A RETROSPECTIVE ANALYSIS OF FERTILITY DECLINE IN TURKEY: AN APPLICATION OF OWN-CHILDREN METHOD TO TDHS DATA SETS[1]

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Own-children method is one of the indirect methods of fertility estimation that uses the current information about the age-structure of women and children as well as their mortality pattern in order to provide the estimations of fertility rates for the 15-year period preceding a census or survey.The prior objective of this study is to apply the own-children method to the household data sets of 1993 and 2003 Turkey Demographic and Health Survey carried out by Hacettepe Institute of Population Studies every five years nationwide. When employing the method, mortality is assumed to have remained constant during the 15-year time period and East model among Coale-Demeny model life tables has been preferred. Own-children provides the opportunity to do analyses related to the level and trend of fertility in Turkey without any age restrictions.Overlapping estimates of overall fertility rates derived from the two approaches and resembling findings for fertility attained from either TDHS itself or own-children method.

I. INTRODUCTION

Fertility which is one of the most significant issues is on the top of demographers' agenda. Main sources of information on fertility are vital registration systems, censuses and demographic researches. However, vital registration systems in Turkey are not very reliable as in most of the developing countries. On the other hand, census data is not appropriate to attain demographic data about fertility in detail, because of its costly implications. In addition, its workload is too high. There also exists the risk of collecting erroneous information for the retrospective questions in censuses. Despite all these limitations, until mid-1960s, information on the levels and trends in Turkish fertility had been withdrawn from indirect methods applied to census data (Ergöçmen, 1997). In order to study the diverse factors related to fertility in Turkey, Hacettepe University Institude of Population Studies has performed quinquennial nationwide demographic surveys since 1968.

In the countries like Turkey, where the reliability of vital registration is a problem, the own-children method can be given the priority to determine the fertility estimates. In short, the own-children method, a standard tool of indirect fertility estimation, is a census or survey-based reverse survival technique for estimating age-specific birth rates for years preceding a census or survey (Cho, Retherford and Choe, 1986). It is important to point out that the own-children method does not suffer from age truncation unlike fertility estimations based on birth history data. In other

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words, for the whole 15-year estimation period, the own-children method provides the opportunity for the 15-49 age group to be fully covered in the computation process of the total fertility rate, which is the most desirable measure. The fact that makes this method preferable is that various mortality assumptions are allowed to be used for different periods. It ensures flexibility regarding the utilization of constant or changing mortality.

There exists a good number of examples of own-children applications all over the world. The method has been employed most extensively in Asia, Africa, Latin America as well as in more developed countries such as United States. For instance, the method was tested in Tibet by using its 1958 Census and found to be a reliable method when the results were compared with the ones obtained from other sources (Childs, 2004). Likewise, in Korea, the findings of the own-children method were approved to be in line with the rates obtained in 1975 and 1980 censuses. On the other hand in Pakistan, the estimates of own-children were stated to be biased due to inaccurate age reporting (Cho, Retherford and Choe, 1986). in Turkey, the only study as regards the application of own-children method has been performed by Can and Arslan (1997). They tried to compute total fertility rate of Turkey by applying the own-children method to the "Multiple Indicator Cluster Survey" (MICS) conducted in 1995. Based on the result, it was concluded that own-children method was a method that could reliably be used in TFR estimations. In fact, in Turkey this is the only study related to the own-children method. Therefore, the primary objective is to indicate the fertility levels and trends as well as the age pattern in Turkey 15 years preceding the survey dates of 1993 and 2003 by employing the own-children method. When the level of Turkey's total fertility rates obtained from demographic surveys is examined, there has been a continuous decline for the last 25 years. According to Turkey Demographic and Health Survey, the last of which was conducted in 2003-2004, a woman will give birth to an average of 2.2 children during her reproductive years. This rate is 50 percent lower than the total fertility rates recorded in 1970s (Koç and Özdemir, 2004). In the light of these facts, Turkey is just above the replacement level of fertility which is 2.1 in terms of the point it has reached in 2003. Accordingly, the secondary objective is to compare the findings of own-children method with the TDHS-type fertility estimations in order to manifest whether this technique is a reliable and practicable way of fertility estimations.

II. THE METHODOLOGY

II.1. METHOD USED IN THE STUDY

The own-children method of fertility estimation is a reverse-survival technique for estimating age-specific birth rates for years previous to a census or household survey using the current mortality pattern of adult females as well as the children. In other words, this method is a retrospective process in which numbers of births by age of mother and numbers of women by single age in previous years are calculated prior to the census or survey. The rationale of the technique and its computational prodcedure are explicated in "Manual X" (UN, 1983), "The Own Children Method of Fertility Estimation" (Cho, Retherford and Choe, 1986) and "The Analyses of Fertility Trends in Turkey: An Application of Own-Children

Method to 1993, 1998 and 2003 Turkey Demographic and Health Survey” (Çağatay, 2006).

II.2. DATA REQURED

a. The number of children under 15 whose mother was identified, classified according to single year of own age and single year of age of mother
b. The number of children under 15 whose mother could not be identified (probably because the mother had died or because she did not live in the same house as her child), classified by single year of age
c. The number of all women disregarding whether they are mothers or not, classified by single year of age
d. Estimates of child survivorship
e. Estimates of female adult mortality

II.3. DATA SOURCE

The analyses and the application of the own children method are carried out with the data of the last two Turkish Demographic and Health Surveys (TDHS), as a part of the international DHS project, conducted by Hacettepe University Institute of Population Studies in 1993 and 2003-2004. Among the variables used in TDHS-1993 and TDHS-2003, the followings are selected for the data set construction process are as follows:

Table II.3.1. Variables Used in Each TDHS

Variables	TDHS-1993	TDHS- 2003
mother’s line number (sh9 and sh11)	√	√
sample weight (hv005)	√	√
slept last night (hv103)	√	√
sex of household member (hv104)	√	√
age of household member (hv105)	√	√
mother age (mage)	√	√

III. APPLICATION OF THE METHOD TO TDHS-1993 AND TDHS-2003

The special tabulation in which children are matched to mothers and classified by age of mothers, is a prerequisite for the application of own-children method. In order to form this table, person data were developed for each of the three surveys by choosing necessary variables among the ones used in the household questionnaires of TDHS-1993 and TDHS-2003. In addition to these variables, a new variable named “MAGE” was created, which defines the mother age. Matching procedure was completed by utilizing the line number of mother rather than using the answers to the questions of age, sex, marital status, number of living children or relation to head of household.

Matching of children to mothers has been accomplished by SPSS which is a software package for statistical analyses and data management systems. First of all, a syntax has been written by using the variables as mentioned above in order to compose the data for the matching stage. Since the record of "mother's line number" exists for each children in each of the household data of TDHS-1993 and 2003, this information has been utilised to link children with their mothers.

The rationale behind this algorithm is that the mother's line number (sh9 or sh11) of potential "own" children in the household has been scanned. If the mother is found, then her age is recorded under the heading of "MAGE" variable. Otherwise "MAGE" is recorded as 99 which refers to "unmatched" children. This matching procedure has been applied to each survey yielding three separate data files in SPSS that contains all the variables required. Later, cross-tabulations in which rows and columns indicates the "MAGE" and "age of household member" (hv105) respectively, have been established to attain the own-children data with children classified by single year of age and single year age of mother. All women in the age range 15-64, all children below age 15 and all non-own children recorded as 99 have been selected from this table. To determine the number of women, the frequency of all women in 15-64 age group has been computed. It should be reiterated that matching is usually limited to children younger than 15 since many children may begin to live away from their mothers starting at about age 15 (Cho, Retherford and Choe, 1986). Once these data files in SPSS have been formed, own-children estimates of fertility can be tabulated by whatever characteristics recorded in the data files.

Table III.2 and III.3 show the weighted number of own-children obtained from the *de facto* survey populations of TDHS-1993 and TDHS-2003 respectively.

Table III.2. Own-Children Data Classified by Single Year of Age and Single Year Age of Mother Derived from Household Data of TDHS-1993

Age of mother	Number of children by age of child																Number of women
	0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	
15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	471
16	6	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	498
17	15	4	4	1	0	0	0	0	0	0	0	0	0	0	0	0	521
18	25	16	3	2	1	2	1	0	1	0	1	1	1	0	0	0	492
19	37	17	14	7	4	1	0	0	0	0	0	0	0	0	0	0	382
20	66	44	38	17	20	13	6	3	4	0	2	0	0	0	0	0	453
21	46	58	28	15	13	14	9	6	2	0	0	0	0	0	0	0	352
22	72	54	57	35	40	20	19	6	3	0	0	0	0	0	0	0	389
23	59	58	41	56	43	30	21	16	10	2	1	0	0	0	1	0	360
24	56	45	51	55	60	25	32	17	11	5	1	0	0	0	0	0	317
25	69	55	57	63	56	48	39	35	32	11	20	4	6	1	0	0	355
26	36	35	46	39	46	57	58	48	28	20	17	5	5	0	0	1	284
27	53	45	37	58	52	65	62	65	51	34	33	17	13	3	2	0	315
28	37	37	41	49	46	50	48	66	61	56	34	28	18	7	1	2	298
29	24	26	28	28	32	35	50	54	40	37	37	25	21	11	8	2	221
30	41	44	47	56	67	78	76	103	89	74	87	78	65	46	19	17	382
31	24	14	13	26	32	29	43	47	62	51	54	53	39	33	18	8	219
32	23	16	28	35	48	44	38	59	51	63	53	50	57	57	26	20	246
33	33	17	16	35	35	40	40	70	65	81	81	66	85	100	51	37	332
34	16	15	10	20	28	28	26	34	44	37	40	61	64	55	48	41	218
35	17	14	24	29	29	32	64	47	72	62	85	63	84	86	70	70	292
36	6	5	9	12	11	18	20	23	38	34	53	45	43	68	49	39	199
37	13	12	10	15	16	16	19	24	35	25	57	29	62	64	52	60	212
38	7	12	15	12	19	9	20	39	49	54	47	57	62	77	62	86	271
39	12	6	9	4	11	12	16	12	19	24	26	31	45	39	38	54	183
40	12	5	16	14	22	26	35	36	45	48	58	53	78	77	77	56	297
41	4	1	5	3	2	7	5	12	9	9	20	15	23	20	25	32	149
42	0	1	2	5	2	8	19	22	21	16	19	25	30	37	37	43	188
43	2	4	2	7	9	5	18	19	25	27	22	34	37	50	53	44	224
44	0	0	3	2	3	3	3	4	13	10	19	17	19	17	21	21	135
45	1	2	4	5	6	5	11	13	27	10	36	29	43	36	40	42	217
46	0	1	3	0	2	3	4	4	8	12	15	16	14	13	21	26	139
47	1	0	0	1	1	1	4	6	8	6	15	14	16	17	24	18	134
48	0	0	0	3	0	3	0	5	10	5	10	9	9	17	18	21	157
49	0	1	0	0	1	1	0	0	4	2	3	4	11	3	7	14	81
50	0	0	0	1	6	2	1	9	7	10	15	8	23	22	28	26	198
51	0	0	0	0	0	0	4	4	5	4	12	12	13	21	20	23	169
52	0	0	0	0	0	0	4	2	3	6	7	11	10	14	25	29	209
53	0	0	1	0	1	0	0	0	3	3	4	6	8	9	15	12	191
54	0	0	0	0	0	2	1	2	0	3	3	1	8	8	11	10	130
55	0	0	0	0	0	0	1	4	1	2	8	4	11	9	29	16	285
56	0	0	0	0	0	0	0	0	2	0	2	1	4	3	4	3	126
57	0	0	0	0	0	0	0	0	1	0	0	1	0	4	4	7	126
58	0	0	0	0	0	0	0	0	0	2	5	2	2	4	0	7	116
59	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	76
60	0	0	0	0	0	0	0	0	0	0	0	0	0	1	8	2	327
61	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	2	64
62	0	0	0	0	0	0	0	1	0	0	1	0	0	2	0	0	99
63	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	108
64	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	78
Unknown	4	7	16	10	13	21	18	24	33	36	43	28	52	52	60	77	
TOTAL	**817**	**672**	**679**	**721**	**777**	**753**	**835**	**941**	**992**	**881**	**1049**	**903**	**1081**	**1084**	**973**	**968**	

Table III.3. Own-Children Data Classified by Single Year of Age and Single Year Age of Mother Derived from Household Data of TDHS-2003

Age of mother	Number of children by age of child 0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Number of women
15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	387
16	3	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	445
17	14	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	468
18	24	7	3	4	0	0	0	0	0	0	0	0	0	0	0	0	435
19	30	32	12	5	3	0	0	0	0	0	0	0	0	0	0	0	369
20	39	33	30	20	6	3	0	0	0	0	0	0	0	0	0	0	442
21	40	41	37	23	5	4	0	0	0	0	0	0	0	0	0	0	364
22	85	50	60	39	43	26	13	4	4	1	1	0	0	0	0	0	484
23	62	51	51	52	43	26	15	11	1	1	1	0	0	0	0	0	435
24	66	45	55	50	40	34	23	16	10	2	0	0	0	0	0	0	411
25	58	50	58	59	58	44	40	29	21	11	2	2	1	0	0	0	409
26	55	57	60	79	51	60	64	43	34	22	14	5	2	0	0	0	412
27	55	35	69	55	53	45	46	41	36	37	18	6	4	1	0	0	343
28	27	56	58	73	59	54	46	60	48	39	38	21	14	6	3	0	374
29	33	49	43	54	56	59	63	60	76	51	39	35	28	18	5	1	337
30	37	36	55	72	67	80	70	74	72	58	74	57	42	25	13	6	414
31	27	22	35	40	45	47	50	69	56	63	44	43	42	36	20	9	305
32	28	29	40	44	42	36	55	58	67	73	68	67	44	36	31	27	311
33	17	15	40	45	38	31	48	60	50	49	60	71	64	57	39	27	334
34	15	20	32	33	34	27	35	42	53	52	40	51	42	52	47	29	283
35	21	20	16	27	35	44	36	45	52	49	56	58	54	72	63	54	325
36	7	19	9	21	21	25	29	31	32	33	30	39	37	40	55	29	224
37	7	6	19	10	24	34	46	37	33	28	56	50	58	66	56	50	298
38	13	15	17	16	20	24	38	32	41	43	42	59	55	74	59	57	327
39	5	12	14	14	21	28	28	36	30	38	41	44	42	52	61	65	334
40	6	6	11	18	14	22	23	19	30	24	34	43	45	67	42	59	306
41	3	6	6	10	8	8	16	30	22	24	29	30	29	36	54	40	262
42	2	0	5	10	8	9	8	15	21	19	33	29	24	42	31	36	274
43	3	5	9	9	6	13	12	16	23	20	19	25	22	43	38	55	316
44	1	3	1	4	2	12	7	11	10	18	24	26	33	29	35	33	250
45	0	1	1	4	3	5	10	9	10	12	17	17	22	37	32	35	287
46	0	0	2	1	6	2	4	4	5	3	12	13	13	18	24	13	215
47	0	0	0	0	1	2	0	3	6	9	7	16	10	16	18	19	225
48	0	1	2	0	0	4	3	5	4	4	11	3	11	15	16	23	242
49	0	0	0	1	1	1	2	2	2	4	1	4	5	12	14	10	166
50	0	0	1	2	1	1	4	2	4	6	7	6	6	12	13	17	198
51	0	0	0	0	0	1	0	0	3	3	4	7	13	7	9	15	193
52	0	0	0	0	1	1	0	1	6	4	3	9	10	10	15	12	240
53	0	0	1	0	0	1	1	2	2	3	1	5	5	4	11	11	243
54	0	0	0	0	0	0	0	1	2	2	3	4	4	3	8	5	196
55	0	0	0	0	0	0	0	0	2	1	3	4	7	6	9	7	220
56	0	0	0	0	0	0	0	0	0	0	0	3	2	4	9	4	125
57	0	0	0	0	0	0	0	0	0	1	0	1	1	1	2	1	139
58	0	0	0	0	0	0	0	0	0	0	0	0	1	2	5	1	169
59	0	0	0	0	0	0	0	0	0	0	0	0	2	0	2	3	91
60	0	0	0	0	0	0	0	0	2	0	0	0	0	0	1	1	185
61	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	83
62	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	3	107
63	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	133
64	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	128
Unknown	7	6	13	27	20	28	18	21	28	18	34	29	23	35	50	70	
TOTAL	**790**	**731**	**866**	**923**	**836**	**841**	**853**	**889**	**898**	**825**	**866**	**883**	**817**	**935**	**892**	**828**	

Step 2: Redistribution of Children with Unidentified Mother[3]

The number of children whose mother could not be identified at the matching stage are given in the penultimate row of the tables. The last rows indicates the totals of each column. The procedure for computing the expansion factor, K_x, used in the redistribution of unmatched children for each of the three surveys are illusrated below based on the information presented in Table III.2 and III.3.

[3] U_x denotes the number of unmatched children aged *x*, C_x denotes the number of matched children aged *x*

<u>*TDHS-1993:*</u> Considering the 10-year old children showed in Table V.2.2, a total of 1,049 has been enumerated out of which 43 children has no mother. Therefore the expansion factor is calculated as,

$$C_x = Total - unmatched \Rightarrow 1{,}049 - 43 = 1{,}006$$

$$K_x = (1.0 + U_x / C_x) \Rightarrow 1.0 + 43/1{,}006 = 1.0427$$

<u>*TDHS-2003:*</u> In Table V.2.4, the total of the children aged 12 is given as 817. Among these, mothers of 23 children has been identified as non-own. Then, each children aged 12 is multiplied by 1.029 for the reverse-projection.

$$C_x = Total - unmatched \Rightarrow 817 - 23 = 794$$

$$K_x = (1.0 + U_x / C_x) \Rightarrow 1.0 + 23/794 = 1.029$$

Values of the expansion factor K_x for $0 \leq x \leq 15$ are given in Table III.4 concerning the total survey population in each of the three surveys. These factors has been used at the stage of estimating numbers of births for each of the 15 year preceding the surveys.

Table III.4. Values of Expansion Factors, K_x

Age of child (x)	TDHS-1993 K_x	TDHS-2003 K_x	Age of child (x)	TDHS-1993 K_x	TDHS-2003 K_x
0	1.0049	1.0089	8	1.0344	1.0322
1	1.0105	1.0083	9	1.0426	1.0223
2	1.0241	1.0152	10	1.0427	1.0409
3	1.0141	1.0301	11	1.0320	1.0340
4	1.0170	1.0245	12	1.0505	1.0290
5	1.0287	1.0344	13	1.0504	1.0389
6	1.0220	1.0216	14	1.0657	1.0594
7	1.0262	1.0242	15	1.0864	1.0923

Step 3: Estimation of Survivorship Probabilites for Children and Adult Females

At this stage of the own-children method, mortality levels provided by Turkish Demographic and Health Surveys have been utilised for the application of the method to TDHS-1993 and TDHS-2003, which is different from the procedure required by the method. Since there are no other reliable and accurate mortality data derived form vital registration systems or censuses, these rates have been preferred.

In Turkish Demographic and Health Surveys, infant mortality (${}_1q_0$) child mortality (${}_4q_1$) and under-five mortality (${}_5q_0$) rates by five- and ten-year periods preceding the survey has been given. These rates are available for both males and females. Among these rates, under-five mortality (${}_5q_0$) rates for ten-year period preceding the survey for each sex have been employed. This means that for TDHS-1993, these mortality rates refer to a mortality level for 1983-1993 period and similarly for the TDHS-2003, the period 1993-2003 are considered (Table III.5). Moreover, only one set of mortality rates has been used for each of the three surveys in reverse projection of the population implicitly assuming that mortality have remained constant during each period. In addition, since there are no strict rules for the mortality assumptions in own-children method, the utilisation of different mortality schedules for different periods is also granted concerning the 15-year estimation period.

Table III.5 Under-Five Mortality Rates for the Ten-Year Period Prior to Survey

	Under Five Mortality Rates ($_0q_5$)	
	TDHS-1993	**TDHS-2003**
Male	82.0	48.0
Female	78.7	45.0

The underlying reason for utilising under-five mortality instead of infant or child mortality is that under-five mortality is thought to have a more composite structure since it covers both of them. Besides, when under-five mortality is compared to infant and child mortality, it is superior in terms of the number of observations in under-five mortality. The lack of observations may be a potential for infant and child mortality to fluctuate. In contrast, such fluctuations tend to be low for under-five mortality due to a relatively smoother structure.

Although the own-children method is not very sensitive to assumptions about recent changes in the level of mortality, it requires detailed estimates of mortality for both children and females (UN, 1983). Therefore, in order to correspond at least to the decade preceding the survey, under-five mortality ten-year period prior to the survey rather than that of five-year period has been found appropriate to be used in the estimation of survivorship ratios. If mortality is assumed to have changed during the period, under-five mortality five year preceding the survey will be more accurate. However, in the application of own-children method to the Turkish Demographic and Health Surveys, constant mortality is assumed. As a result, under-five mortality for the ten-year period has been considered to produce more precise since it refers to the estimation period in the method.

Table III.6 Number of Persons Surviving to Age 5 (l_x) Derived from Under- Five Mortality Rates

	Number of Survivors at Exact Age 5 (l_5)	
	TDHS-1993	**TDHS-2003**
Male	82.0	48.0
Female	78.7	45.0

To estimate the necessary survivorship probablities, first of all, the number of persons surviving to exact age 5 *(l_5)*, one of the life table functions, has been produced for each sex by using under-five mortality rates (Table III.6).

Next, by employing MORTPAK software, abridged life tables have been formed seperately for each sex. For the creation of these life tables, MATCH application in MORTPAK has been used. The software requires a mortality value for one of four life table functions which are ${}_nm_x$, ${}_nq_x$, l_x or e_x. The number of persons surviving to age 5 (l_5) has been utilised for this application. For model life table pattern, Coale-Demeny East model life table, which is characterized as high infant and high old-age mortality relative to childhood and adult rates, has been employed. However, demographers argue that it is not easy to identify an exact model for the pattern of Turkish mortality. Hence, there has not been a consensus on the model that best fits the mortality pattern in Turkey. For instance, some demographers suggest that East and Chilean models are found to be appropriate for childhood mortality while West and General models is said to give the best fit for adult mortality. On the other hand, some demographers have stated that Coale-Demeny South model failed to reflect the child mortality in Turkey. On the contrary, it has proved to be suitable for adult mortality (Türkyılmaz, 1998). It is pointed out by Hancıoğlu (1991) that Chilean and East models reflect infant mortality and under-five mortality the best. Shorter and Macura (1982) also indicates that East model is more compatible with the mortality pattern in Turkey. Therefore, East model has been preferred due to the fact that it best fits for both the mortality pattern in Turkey and under-five mortality.

For the calculation of children survivorship ratios, life tables have been combined to attain them for both sexes. Abridged life tables have been converted into single-year life tables by using UNABR application in MORTPAK due to the fact that single-year ages are used in the own-children method. At this stage, q_x values are required in the life tables produced. In this way, l_x values have been achieved to be used in the stage of reverse survival of children and adult females. The estimates of probabilities of surviving for children and adult females are displayed in Table III.7 and III.8.

Table III.7. Estimates of Survivorship Probabilities for Children and Adult Females for TDHS-1993 Refering to the Period 1983-1993

Age of Child	Child L_x		Age of women	Women L_x		Age of women	Women L_x	
	l_x	L_x		l_x	L_x		l_x	L_x
0	100000	0.95374	15	91175	0.90909	40	86524	0.86527
1	93403	0.93203	16	91085	0.91589	41	86235	0.86000
2	92690	0.92574	17	90987	0.90598	42	85934	0.85831
3	92316	0.92164	18	90881	0.90551	43	85619	0.85530
4	92069	0.91919	19	90766	0.91241	44	85288	0.85122
5	91887	0.92258	20	90641	0.89865	45	84939	0.84598
6	91744	0.91406	21	90508	0.90506	46	84571	0.84267
7	91627	0.91667	22	90365	0.90476	47	84180	0.84073
8	91528	0.91579	23	90213	0.89888	48	83763	0.83459
9	91441	0.91860	24	90053	0.89840	49	83319	0.83246
10	91362	0.91358	25	89885	0.89796	50	82842	0.82553
11	91288	0.91250	26	89709	0.89756	51	82331	0.82116
12	91215	0.90244	27	89525	0.89202	52	81780	0.81507
13	91141	0.91954	28	89335	0.89593	53	81185	0.80881
14	91061	0.90625	29	89137	0.89083	54	80542	0.80207
15	90974	0.90654	30	88933	0.88608	55	79845	0.79495
			31	88723	0.88525	56	79089	0.78640
			32	88507	0.88492	57	78268	0.77855
			33	88284	0.88077	58	77375	0.76880
			34	88055	0.87687	59	76404	0.75879
			35	87820	0.87726	60	75347	0.74756
			36	87577	0.87413	61	74198	0.73632
			37	87327	0.87162	62	72947	0.72234
			38	87069	0.87013	63	71589	0.70831
			39	86801	0.86563	64	70115	0.69341

Table III.8. Estimates of Survivorship Probabilities for Children and Adult Females for TDHS-2003 Refering to the Period 1993-2003

Age of Child	Child L_x		Age of women	Women L_x		Age of women	Women L_x	
	l_x	L_x		l_x	L_x		l_x	L_x
0	100000	0.97171	15	94867	0.94805	40	91125	0.90975
1	95900	0.95827	16	94794	0.94505	41	90873	0.90728
2	95663	0.95828	17	94708	0.95238	42	90599	0.90303
3	95519	0.95831	18	94608	0.94167	43	90301	0.90305
4	95414	0.95275	19	94495	0.94737	44	89975	0.89899
5	95329	0.95225	20	94369	0.94444	45	89619	0.89425
6	95257	0.95466	21	94233	0.94079	46	89230	0.89121
7	95194	0.94968	22	94090	0.93671	47	88804	0.88403
8	95137	0.94611	23	93942	0.93789	48	88339	0.88235
9	95084	0.95216	24	93791	0.93789	49	87829	0.87579
10	95035	0.95121	25	93640	0.93789	50	87272	0.87000
11	94986	0.94967	26	93489	0.93711	51	86663	0.86252
12	94938	0.95106	27	93340	0.93038	52	85998	0.85630
13	94886	0.94342	28	93193	0.92994	53	85271	0.84813
14	94829	0.94681	29	93047	0.92994	54	84478	0.84062
15	94764	0.95163	30	92901	0.92405	55	83613	0.83230
			31	92755	0.93125	56	82670	0.82131
			32	92606	0.92121	57	81645	0.81091
			33	92454	0.92398	58	80530	0.79921
			34	92296	0.92179	59	79320	0.78657
			35	92131	0.92105	60	78008	0.77300
			36	91956	0.92079	61	76588	0.75828
			37	91770	0.91705	62	75054	0.74237
			38	91571	0.91453	63	73400	0.72523
			39	91357	0.91339	64	71621	0.70678

Step 4: Reverse Survival of Children

The children have been reverse-projected to birth by utilizing the C_x^a (the children aged x whose mother's age at the time of enumeration was a) values and ${}_1L_x$ estimates for children calculated by using under-five mortality rates described in Step 3. The following examples for each of the three surveys based on the household data nationwide are given so as to show the computational procedure of this step.

<u>*TDHS-1993:*</u> In order to estimate the births occuring in 1983 to women aged 20, the procedure to be followed is (Table V.2.2 for C_x^a and Table V.2.8 for ${}_1L_{10}$)

$$M_{1983}^{20} = K_{10}(C_{10}^{30} / {}_1L_{10}) = 1.0427(87/0.91358) = 99.30$$

$$M_{1983}^{21} = K_{10}(C_{10}^{31} / {}_1L_{10}) = 1.0427(54/0.91358) = 61.63$$

$$B_{1983}^{20} = (M_{1983}^{20} + M_{1983}^{21})/2 = (99.30 + 61.63)/2 = 80.46$$

80.46 refers to the number of births occured to 20-year old women in 1983.

<u>*TDHS-2003:*</u> When considering the number of births women aged 17 in 1998 has been calculated as 28.15 (Table V.2.4 for C_x^a and Table V.2.10 for ${}_1L_5$).

$$M_{1998}^{17} = K_5(C_5^{22} / {}_1L_5) = 1.0344(26/0.95225) = 28.24$$

$$M_{1998}^{18} = K_5(C_5^{23} / {}_1L_5) = 1.0344(26/0.95225) = 28.24$$

$$B_{1998}^{17} = (M_{1998}^{17} + M_{1998}^{18})/2 = 28.24$$

Step 5: Reverse Survival of Adult Females

To estimate the fertility rates for the period concerned in own-children method, the reverse projection of females required is figured out by employing the ${}_1L_x$ values of adult females estimated in Step 3. Some examples are given in order to display the computational procedure of this stage concerning the overall survey population in TDHS-1993 and TDHS-2003.

<u>TDHS-1993:</u> Concerning the women aged 42, the mid-year population of these females 11 years preceding the survey is found to be 170.90 (Table V.2.2 for W_t^a and Table V.2.8 for ${}_1L_x$).

$$W_{1982}^{42} = W_{1993}^{53}({}_1L_{42}/{}_1L_{53}) = 191(0,8583/0,8088) = 202.69$$
$$W_{1981}^{42} = W_{1993}^{54}({}_1L_{42}/{}_1L_{54}) = 130(0,8583/0,8021) = 139.12$$
$$N_{1982}^{42} = (202.69 + 139.12)/2 = 170.90$$

<u>TDHS-2003:</u> The reverse projection of 28-year old adult females to the mid year (2000/01) is done according to the following computations (Table V.2.4 for W_t^a and Table V.2.10 for ${}_1L_x$).

$$W_{2001}^{28} = W_{2003}^{30}({}_1L_{28}/{}_1L_{30}) = 414(0,92994/0,92405) = 416.64$$
$$W_{2000}^{28} = W_{2003}^{31}({}_1L_{28}/{}_1L_{31}) = 305(0,92994/0,93125) = 304.57$$
$$N_{2001}^{28} = (416.64 + 304.57)/2 = 360.60$$

Step 6: Computation of Age-Specific Fertility Rates

To demostrate the procedure of finding age-specific fertility rates by single year of age and five-year age group regarding the whole country, following examples are given.

<u>TDHS-1993:</u> To calculate the ASFR of women aged 20 for the 15th year prior to the survey, the number of births occured in 1979 to 20-year old women are divided by the number of all women aged 20 in that year.

$$f_{1979}(20) = B_{1979}^{20} / N_{1979}^{20} = 69.38/261.31 = 0.2655$$

The ASFR for 15-19 in 1979 is computed as according to the following equation:

$$f_{1979}(1) = (f_{1979}(15) + f_{1979}(16) + f_{1979}(17) + f_{1979}(18) + f_{1979}(19))/5$$
$$f_{1979}(1) = (0.0515 + 0.0701 + 0.1088 + 0.1529 + 0.2041)/5 = 0.1175$$

<u>TDHS-2003:</u> In order to find the ASFR for both women aged 43 in 2002 and their age group, following computations are carried out:

$$f_{2002}(43) = B_{2002}^{43} / N_{2002}^{43} = 2.10 / 270.57 = 0.0078$$
$$f_{2002}(6) = (f_{2002}(40) + f_{2002}(41) + f_{2002}(42) + f_{2002}(43) + f_{2002}(44)) / 5$$
$$f_{1979}(1) = (0.0117 + 0.0089 + 0.0148 + 0.0078 + 0.0021) / 5 = 0.0091$$

Table III.9. Estimated Single-Year Fertility Rates by Single Year Age of Mother Derived from TDHS-1993

Age of woman	Single Years														
	1978/79	1979/1980	1980/81	1981/82	1982/83	1983/84	1984/85	1985/86	1986/87	1987/88	1988/89	1989/90	1990/91	1991/92	1992/93
15	0.051	0.039	0.058	0.041	0.065	0.027	0.035	0.033	0.042	0.037	0.032	0.011	0.008	0.005	0.007
16	0.070	0.105	0.085	0.081	0.093	0.054	0.071	0.053	0.059	0.051	0.045	0.031	0.021	0.021	0.022
17	0.109	0.147	0.163	0.114	0.123	0.101	0.105	0.086	0.087	0.074	0.079	0.044	0.069	0.041	0.042
18	0.153	0.216	0.197	0.190	0.154	0.164	0.147	0.144	0.117	0.090	0.122	0.074	0.090	0.079	0.075
19	0.204	0.301	0.233	0.240	0.229	0.199	0.202	0.207	0.167	0.119	0.166	0.132	0.126	0.136	0.129
20	0.266	0.315	0.281	0.247	0.264	0.207	0.218	0.238	0.223	0.183	0.191	0.180	0.145	0.165	0.147
21	0.276	0.306	0.307	0.222	0.257	0.231	0.237	0.255	0.198	0.224	0.175	0.192	0.149	0.162	0.168
22	0.278	0.347	0.327	0.254	0.258	0.273	0.278	0.286	0.208	0.206	0.179	0.174	0.176	0.164	0.184
23	0.269	0.356	0.293	0.268	0.246	0.278	0.271	0.276	0.231	0.181	0.176	0.177	0.178	0.161	0.179
24	0.250	0.323	0.288	0.242	0.273	0.238	0.223	0.252	0.218	0.207	0.165	0.191	0.153	0.153	0.196
25	0.272	0.282	0.289	0.198	0.313	0.215	0.219	0.246	0.192	0.196	0.180	0.162	0.140	0.144	0.173
26	0.259	0.266	0.265	0.195	0.296	0.216	0.251	0.207	0.149	0.173	0.180	0.152	0.146	0.144	0.156
27	0.209	0.241	0.290	0.213	0.240	0.159	0.248	0.175	0.132	0.161	0.189	0.149	0.137	0.132	0.155
28	0.246	0.185	0.254	0.191	0.178	0.180	0.195	0.156	0.193	0.135	0.157	0.143	0.109	0.125	0.123
29	0.232	0.232	0.177	0.167	0.194	0.190	0.192	0.125	0.188	0.129	0.125	0.132	0.097	0.104	0.113
30	0.195	0.206	0.183	0.130	0.195	0.166	0.166	0.143	0.104	0.112	0.122	0.109	0.084	0.070	0.114
31	0.192	0.165	0.175	0.157	0.128	0.142	0.147	0.123	0.089	0.091	0.089	0.105	0.052	0.062	0.107
32	0.184	0.150	0.196	0.155	0.110	0.082	0.134	0.110	0.087	0.057	0.072	0.091	0.073	0.063	0.102
33	0.162	0.120	0.179	0.142	0.126	0.115	0.098	0.118	0.117	0.051	0.079	0.071	0.074	0.061	0.094
34	0.117	0.128	0.123	0.138	0.172	0.114	0.123	0.111	0.099	0.087	0.072	0.061	0.051	0.042	0.068
35	0.139	0.091	0.096	0.119	0.157	0.062	0.116	0.109	0.078	0.081	0.075	0.038	0.057	0.045	0.049
36	0.145	0.097	0.093	0.086	0.121	0.068	0.125	0.070	0.099	0.049	0.059	0.041	0.058	0.054	0.049
37	0.131	0.127	0.135	0.059	0.094	0.072	0.108	0.053	0.064	0.035	0.013	0.042	0.057	0.043	0.044
38	0.110	0.099	0.108	0.046	0.060	0.041	0.064	0.052	0.043	0.024	0.029	0.026	0.052	0.025	0.044
39	0.089	0.062	0.067	0.059	0.070	0.032	0.068	0.040	0.046	0.025	0.037	0.032	0.023	0.015	0.053
40	0.104	0.056	0.049	0.065	0.080	0.047	0.064	0.041	0.032	0.024	0.028	0.027	0.011	0.006	0.038
41	0.087	0.043	0.054	0.045	0.055	0.041	0.043	0.023	0.015	0.016	0.024	0.022	0.015	0.013	0.013
42	0.034	0.031	0.049	0.023	0.030	0.029	0.035	0.035	0.000	0.015	0.012	0.015	0.022	0.012	0.005
43	0.018	0.029	0.039	0.013	0.023	0.024	0.023	0.038	0.004	0.018	0.004	0.004	0.021	0.006	0.006
44	0.000	0.034	0.017	0.013	0.028	0.020	0.016	0.017	0.015	0.012	0.005	0.015	0.012	0.009	0.003
45	0.021	0.027	0.009	0.008	0.026	0.013	0.010	0.005	0.023	0.006	0.027	0.014	0.000	0.004	0.003
46	0.021	0.005	0.011	0.013	0.008	0.005	0.003	0.007	0.011	0.000	0.018	0.004	0.000	0.000	0.004
47	0.000	0.003	0.000	0.011	0.022	0.000	0.008	0.015	0.003	0.000	0.000	0.003	0.000	0.005	0.004
48	0.000	0.012	0.000	0.000	0.033	0.009	0.013	0.010	0.005	0.007	0.003	0.000	0.000	0.004	0.000
49	0.005	0.009	0.000	0.000	0.003	0.011	0.004	0.000	0.003	0.005	0.003	0.000	0.000	0.000	0.000
TFR	**4.90**	**5.15**	**5.09**	**4.14**	**4.73**	**3.83**	**4.26**	**3.86**	**3.34**	**2.88**	**2.93**	**2.66**	**2.41**	**2.27**	**2.66**

Table III.10. Estimated Single-Year Fertility Rates by Five-Year Age Group Derived from TDHS-1993

	Estimated Fertility Rates														
Age group	1978/79	1979/1980	1980/81	1981/82	1982/83	1983/84	1984/85	1985/86	1986/87	1987/88	1988/89	1989/90	1990/91	1991/92	1992/93
15-19	0.117	0.161	0.147	0.133	0.133	0.109	0.112	0.105	0.094	0.074	0.089	0.058	0.063	0.056	0.055
20-24	0.268	0.329	0.299	0.247	0.260	0.245	0.245	0.261	0.216	0.200	0.177	0.183	0.160	0.161	0.175
25-29	0.244	0.241	0.255	0.193	0.244	0.192	0.221	0.182	0.171	0.159	0.166	0.148	0.126	0.130	0.144
30-34	0.170	0.154	0.171	0.144	0.146	0.124	0.134	0.121	0.099	0.080	0.087	0.087	0.067	0.060	0.097
35-39	0.123	0.095	0.100	0.074	0.101	0.055	0.096	0.065	0.066	0.043	0.043	0.036	0.049	0.036	0.048
40-44	0.049	0.039	0.042	0.032	0.043	0.032	0.036	0.031	0.013	0.017	0.014	0.017	0.016	0.009	0.013
45-49	0.009	0.011	0.004	0.006	0.018	0.008	0.007	0.008	0.009	0.004	0.010	0.004	0.000	0.002	0.002
TFR	**4.90**	**5.15**	**5.09**	**4.14**	**4.73**	**3.83**	**4.26**	**3.86**	**3.34**	**2.88**	**2.93**	**2.66**	**2.41**	**2.27**	**2.66**

Table III.11. Estimated Three-Year Fertility Rates by Five Year Age Group Derived from TDHS-1993

Age group	1979-1981	1982-1984	1985-1987	1988-1990	1991-1993
15-19	0.142	0.125	0.104	0.074	0.058
20-24	0.299	0.251	0.241	0.187	0.165
25-29	0.247	0.210	0.191	0.158	0.133
30-34	0.165	0.138	0.118	0.085	0.074
35-39	0.106	0.077	0.076	0.040	0.044
40-44	0.043	0.036	0.027	0.016	0.013
45-49	0.008	0.011	0.008	0.006	0.002
TFR	**5.05**	**4.23**	**3.82**	**2.83**	**2.45**

Table III.12. Estimated Five-Year Fertility Rates Derived from TDHS-1993

Age group	1979-1983	1984-1988	1989-1993
15-19	0.138	0.099	0.064
20-24	0.281	0.234	0.171
25-29	0.235	0.185	0.143
30-34	0.157	0.111	0.080
35-39	0.098	0.065	0.042
40-44	0.041	0.026	0.014
45-49	0.010	0.007	0.004
TFR	**4.80**	**3.63**	**2.59**

Table III.13. Estimated Single-Year Fertility Rates by Single Year Age of Mother Derived from TDHS-2003

Age of woman	Single Years 1988/89	1989/90	1990/91	1991/92	1992/93	1993/94	1994/95	1995/96	1996/97	1997/98	1998/99	1999/00	2000/01	2001/02	2002/03
15	0.026	0.036	0.027	0.016	0.021	0.017	0.014	0.017	0.016	0.009	0.012	0.012	0.005	0.003	0.004
16	0.050	0.062	0.063	0.040	0.046	0.043	0.041	0.034	0.032	0.038	0.015	0.033	0.020	0.009	0.019
17	0.090	0.091	0.098	0.084	0.083	0.082	0.072	0.058	0.047	0.060	0.060	0.057	0.054	0.051	0.043
18	0.119	0.127	0.124	0.131	0.117	0.112	0.100	0.094	0.082	0.077	0.100	0.078	0.088	0.085	0.070
19	0.152	0.155	0.148	0.148	0.161	0.133	0.125	0.118	0.134	0.102	0.104	0.105	0.120	0.096	0.088
20	0.197	0.190	0.177	0.191	0.176	0.153	0.187	0.150	0.154	0.136	0.128	0.129	0.127	0.112	0.102
21	0.235	0.220	0.182	0.229	0.196	0.178	0.212	0.180	0.136	0.150	0.142	0.142	0.132	0.115	0.153
22	0.233	0.221	0.168	0.212	0.214	0.234	0.192	0.190	0.163	0.149	0.148	0.181	0.146	0.119	0.166
23	0.201	0.219	0.176	0.192	0.175	0.200	0.215	0.212	0.187	0.171	0.167	0.190	0.152	0.122	0.157
24	0.198	0.241	0.193	0.189	0.170	0.173	0.195	0.220	0.176	0.199	0.172	0.190	0.180	0.137	0.157
25	0.175	0.205	0.191	0.182	0.168	0.175	0.179	0.194	0.180	0.190	0.174	0.190	0.186	0.128	0.143
26	0.183	0.199	0.155	0.185	0.177	0.158	0.185	0.176	0.168	0.145	0.166	0.178	0.149	0.133	0.151
27	0.173	0.195	0.144	0.167	0.169	0.124	0.165	0.153	0.143	0.112	0.151	0.167	0.138	0.155	0.119
28	0.127	0.156	0.138	0.145	0.135	0.120	0.134	0.148	0.124	0.101	0.132	0.146	0.132	0.119	0.088
29	0.140	0.154	0.104	0.137	0.126	0.129	0.127	0.139	0.125	0.126	0.125	0.147	0.129	0.085	0.096
30	0.135	0.137	0.082	0.117	0.119	0.103	0.116	0.118	0.153	0.136	0.122	0.136	0.131	0.087	0.093
31	0.120	0.130	0.102	0.097	0.123	0.088	0.100	0.109	0.141	0.121	0.108	0.105	0.123	0.071	0.092
32	0.103	0.117	0.108	0.096	0.094	0.085	0.098	0.092	0.106	0.100	0.092	0.094	0.084	0.060	0.073
33	0.078	0.082	0.073	0.085	0.081	0.069	0.086	0.091	0.084	0.085	0.075	0.063	0.048	0.069	0.054
34	0.078	0.070	0.054	0.063	0.081	0.070	0.080	0.089	0.072	0.084	0.066	0.044	0.057	0.075	0.061
35	0.078	0.070	0.047	0.069	0.061	0.058	0.062	0.056	0.047	0.057	0.058	0.048	0.061	0.050	0.053
36	0.059	0.069	0.041	0.042	0.046	0.031	0.040	0.050	0.036	0.034	0.041	0.053	0.049	0.035	0.028
37	0.058	0.051	0.031	0.018	0.041	0.028	0.032	0.039	0.035	0.040	0.032	0.052	0.041	0.043	0.033
38	0.056	0.041	0.050	0.028	0.031	0.029	0.026	0.027	0.033	0.047	0.025	0.040	0.031	0.030	0.028
39	0.045	0.030	0.054	0.034	0.023	0.020	0.023	0.017	0.029	0.034	0.015	0.034	0.022	0.022	0.018
40	0.042	0.016	0.031	0.038	0.029	0.028	0.016	0.018	0.009	0.015	0.010	0.024	0.025	0.012	0.016
41	0.053	0.022	0.021	0.030	0.017	0.024	0.017	0.018	0.007	0.010	0.019	0.016	0.019	0.009	0.010
42	0.042	0.029	0.026	0.021	0.009	0.017	0.019	0.011	0.013	0.014	0.017	0.011	0.004	0.015	0.009
43	0.023	0.019	0.026	0.019	0.009	0.015	0.022	0.005	0.017	0.013	0.002	0.002	0.006	0.008	0.007
44	0.027	0.010	0.011	0.020	0.015	0.011	0.017	0.002	0.011	0.006	0.003	0.000	0.005	0.002	0.002
45	0.011	0.008	0.006	0.015	0.009	0.007	0.009	0.006	0.000	0.005	0.006	0.003	0.004	0.000	0.000
46	0.004	0.000	0.011	0.003	0.000	0.003	0.010	0.007	0.002	0.005	0.003	0.009	0.005	0.002	0.000
47	0.010	0.004	0.007	0.000	0.000	0.004	0.006	0.002	0.002	0.004	0.002	0.005	0.003	0.003	0.000
48	0.008	0.005	0.000	0.000	0.000	0.003	0.000	0.000	0.000	0.002	0.002	0.000	0.003	0.000	0.000
49	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
TFR	**3.33**	**3.38**	**2.87**	**3.04**	**2.92**	**2.73**	**2.92**	**2.84**	**2.67**	**2.58**	**2.49**	**2.69**	**2.48**	**2.06**	**2.13**

Table III.14. Estimated Single-Year Fertility Rates by Five-Year Age Group Derived from TDHS-2003

	Estimated Fertility Rates														
Age group	1988/89	1989/90	1990/91	1991/92	1992/93	1993/94	1994/95	1995/96	1996/97	1997/98	1998/99	1999/00	2000/01	2001/02	2002/03
15-19	0.088	0.094	0.092	0.084	0.086	0.078	0.070	0.064	0.062	0.057	0.058	0.057	0.057	0.049	0.045
20-24	0.213	0.218	0.179	0.202	0.186	0.188	0.200	0.190	0.163	0.161	0.151	0.166	0.147	0.121	0.147
25-29	0.160	0.182	0.146	0.163	0.155	0.141	0.158	0.162	0.148	0.135	0.150	0.166	0.147	0.124	0.119
30-34	0.103	0.107	0.084	0.091	0.100	0.083	0.096	0.100	0.111	0.105	0.093	0.088	0.088	0.072	0.075
35-39	0.059	0.052	0.044	0.038	0.040	0.033	0.037	0.038	0.036	0.042	0.034	0.046	0.041	0.036	0.032
40-44	0.037	0.019	0.023	0.026	0.016	0.019	0.018	0.011	0.011	0.011	0.010	0.011	0.012	0.009	0.009
45-49	0.006	0.003	0.005	0.004	0.002	0.003	0.005	0.003	0.001	0.003	0.003	0.003	0.003	0.001	0.000
TFR	**3.33**	**3.38**	**2.87**	**3.04**	**2.92**	**2.73**	**2.92**	**2.84**	**2.67**	**2.58**	**2.49**	**2.69**	**2.48**	**2.06**	**2.13**

Table III.15. Estimated Three-Year Fertility Rates by Five Year Age Group Derived from TDHS-2003

Age group	1989-1991	1992-1994	1995-1997	1998-2000	2001-2003
15-19	0.091	0.082	0.066	0.058	0.050
20-24	0.203	0.192	0.185	0.160	0.138
25-29	0.163	0.153	0.156	0.150	0.130
30-34	0.098	0.091	0.102	0.095	0.078
35-39	0.052	0.037	0.037	0.041	0.036
40-44	0.027	0.020	0.013	0.011	0.010
45-49	0.005	0.003	0.003	0.003	0.001
TFR	**3.19**	**2.90**	**2.81**	**2.59**	**2.22**

Table III.16. Estimated Five-Year Fertility Rates Derived from TDHS-2003

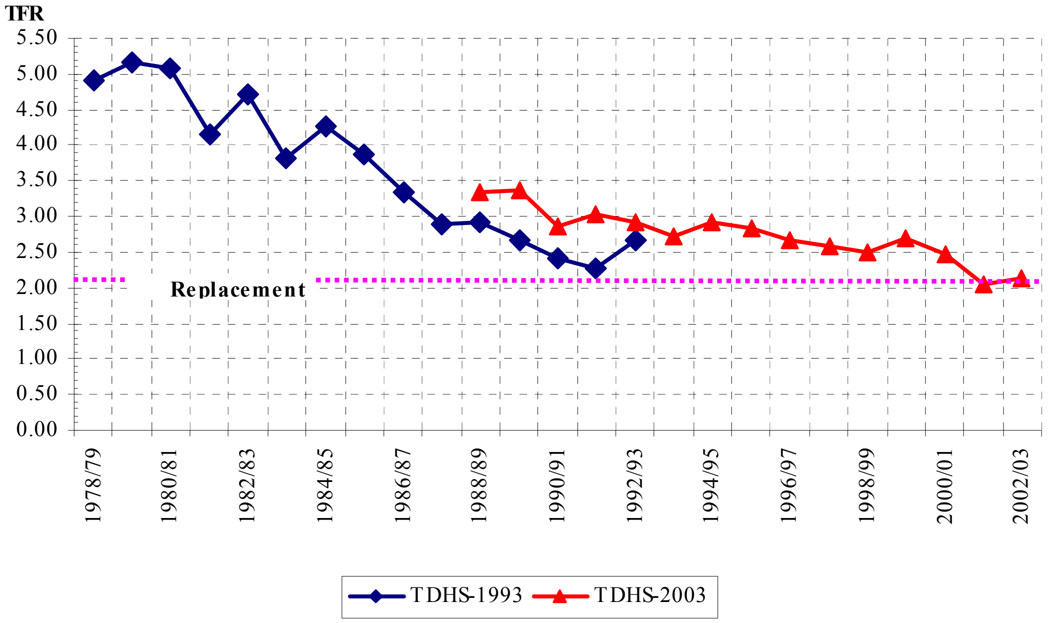
Age group	1989-1993	1994-1998	1999-2003
15-19	0.089	0.066	0.053
20-24	0.200	0.180	0.147
25-29	0.161	0.149	0.141
30-34	0.097	0.099	0.083
35-39	0.047	0.037	0.038
40-44	0.024	0.014	0.010
45-49	0.004	0.003	0.002
TFR	**3.11**	**2.75**	**2.37**

Figure III.1 displays the estimated single-year total fertility derived from TDHS-1993 and TDHS-2003. Annual fluctuations in the own-children estimates of fertility for each of the three surveys are apparently seen from the figure. The estimates obtained form own-children for TDHS-1993 show a more jagged pattern than TDHS-2003. In fact, these immediate fluctuations are the indicator for inaccurate age reporting.

In TDHS-1993, the peaks and troughs are observed especially for the 10-12th, years before the survey (Figure III.1). The information about age for these calendar years belongs to the 9-11 year old children respectively at the time of survey. Heaping on age 10 inflates the birth rate estimates for the 11th year prior to the survey producing overestimates of fertility. The spurious trends owing to the overestimation and underestimation for the 9th, 10th and 11th can be explained by the considerable preference for ages with terminal digit 0 and the avoidance of ages ending with 1 and 9 in TDHS-1993.

In TDHS-2003, the fluctuations are at its lowest due to the fact that age reporting has been improved in the course of time. Fertility estimates for TDHS-2003 show a somewhat smoother pattern when compared to TDHS-1993. However, fertility estimates for the second and the thirteenth year prior to the survey seem to low because children of ages 1 and 12 may be ignored (Figure III.1).

Figure III.1. Overall Annual Total Fertility Rates Derived from the Application of Own-Children Method to TDHS Household Data Sets



Own-children estimates of fertility are available from two surveys taken ten years apart and each survey yield a 15-year fertility trend. Therefore, these two trends overlap during the five years immediately preceding the first of the survey. Between 1989 and 1993, fertility estimates are expected to overlap. However, the trends overlap poorly (Figure III.1). In fact each trend has been destroyed in the same way by age misreporting and therefore they overlap poorly (Cho, Retherford and Choe, 1986).

Since reverse-projection is used to estimate birth rates by single years, they are derived from enumerated children classified by single year of age. Therefore, these estimates are usually not smooth. In addtiton to these, differential completeness of enumeration,age-misreporting and age-heaping will affect them substantially and a pattern of distortion in the estimated trends is revealed (UN, 1983). In fact, aggregated estimates over five year period can smooth out some of the peaks nad troughs observed in the single-year fertility estimates.

The three-year total fertility rates by five-year age group estimated by means of own-children are displayed in Figure III.2 and III.3. The descending trend of fertility rates is more clearly seen from the estimates of three-year time period. In addition to these, a smoother structure without a jagged pattern with sharp peaks, which is a matter of fact in single-year estimates (Figure III.1), can be experienced in three-year fertility estimation.

The difference between the single-year and three-year total fertility estimates of TDHS-1993 is outstanding. In fact, it is difficult to understand the gradual decline in overall total fertility rates from Figure III.1. However, a steady decrease can be easily observed from Figure III.2.

Figure III.2. The Own-Children Estimates of Overall Three-Year Total Fertility Rates Derived from TDHS-1993

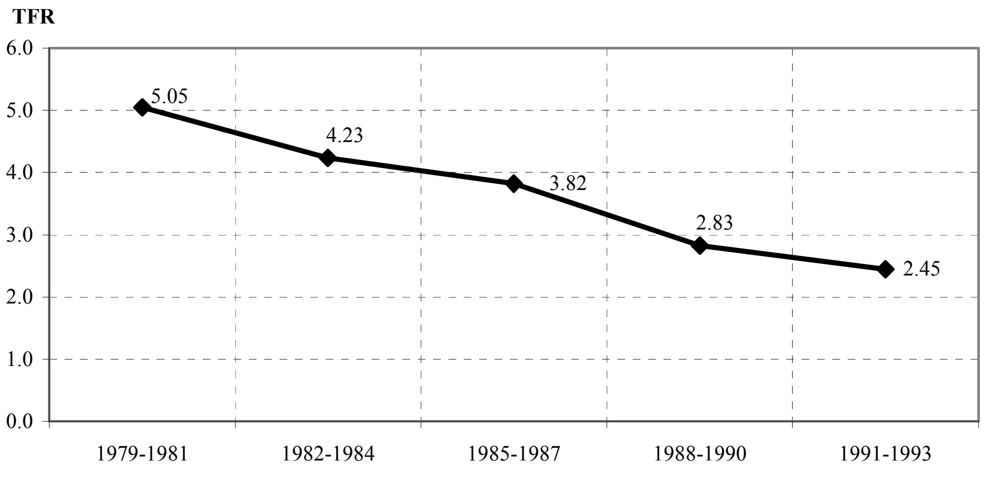
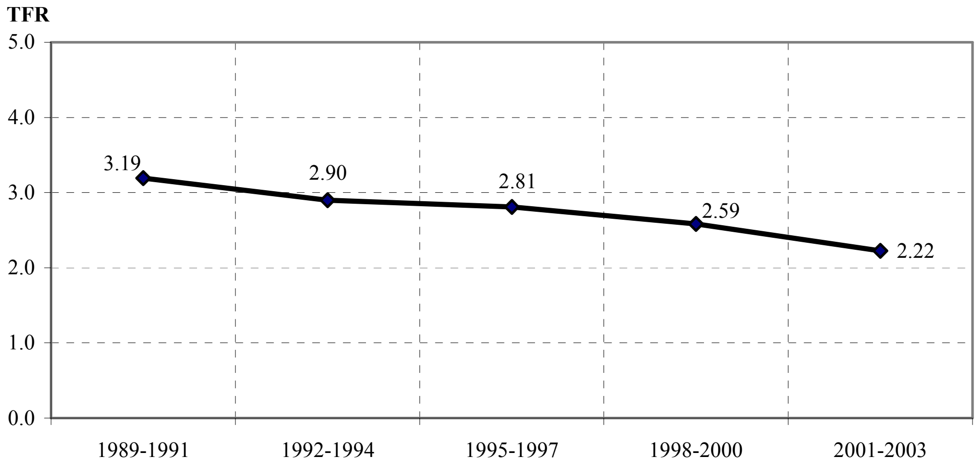


Figure III.3. The Own-Children Estimates of Overall Three-Year Total Fertility Rates Derived from TDHS-2003



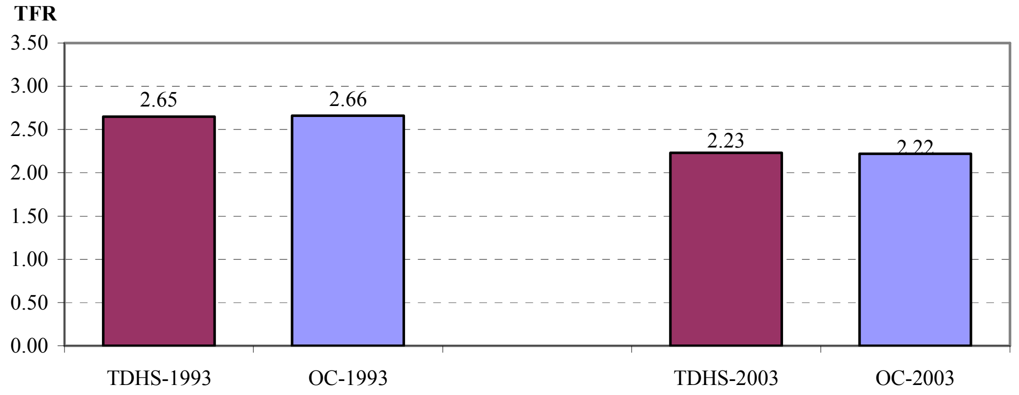
When compared to TDHS-1993, TDHS-2003 has the smoothest pattern for both single-year and three-year total fertility estimates. Indeed, the more accurate the age reporting, the less smoother the fertility estimates are.

IV. TDHS-TYPE FERTILITY ESTIMATION VERSUS FERTILITY ESTIMATES OF OWN-CHILDREN METHOD

Own-children method has various advantages that make it more appealing to be used. However, the results of own-children method should be compared to the ones obtained from an existing survey or census in order to show the appropriateness of its utilization for fertility estimations. If the own-children method is found to be suitable, it can also be used as a validity check on fertility rates derived from other sources. Therefore, in this section, the comparison of fertility estimates derived from the application of own-children method to the Turkish Demographic and Health Surveys conducted in 1993 and 2003 with the estimates reckoned directly through these surveys has been made based on the three-years prior to the survey. The analyses related to the TDHS-1993 refer to one-year preceding the survey.

Figure IV.1 indicates the total fertility estimates derived from own-children method and TDHS. According to the findings of TFRs concerning the overall total fertility rates, the own-children estimates closely resemble those calculated by directly from these two surveys.

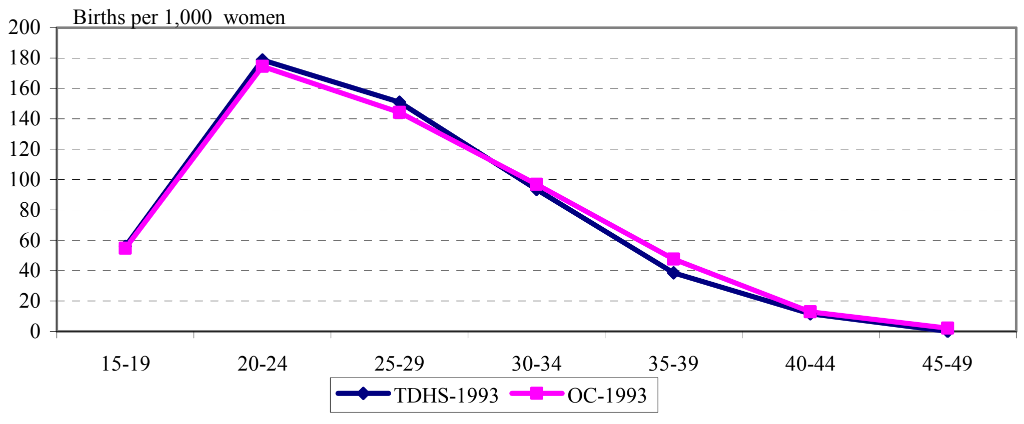
Figure IV.1. TDHS-Type Estimates versus Own-Children Estimates Regarding Total Fertility Rates



As well as total fertility rates, age-specific fertility rates (ASFRs) are outstanding aspects of fertility analyses since they help to explain the change in TFRs. Therefore, not only the total fertility rates, but also age-specific fertility rates derived from own-children method is needed to ensure a resemblance to the ones in surveys or censuses in order to consider the own-children method as an appropriate validity check. The accuracy of own-children esitmates of fertility has been evaluated by comparing the overlapping estimates of age-specific fertlity rates derived from TDHS-1993 and TDHS-2003.

The age-specific fertility rates derived from the own-children method by using the data sets of TDHS-1993 and TDHS-2003 and the ones computed directly from each of the two surveys are presented below. Figure IV.2 indicates the level of agreement between TDHS-type and own-children age-specific fertility estimates for 1993 data. Indeed, two estimates of ASFRs one year prior to the survey coincide reasonably close to each other especially for under the age of 24 and for the ages between 40-49, but a slight difference exists from 24 to 40.

Figure IV.2. TDHS-Type Estimates versus Own-Children Estimates Regarding Age-Specific Fertility Rates One Year Preceding the Survey Using TDHS-1993 Data



On the other hand, age-specific fertility rates three years preceding the survey attained from the own-children and the TDHS demostrate almost a perfect agreement for the TDHS-2003 (and IV.3). TDHS-type and own-children for 2003 overlap almost completely when compared to TDHS-1993. However, a slight difference at the age group 20-24 and 25-29 which does not violate the agreement of two approaches is observed for TDHS-2003.

Figure IV.3. TDHS-Type Estimates versus Own-Children Estimates Regarding Age-Specific Fertility Rates Three Years Preceding the Survey Using TDHS-2003 Data

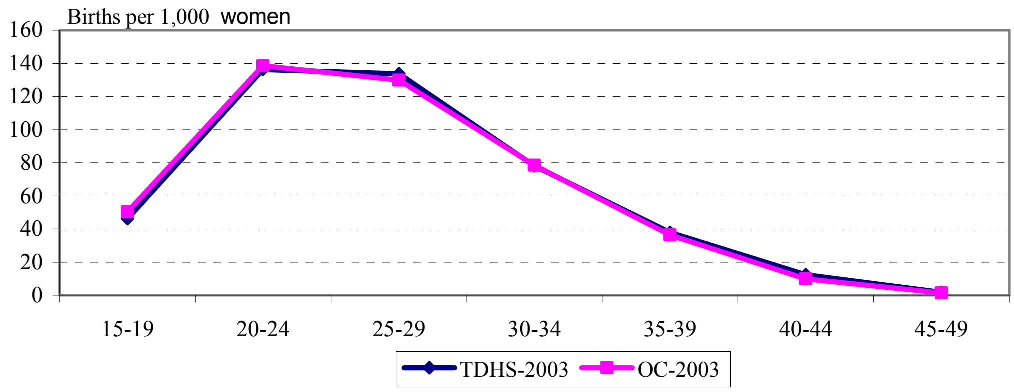


Figure IV.4 and IV.5 shows the differentiation in age-specific fertility rates computed by the TDHS itself and the own-children method by using the data sets of TDHS-1993 and TDHS-2003. The resembling patterns can be examined regarding the fertility rates of two approaches. In other words, the high level of fertility in younger ages according to the TDHS findings can also be seen from those of own-children. In additon to these, the fertility decline in the age group 20-24 in terms of own-children method is also emphasized in a similar way when compared to result of TDHS-type estimates. In fact, when the age-specific fertility estimates of TDHS-1993 and TDHS-2003 are compared to the results of the own-children methods separately, the agreement revealed between the TDHS-type and the own-children is more outstanding. In fact, the similarity between two approaches regarding the age-specific fertility rates also leads to an overlapping estimates of total fertility derived from the TDHS and the own-children method for the three demographic and health surveys conducted in 1993 and 2003.

Figure IV.4. Age-Specific Fertility Rates for the Total Derived from TDHS Data

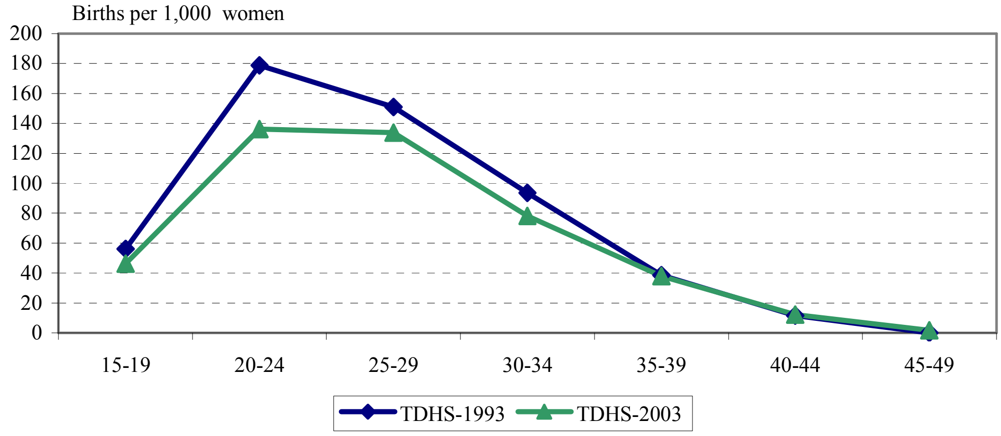
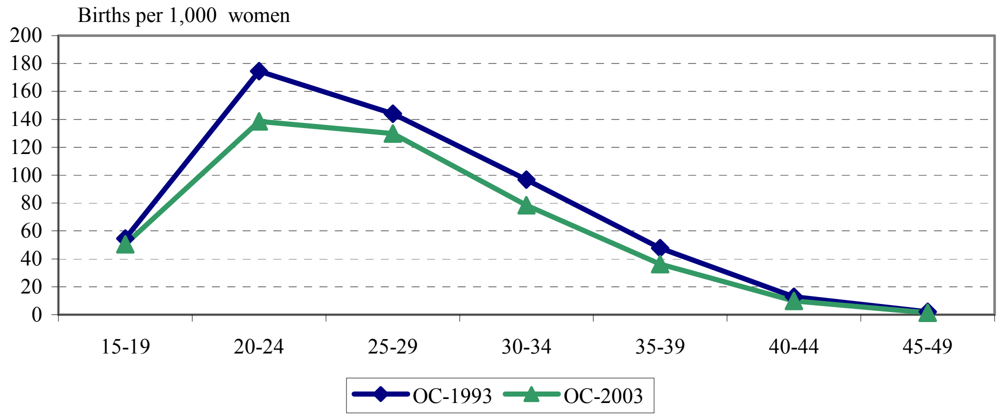


Figure IV.5. Age-Specific Fertility Rates for the Total Derived from Own-Children Method



The own-children method has produced considerably accurate results for fertility estimations concerning the three-year period prior to the survey when compared to the TDHS-type. In addition, findings of own-children methods also need to be evaluated with those of TDHS when going further back to the survey whether the overlapping estimates for the three-year preceding the survey still exist. However, when assessing the estimates of two approaches over three years previous to the survey, age truncation is a significant barrier for TDHS-type estimations, because as the time prior to the survey increases, age groups considered in age-specific fertility rates progressively truncated. Therefore, the entire range of reproductive ages cannot be covered in the TDHS-type computations of fertility rates. On the other hand, the own-children method is at an advantage in terms of age truncation when compared to the TDHS-type fertility estimations. When the own-children method is applied to a survey or census, there is no need to deal with age truncation since it can produce fertility esitmations for all women between the ages of 15 and 49.

Table IV.1. Age-Specific Fertility Rates for Five-Year Periods Prior to the Survey

	Number of years preceding the survey					
	0-4		5-9		10-14	
Mother's age	TDHS-1993	OC-1993	TDHS-1993	OC-1993	TDHS-1993	OC-1993
15-19	57	64	88	99	121	138
20-24	174	171	231	234	269	281
25-29	146	143	184	185	235	235
30-34	84	80	123	111	156	157
35-39	43	42	71	65	[102]	98
40-44	13	14	[26]	26		41
45-49	[2][4]	4		7		10

	Number of years preceding the survey					
Mother's age	TDHS-2003	OC-2003	TDHS-2003	OC-2003	TDHS-2003	OC-2003
15-19	51	53	61	66	86	89
20-24	142	147	180	180	200	200
25-29	141	141	156	149	159	161
30-34	84	83	103	99	96	97
35-39	38	38	37	37	[45]	47
40-44	12	10	[12]	14		24
45-49	[2]	2		3		4

For 5 to 9 years prior to the survey, 45-49 age group is devoid of TDHS-type estimations. Besides, ages above 39 cannot be included in the analyses of age-specific fertility rates for the period of 10-14 years. Therefore, it is not possible to evaluate the agreement between TDHS-type estimates and own-children for the other age groups.

Based on the five-year periods prior to the survey, the consistency between two approaches still exits in TDHS-1993 (Table IV.1). Regarding the first five-year period preceding the survey, there is a small difference for the 15-19 age group while age-specific fertility rates derived from own-children and TDHS itself fully agree for the rest of the age-groups. For the second five-year periods, resembling fertility estimates are valid for 20-24, 25-29 and 40-44 age groups. Except these, findings of two approaches for other age groups slightly differentiate from each other. When concerning the 10-14 period, overlapping results can be observed for the ages between 25 and 34 whereas TDHS-type estimates are lower than that of own-children for the ages below 25.

For TDHS-2003, overlapping estimates can be obviously seen regarding 0-4 and 10-14 years preceding the survey. (Table IV.1). However, a tiny difference is revealed at the age group of 20-24 for 0 to 4 years. Concerning the second five-year

[4] Estimates in brackets are truncated.

period, own-children estimates for 15-19, 25-29 and 30-34 differ from the ones in TDHS-type. However, the difference is more apparent for 25-29. Age-specific estimates derived from own-children and directly form TDHS for the other age groups coincide close to each other.

Total fertility rates 3-year preceding the survey are used to compare the own-children method estimates with those of TDHS. However, if one goes back more than 3 years, total fertility rates cannot be computed from TDHS itself owing to the age truncation. Therefore, these cumulative rates have been calculated for the evaluation of two approaches for the five-year periods preceding the survey.

Table IV.2. Cumulative Total Fertility Rates up to Age 35, CFR(35), Derived from TDHS and Own-Children Method (OC)

	Cumulative Total Fertility Rates up to Age 35			
Numbers of year preceding the survey	TDHS-1993	OC-1993	TDHS-2003	OC-2003
0-4	2.31	2.29	2.09	2.12
5-9	3.13	3.14	2.50	2.47
10-14	3.91	4.06	2.71	2.73

CFRs(35) derived from the own-children method for each of the three surveys are mostly similar to those of obtained from TDHS. Among the five-year periods prior to the survey, the highest difference between two approaches reveals for 10-14 concerning the TDHS-1993. On the other hand, CFRs(35) calculated by means of own-children and TDHS itself using the data of TDHS-2003 mostly differentiate for 0-4 and 5-9 year period when compared to the period from 10 to 14 years preceding the survey. In fact, CFR(35) estimates of two approaches for TDHS-2003 resemble to each other especially for 10-14. The similarity of the findings for TDHS-1993 is apperantly observed for 5-9 whereas cumulative fertility rates attained from TDHS-1993 are quite different for each of the five-year period prior to the survey.

V. CONCLUSION

In recent years, Turkey has experienced a rapid fertility decline which has been manifested by certain indicators such as age-specific fertility rates and total fertility rates. To compute these rates, direct methods are frequently employed based on the information obtained from censuses and demographic surveys. Indirect methods are rarely applied to estimate the fertility rates. In fact, own-children method is one of the indirect methods that has been utilised to figure out the levels and trends of fertility by using the current information about the age structure of women and children as well as their mortality pattern.

The initial objective was to apply the own-children method to three successive Turkish Demographic and Health Surveys conducted in 1993 and 2003. It is possible to assess the overall fertility trend as well as the age pattern of fertility in Turkey as of 1978 since each survey has provided a 15-year estimation period. Based on the results of own-children method, it has been indicated that overall fertility in Turkey has gradually decreased since the beginning of 1980s. However, fertility estimates have revealed annual fluctuations especially for TDHS-1993 concerning the total fertility rates. Such peaks and troughs have been most probably due to the age reporting errors. In fact, age and birth date reporting is relatively poor in Turkey, which is a potential risk not only for fertility analyses but also for other demographic analyses. Furthermore, overlapping trends during the five years prior to the first survey have also been expected since more than one survey has been concerned. However, the two trends overlap poorly owing to the similar distortions as regards the age misreporting. Although errors related to age reporting have been prevailed, this has not given a rise to significant bias in fertility indicators. Moreover, own-children method has also provided an analysis of age pattern. Fertility decline has also been experienced in each age group. Findings of own-children have marked that the highest fertility rate has been estimated for 20-24. In the light of these findings, own-children estimates are line with the overall declining trend in Turkey, which can be defined as accelerated and sustained.

This study further aimed at comparing the own-children fertility estimates with those computed directly from TDHS itself so as to find out whether own-children can be an alternative way of estimating fertility rates. Practical applications of own-children method have indicated that the method can provide reliable results of overall fertility level and the age pattern of fertility which are compatible with the ones derived from TDHS itself. As of 2003, total fertility rate estimated as 2.22 three years preceding the survey by means of own-children is almost the same when compared to the rate, which is 2.23, derived from TDHS-2003. This similarity between the results of own-children method and TDHS-type has also been experienced concerning the TDHS-1993 despite very slight differences. Furthermore, in terms of age-specific fertility rates three years prior to the survey, overlapping estimates of fertility trends for each survey have been impressive especially for TDHS-2003 whereas slight differences at the age groups of 25-29 and 35-39 have been observed regarding the rates one year period preceding the TDHS-1993. Indeed, far closer agreement than the one expected has been displayed for the fertility estimates of these two approaches. The precision of the own-children method can be said to be highly approved. Therefore, the own-children method can be proposed to be used as validity check for other existing fertility estimates derived from different sources.

The age-specific fertility rates of the two approaches have also been compared when going further back to the survey. However, TDHS-type estimations are exposed to age truncation which is not a restriction for the own-children method. Indeed, when the analyses have been carried out for the five-year periods preceding the survey, age groups are gradually truncated in Turkish Demographic and Health Surveys whereas the entire reproductive age range can be fully covered by own-children method. Since total fertility rates five-year periods prior to the survey are not possible to be computed for TDHS-1993 and TDHS-2003, cumulative fertility rates up to 35, CFR(35), have been used to compare the own-children with TDHS-type estimates. In fact, similar results have been obtained again. In TDHS-2003, the most similar results have been revealed from 10 to 14 year prior to the survey while these resembling estimates have belonged to 5-9 period for TDHS-1993. Even if there has been such an obstacle for TDHS-type estimations, overlapping results derived from each of the two methods has still exist.

These analyses have been done with the assumption of constant mortality for the whole estimation period. Basically, the own-children method provides the opportunity to employ different mortality schedules for different periods. An argument can come up whether to make the analyses by means of constant or changing mortality because it is believed that in the past, mortality was higher than the recent levels in Turkey. However, regarding TDHS-1993 and TDHS-2003, own-children method produces estimates which are compatible with the ones derived from the TDHS itself. At the same time, these remarkable results achieved by own-children method are also the indicator of appropriateness of the mortality assumption. Since satisfactory findings have been attained with fixed mortality, no attempt has been made for the utilisation of variable mortality assumptions.

Consequently, the own-children method can be proposed as an alternative for the birth history section of the individual questionnaires employed in Turkish Demographic and Health Survey. In birth history module, information about the birth date and age of each child alive as well as the dead ones owned by women has been retrospectively collected. However, this type of information is hard to be collected in Turkey since age and birth date reporting is found to be relatively poor. Apart from this, considerable effort is needed to obtain precise information due the low level of women's education and the recall problems. Although the birth history provides information for demographic analyses such as infant and child mortality rates, the fulfilment of this section in individual questionnaires is not only time-consuming but it also increases the workload. To sum up, since the own-children accurately estimates the fertility rates, this method can be utilised rather than TDHS-type fertility estimations. Besides, it might as well be a new option for demographic and health surveys in which the birth history section might be modified in order to make this part shorter and the fertility analyses might be carried out through own-children method.

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