1972-76	82,604.426	9,875.568	92,479.994
1977	22,053.403	18,717.325	40,770.728
1978	21,118.826	26,320.861	47,439.687
1979	16,493.019	21,340.305	37,833.324
1980	13,552.874	17,531.928	31,084.802
1981	9,483.624	12,651.197	22,134.821
1977-81	82,701.746	96,561.616	179,263.362

Table 13. (Continued)

Year	Type of Sterilization		Both methods
	Vasectomy	Tubal ligation	
1982	6,246.654	7,977.610	14,224.264
1983	5,048.478	6,755.137	11,803.615
1984	3,549.032	4,991.185	8,540.217
1985	2,319.107	3,459.037	5,778.144
1986	1,327.908	2,298.288	3,626.196
1982-86	18,491.179	25,481.257	43,972.436
1987	1,106.601	1,339.266	2,455.867
1988	778.480	1,007.600	1,786.080
1989	479.203	725.939	1,205.142
1990	284.483	472.552	757.035
1991	174.460	294.268	468.728
1987-91	2,823.227	3,839.625	6,662.852
1992	102.163	139.006	241.169
1993	74.914	109.949	184.863
1994	49.679	81.823	131.502
1995	29.100	54.822	83.922
1996	14,239	29.605	43.844
1992-96	270.095	415.205	685.300
1997	5.402	7.765	13.167
1998	3.870	6.038	9.908
1999	2.439	4.372	6.811
2000	1.289	2.784	4.073
2001	0.470	1.299	1.769
1997-2001	13.470	22.258	35.728
Total	280,731.136	136,195.529	416,926.665

Sterilization Effect on Induced Abortions Averted Under the Government Program

Using the same method we tried to find out how many induced abortions there would be if women did not accept sterilization or other contraceptives. The projection of induced abortions was calculated by multiplying age-specific PC's by the age-specific induced abortion rate. Table 14 shows the induced abortion rate by age cohort and year.

Table 14. Age-Specific Abortion Rates by Year

Age	1961*	1970*	1975**
20-24	9	29	63
25-29	25	48	85
30-34	35	102	158
35-39	40	102	153
40-44	12	46	75
45-49	(1)	5	19

* Hong & Watson, 1976.
** 1976 National Fertility Survey.

Table 15 shows the projection of induced abortions averted by five year groups. According to Table 15 the total number of induced abortions averted by sterilization acceptance during 1962-1976 amounted to 132,729 and another 588,739 will be averted by the 1962-77 sterilization cohorts over the next 30 years. Thus one sterilization conducted between 1962 and 1977 can be expected to averted approximately 1.16 abortions in addition to approximately 0.67

live birth. It is one of the most complex tasks to measure the association between births and induced abortions averted. Because these two factors are so closely interrelated.

Table 15. Number of Induced Abortions Averted through Sterilization by Year, Method: 1962-2006

Year	Type of Sterilization		Both methods
	Vasectomy	Tuballigation	
1962-1966	4,158.401	–	4,158.401
1967-1971	31,950.996	–	31,950.996
1972-1976	36,506.983	10,112.953	96,619.936
1977-1981	137,415.889	135,799.767	273,215.656
1982-1986	87,381.699	105,900.888	193,282.587
1987-1991	38,657.316	51,301.005	89,958.321
1992-1996	11,283.150	15,970.788	27,253.938
1997-2001	1,877.857	2,836.609	4,714.466
2002-2006	118.104	195.700	313.804
Total	399,350.395	322,117.710	721,468.105

VII. CONCLUSIONS

If things go well with the fourth 5-year plan, the 1981 population will be 38,810,000 with a 1.6% annual increase rate. The long-term economic and social development plan calls for 45,250,000 population and a 1.3% increase rate in 1991. The decline in population growth has been greatly affected by family planning activities. The fact that the increase rate is expected to stabilize at 1.3% in 1991, with a mean

size of family of 2.1, indicates that the demographic transition is very nearly complete in Korea.

It may be possible to reach these goals before 1991, because of such favorable conditions as the rising use of contraception among married couples and the falling ideal family size (2.8 in 1978).

In order to reach the population size and increase rate in 1981 as planned, we must avert 0.73 million births. (real births = 0.93 million). Sterilization is expected to contribute a great deal to total births averted. 1.52 million sterilizations (government sector + private sector) seems to be a high enough goal in fifth 5 year plan period, 1977-1981. Given the demand for sterilization and the attainment of government program in 1977 (0.24 million), it seems that the total performance will exceed that goal.

Needless to say, most Koreans (81% of all users) practice contraception to terminate fertility. Therefore every woman with three children or more (at least one son) can be considered a potential acceptor or target for sterilization. About 0.4 million sterilization a year (6% of eligible women) seems to be possible for the next few years, depending on the service and the satisfaction of the acceptors. The sterilization program, which reduces both births and induced abortions, will contribute a great deal to both maternal and child health care and fertility control.

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