Regional analysis of the proximate determinants of fertility in Mexico

Humberto González Galbán, Yolanda Palma
and María de Lourdes Montes

El Colegio de la Frontera Norte/Universidad Autónoma de Nayarit

Resumen

El importante descenso de los niveles de la fecundidad es un hecho que parece consumado en México, pero aún se aprecian diferencias territoriales al respecto, lo cual está condicionado, en última instancia, por el desigual desarrollo regional imperante y la repercusión de ello en la situación demográfica local. En este trabajo se aborda el análisis regional de los determinantes directos de los niveles de fecundidad, como un medio para la mejor comprensión de la problemática planteada. La anticoncepción, las relaciones sexuales, la infecundidad posparto y la interrupción voluntaria de los embarazos son estudiados con una fuente de información reciente, y mediante el método de los determinantes próximos modificado por Stover, que ya fue aplicado en otros países latinoamericanos y cuyos resultados para México y sus regiones es mostrado en el presente artículo.

Palabras clave: fecundidad regional, anticoncepción, relaciones sexuales, infertilidad posparto, aborto, México.

Abstract

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The important reduction of fertility levels is a known fact in Mexico, but territorial differences are still noticed on this matter, which is conditioned to ruling uneven regional development and its repercussion in the local demographic situation. In this work, the regional analysis of direct determinants of the fecundity levels is approached, as a means to better understand the proposed problematic. Contraception, sexual intercourse, post-partum infertility and voluntary interruption of pregnancy are studied with a recent source of information, and by means of the proximate determinants method, modified by Stover, already applied in other Latin American countries and whose results for Mexico and its regions are shown in this paper.

Key words: regional fertility, contraception, sexual relations, postpartum infertility, abortion, Mexico.

Introduction

Fertility has been considered for several years as the most important variable of demographic change in Mexico, although in recent decades there has been a general tendency to lower its levels, there are still noticeable regional differences in such sense; the latter has been linked to the advancement of the demographic transition degree in these States and ultimately to the uneven socioeconomic development prevailing in the country.

The aforementioned uneven fertility levels are also due to the different modalities in relation to reproduction control, where the intermediate variables take place, a topic which has motivated the realization of the present analysis, directed to study the factors that directly condition the territorial differences of this important variable of demographic change.

Paying attention to the referred thematic, we state that the regions such as those of the Mexican northern border, where a higher socio-demographic development is observed, the fertility levels are lower, for there is a larger contraceptive prevalence, a rather absent condition in other regions of the country, particularly in the southern States.[1] Sexuality is playing an outstanding role in the manifestation of fertility at early ages in all of the considered regions, whereas the practice of induced abortion contributes to decrease fertility, mainly in the northern and central States, conversely to the postpartum amenorrhea, which has a relatively high relevance for the southern States.

With the aim to corroborate the exposed statements, there are indicators of the so-called proximate determinants of the fertility in the regions considered for this work; we strive to learn the ways in which contraception, sexual activity, postpartum infertilizability caused by amenorrhea, and induced abortion influence the regulation of women's fertility, which will allow comparing the conditioning factors of the observed fertility levels in the different regions of the country.

The stated analysis' development is interesting, since it contributes with updated and reliable elements on the demographic conditioners of the changes in fertility levels, both in Mexico as in some groups of States that can be related to country regions.

In order to achieve the aforementioned the following objectives are set:

1. Learn how contraception, sexual activity, postpartum infertility and induced abortion have influenced the manifestation of the fertility levels in recent years for the different regions.

2. Compare the factors which condition the levels of fertility in diverse regions of the country with different advancement degree in the demographic transition.

3. Apply in Mexico and in its regions, in accordance with the changes which have been taking place in them, a new methodology for the study of the fertility proximate determinants.[2]

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[1] Contraception is also distinguished for the other analyzed regions as the most important fertility regulator, but its larger prevalence and effectiveness takes place in the northern region.
[2] A study performed by the Latin American and Caribbean Demographic Center (CELADE), considered four Latin American countries —Brazil, Colombia, Peru and Dominican Republic— for the application of the methodology which puts to the test several adjustments to the traditionally applied model, originally developed by John Bongaarts.

In the current work there is a paragraph where the necessary general considerations on theoretical aspects, methods and adjustments performed in order to obtain the estimated indicators, the characteristics of the information sources and the territorial and demographic universe object of study are presented. Later, some comments on the levels, tendencies and other aspects which characterize the fertility of the considered regions are also presented; this constitutes the preface of the analysis of the factors or the intermediate variables which condition the regional fertility levels observed to which most of this work is devoted to.

General considerations

Fertility dynamics —and particularly the general tendency of descent in this variable's levels— has been explained by means of different theories, among which the so-called 'theory of the demographic transition' is distinguishable, it proposes to relate the fertility descent with the modernization process, conditioner of the changes in the women's social expectations and the regulation of the number of children they want or have.

It can be stated that, in a general way, fertility descent has been experienced in Mexico in a fast manner. However, with irregular rhythm at national level, according to the socioeconomic, cultural, or environmental characteristics of the different demographical groups who live in the diverse country regions, a tendency that agrees with the statements of the said theory; nonetheless, it is complex to precise how the socioeconomic and environmental factors are influencing the regional differences among fertility levels.

In order to transcend such limitation it is necessary to perform the analysis using other factors through which development exercises its influence on the levels of the said variable of demographic change, these are the called fertility proximate determinants, relations on which there is abundant theoretical and methodological literature.[3]

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[3] Among the classical authors of this sort of approach are Davis and Blake, who proposed in 1956 a conceptual theoretical schema on the variables that acted directly upon fertility. Later on, John Bongaarts (1978) simplified and operationalized the relationships among the factors through which the socioeconomic and environmental conditions exerted their influence on the observed fertility levels, which were called intermediate variables or proximate determinants of fertility. From the so-called Bongaarts' model, several authors, such as Stover, have added elements making adjustments to that model, which are considered in this work.

As a required antecedent to study the intermediate variables which take a relevant place in the regulation of the offspring are found in the works by John Bongaarts (1978), where the variations in the fertility levels attributable to the use of contraceptives, nuptiality, induced abortion and postpartum infertility due to amenorrhea are explained. According to Bongaarts' formulation each one of the mentioned factors has an inhibiting effect, at a larger or lower degree, on fertility, so it will be lower than its potential level in respect to how feminine population behaves along their reproductive life before the four aforementioned factors.[4]

The indicators used by Bongaarts have received some modifications' proposals, adjusting them in accordance with the context where they will be used. One of the most recent comes from Stover (1998), who works with sexually active women and not with the married ones or those living in free union, since he supports the idea that pregnancy risk expose is currently closer to sexuality than nuptiality, for several unmarried women have sexual intercourse regularly, whereas other with marital bonds do not have sexual activity. Another adjustments presented by Stover are that of not considering infertile women in the contraception index, for these women's fertility is not actually affected by the use of contraceptives, and because of the same reason, women who take contraceptives must not be considered in the amenorrhea period during six months after the birth, that in this case would be the third adjustment referred to.

The main information source we used in this research is the Survey of Reproductive Health (Encuesta de Salud Reproductiva) carried out in the year 2003, which has national representation and has disaggregated information of the eight States considered at urban-rural level. The advantages of this source consists in allowing the analysis of the determinants of the changes in fertility levels, since it contains an important number of related questions as well as current information and the comparisons that are possible to be made among the populations of the considered States. As a limitation, it can be obviously indicated that it does not disaggregates information on the rest of the Mexican States.

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[4] According to scholars of these topics, if women continued having sexual intercourses during their fertile period, never used contraceptives, never interrupted any pregnancy and had a null amenorrhea, they would have a total fertility (also called potential) of between 13 and 17 children (in accordance with Bongaarts) or around 20 (according to Stover), yet, since these factors appear in a greater or lesser degree in women from the different regions or social groups, the level of fertility actually observed has variations. With this method it is intended to precise how much of the difference between potential fertility and the observed is attributable to the use of contraceptives, the periods of sexual abstinence, abortion practice or the extension of th postpartum amenorrhea basically because of lactation.

The States where the survey was carried out were: Chiapas, Guanajuato, Guerrero, Oaxaca, Puebla, San Luis Potosí, Sonora and Tamaulipas, these were grouped basically upon a geographic criterion of closeness and location in the Country's space in the Southern, Center and Northern regions (1, 2 and 3 respectively, in the following diagram),[5] which is commonly associated with a moderate demographic transition, advanced and highly advanced (CONAPO, 2000).

In relation to the population object of study, these are the women in reproductive ages who are usually considered in the demographic studies as the women from 15 to 49 years of age, captured in the Survey of Reproductive Health carried out in 2003 in the eight Mexican States referred.

REGIONALIZATION

Region 1			Region 2		
Chiapas	Guerrero	Oaxaca	Puebla	Guanajuato	San Luis Potosí

Region 3	
Sonora	Tamaulipas
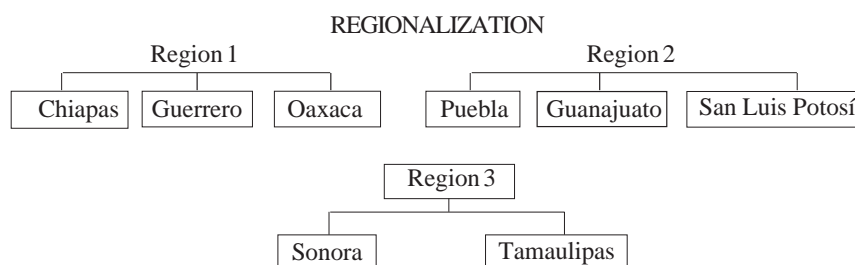
Regional fertility

The referred tendency to fertility descent for the whole of the country is manifested for the considered regions, however, the descent rhythms and fertility levels they reached have evident differences[6] (graph 1).

Thereby, in the southern region women continue having the largest number of children, surpassing in slightly more than two children, on average, women from the northern region. It must be distinguished that the descent in the total fertility rate of the southern region hereby presented is a consequence of the occurrences in Chiapas, where within a decade approximately this indicator was reduced in three children per women; conversely, in Oaxaca and Guerrero the information used suggests that fertility slightly increased.

[5] In addition to the merely geographic criterion, it is considered the development degree the States have, what can be inferred from their marginalization levels. According to CONAPO (2000), the referred southern States have a «very high» marginalization degree, in the central States the marginalization is «high», whereas in the northern States it is «low».
[6] For the realization of these analyses on the fertility's time variations of the different regions the information from the continuous statistics of births issued by INEGI.

States from the central region experienced a descent of slightly more than a child per women, which represented the greatest descent in the total fertility rate in the considered period, with a quite homogeneous behavior for the set of States.

On the other end, the northern region shows the lowest fertility values, marginally below three, nevertheless it could be inferred from the tendency observed in graph 1 that the fertility descent rhythm in the region seems to be stagnating despite it is not so low yet,[7] if we consider that the diminution of the children per women in the eleven years analyzed did not surpass the 0.5 value. In this situation the increment in region's adolescent fertility can be an influence factor, particularly in Sonora, where the specific fertility rate of the women between 15 and 19 years of age increased more than six percentage points from 1990 to 2001, whereas it decreased for the rest of the women older than 20 years of age.[8]

In order to achieve a greater clarity in the analysis of how women regulate their offspring in the regions considered, we present the behavior of each one of the intermediate variables which condition the variations in the fertility levels in the different regional contexts.

GRAPH 1

EVOLUTION OF THE FERTILITY LEVELS. MEXICO AND REGIONS, 1990-2001
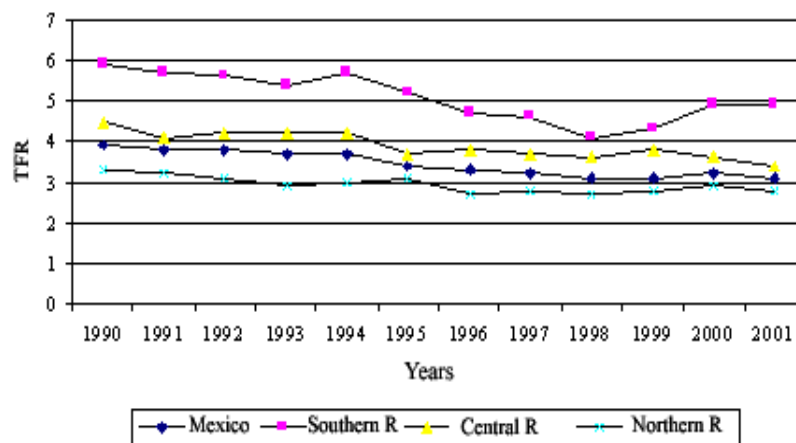
Source: INEGI. Birth statistics: 1990-2001.

[7] Levels close to that of demographic replacement have not been reached yet, as it can be the case of the Federal District that has the lowest fertility level in the country.
[8] Despite the rest of the northern border States are not the object of study (Ensar, did not consider them), by means of the information from the births' continuous records an increment in adolescent females' fertility can be seen in all of them, reaching in Chihuahua 40 percentage points from 1991 to 2001.

Fertility's proximate determinants

As it was already referred, it is understood by proximate determinants or intermediate variables of fertility the biological and/or behavioral factors through which socioeconomic, cultural and environmental factors can affect fertility. Among these variables are noticeable contraception and sterility, sexual intercourse, postpartum infertility and induced abortion. All of them will be independently analyzed ahead in the paper and, later, in a comparative way to precise the relative importance of each of these factors in the control of fertility that women have in the considered regions.

The importance of each intermediate variable in the explanation of the reduction of fertility levels observed depends on the differentiation among these variables as well as the extent at which fertility behavior reacts to them. (Welti, 1998).

According to the previous statement, to inquire into the effect that proximate determinants have on the fertility levels observed in the regions, the influence of the so-called intermediate variables was analyzed using the mathematical model developed by Bongaarts and modified by Stover by means of the previously indicated adjustments, which were considered in the estimation of the indexes whose values are also analyzed ahead.[9]

Nuptiality and sexual activity

Nuptiality is considered a complex phenomenon that depends on demographic factors, social and cultural values and expectations of the different population groups (Ojeda, 1993), and it has been considered to influence in a determinant manner the fertility levels thus, the matrimonial state, the age at the start of the first marriage or union, as well as the stability of the couple relationships, are directly linked to the aforementioned variable of demographic change.

In Mexico, formal marriage and free unions still have the most important role in the beginning of family life. Married marital status, either legally or religiously, is widespread, which becomes more evident as women grow old. It is possible that the relationships that start in unfavorable conditions where some younger women are implicated can be legalized in time (García and Rojas, 2002).

[9] See Bongaarts, 1978, and Stover, 1998, for the complete mathematical formulation of the method developed by these authors.

At regional level there are no significant differences in relation to the general behavior previously distinguished, as it is possible to observe in table 1. Among female adolescents from the southern region it is worth noticing the superior proportion of women who are already in a stable relationship, this is an indicator of the presence of a pattern of early nuptiality in more traditional societies with a lesser development degree.

The early start of marriages or unions is related to a larger exposure to pregnancy risk, thus, a greater fertility. The youngest age at the first union takes place in the southern region, under 19 years of age as median age at the beginning of the union, and on the other end, women in the northern start their couple relationships approximately two years later (table 2).

Altogether with it, new manners of cohabitation similar to the so-called European model are starting to appear, hence there are more births outside traditional unions (Quilodrán, 2000). It is said that sexual activity before marriage or consensual union, as well as an earlier start of it, is becoming widespread and it is taking place in globalization, economic restructuring and social inequalities' contexts (García and Rojas, 2002), which requires to be taken into account when performing this sort of analyses.

In relation to the aforementioned, the beginning of the first sexual intercourse takes place at significantly earlier ages than that at the first union, what is particularly notorious in the northern region where the time interval between the age at the first sexual intercourse and the first union is 2.4 years. For the rest of the considered regions, as well as for the rest of the country, the beginning of sexual activity precedes a year and a half or two to the marriage or union (table 2). In this manner, sexual activity has become a determinant factor in pregnancy exposure, and probably because of that in the fertility levels presented.[10]

It is because of the previously stated reasons important to consider the sexually active women's proportion when analyzing the factors which determine fertility behavior, independently from the marital status, for not being involved into a relationship does not seem to represent sexual abstinence.

When applying the referred method to proximate determinants, when women are considered sexually active to estimate the index of sexual activity, it is possible that its reducing effect on fertility decreases —in relation to the unmarried or no union index, which comprehends every woman in fertile ages— at the extent in which unmarried women would be sexually active, so it is possible

[10] The increment of the interval between the first sexual intercourse and the first stable union, if it is not accompanied by an adequate sexual education, can cause the increment of pregnancy risk or unplanned childbirths, as well as abortions practiced in inappropriate sanitary conditions, with unwanted social and health consequences basically for the most vulnerable groups such as youths can be.

TABLE 1
WOMEN DISTRIBUTION BY COUPLE RELATIONSHIP, ACCORDING TO
RESIDENCE REGION AND BEING AT ADOLESCENT AGES AND OLDER

Residence region	Population group	Married women	Conjugal union	Couple relationship	No couple relationship
Southern	20-49 years	57.4	17.4	74.8	25.2
	15-19 years	12.2	10.3	22.5	77.5
Central	20-49 years	57.6	12.8	70.4	29.6
	15-19 years	5.1	8.9	14.0	86.0
Northern	20-49 years	54.6	18.1	72.7	27.3
	15-19 years	6.4	9.0	15.4	84.6
Mexico	20-49 years	55.4	15.8	71.2	28.8
	15-19 years	7.3	8.7	16.0	84.0

Source: estimation from Ensar, 2003.

to consider that the modification proposed by Stover gives out in a more precise manner information to measure the exposure to pregnancy risk.[11]

According to the results from the Bongaarts model's results with adjustment proposed by Stover, the sexual activity index decreases from northern to southern regions, this means that potential fertility reduction due to the effect of sexual inactivity is lesser in the northern of the country, hence there is a greater exposure to pregnancy risk through a higher sexual activity,[12] which seems to be undermined by means of a more universal and effective contraception.

TABLE 2
AGE AT THE FIRST UNION AND AT THE FIRST SEXUAL INTERCOURSE,
ACCORDING TO RESIDENCE REGION

Residence region	Average age at the first	
	Union	Sexual intercourse
Southern region	18.7	17.1
Central region	20.0	18.1
Northern region	20.6	18.2
Mexico	20.2	18.1

Source: estimation from Ensar, 2003.

[11] From the same information source the so-called Bongaarts' Method was developed, and this with adjustments proposed by Stover, which enables us to perform such affirmation, even though the results hereby presented basically correspond to the adjusted method.
[12] The indexes' values estimated vary between one and zero; when they approach one, it is interpreted that the effect of the referred variable as inhibitor is lesser; on the contrary, the approach to zero suggests a greater relevance to limit fertility in a given context.

Contraception and sterility

The use of contraceptives in Mexico became rapidly widespread as from the 1970's decade, mainly because of the changes in population policies as well as the family planning programs implemented as from 1974, this has influenced its generalized use and also has been the reason why contraceptives have been considered as one of the main determinant factors in the accelerated descent in fertility (Cacique, 2003).

From the total of sexually active women in Mexico, a proportion, larger than two third parts (Ensar 2003), uses some contraceptive method, being the States in the southern below this value, with barely more than a half of the sexually active women using contraceptive methods. Rather close, but still with values below national level, are the women from the central region, whereas the ones from the northern have the highest prevalence with 74.5 percent of the women using contraceptive methods.[13]

Altogether with contraceptive prevalence, the sort of method employed can influence the reduction of the fertility levels. The methods to prevent conception are classified in modern and traditional,[14] as modern are distinguishable sterilization or fallopian tubes' occlusion, which is the preferred by slightly more than two fifth parts of the sexually active women, then there are the women who prefer intrauterine devices, pills and other modern methods, among them condom. The traditional methods are relatively scarcely used in the national context (graph 2).

It is interesting to observe there are regional differences and similarities by type of method used. In such sense, it is noticeable that there are practically no variations in the high sterilization levels among the regions, where the northern region has a higher proportion rate of women users of that method.

The intrauterine devices are more utilized in the central and northern regions, respectively; whereas pills are largely used in the northern States and other modern methods are highly preferred by the users from the south.

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[13] At national level, the contraceptive prevalence among sexually active women was 68.5 percent, being below this value women form the central region (62.6 percent) and the ones from the southern region (54.2 percent).

[14] Among the modern methods are the contraceptive pill, contraceptive devices (IUD), injections, diaphragm, condom, feminine and masculine sterilization. In the traditional ones are voluntary abstinence, retrieval, herbs among other (Welti, 1998).

As it was expected, sexually active women from the Mexican Northern Border States use traditional contraceptive methods in a much smaller proportion than the rest of the regions, this allow increasing their effectiveness to prevent unplanned pregnancy and so a provoked abortion.[15]

In respect to ages, there are also aspects to pinpoint; at national level, as women's age increases, the proportion of users of definite methods also does, methods such as fallopian tubes occlusion, until reaching women of 40 years of age and older, around half of them are users of the said method. These values are rather inferior in the central and southern regions whereas as in the north it increases above 60 percent in the referred age group.

Intrauterine devices and other modern methods are frequently used among the youngest women, basically younger than 35 years of age. In the southern region, the greatest concentration of UID and pills usage is to be found among women younger than 30 years of age, in the rest of the regions these methods are distributed in a more regular manner among women and age groups.

Adolescent females from the northern region are the ones who have the largest prevalence in the sue of contraceptives, with 44 percent of the sexually active youths in the said condition, this represents more than ten percentage points than the women from the southern region. Despite the latter, in the States of the Northern Border where precisely a slower rhythm in the reduction of adolescent fertility, which can be linked to an increment of sexual activity at earlier ages and outside stable marital unions. Precocious unmarried relationships are generally associated with an incorrect use of contraceptives to avoid pregnancy and the —still relatively high— proportion of youths having sexual intercourses without contraceptive protection.

TABLE 3
SEXUALITY INDEX FOR MEXICO AND ITS REGIONS, 2003

Residence region	Sexuality index (Cx)
Mexico	0.53
Southern region	0.54
Central region	0.56
Northern region	0.59

Source: estimations from Ensar, 2003.

15 In accordance with some researchers (Núñez, 2000) the type of methods used is an important conditioner of induced abortion.

GRAPH 2
CONTRACEPTIVE PREVALENCE OF THE SEXUALLY ACTIVE WOMEN.
MEXICO 2003
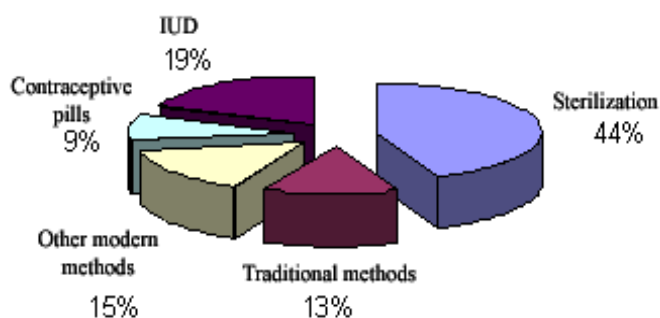
Source: Authors' own elaboration.

The impact contraception has upon fertility diminution depends on the users' proportion and the effectiveness of the utilized methods, considering in this case the prevalence of the use of contraceptive methods in sexually active women.

The reductive effect of the potential fertility due to the use of contraceptives was 59 percent for the country (Table 10), being found that the central and southern regions appear below the national average, whereas the northern States have the highest reductive effect due to contraceptive usage, with a fertility 64 percent lower than its potential level.[16]

Contraceptives' greatest impact in the northern region can be attributed to the fact that it is in this region where there is a larger proportion of female users (73.6 percent) than in the central region (62.6) and even larger than in the south (54.2), besides the utilized methods are generally the most efficient, since sterilization and contraceptive pills prevail,[17] which is reflected on the effectiveness index in the use of contraceptives is higher in the northern region, where this has a value of 0.89, whereas the rest of the regions and that of the country is 0.85 (Montes, 2004).

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[16] The fertility reducing effect due to a certain index is calculated as the index complement, it is, the index value is subtracted from one and then multiplied by 100 for its better understanding.
[17] Nonetheless, adolescent fertility in the northern region has been reduced in a slower manner than in other age groups, despite the contraceptive prevalence is relatively high among female youths, but it seems as though the effect of contraception on fertility is reduced before the risk of pregnancy exposure that early sexuality outside a stable relationship carries without the required knowledge.

In relation to the infertility of women,[18] this must be affecting the level of fertility at a lesser extent, both at national and regional levels, since women younger than 35 years of age (where the total births in the country are concentrated) only five percent of the women are infertile.[19] As women grow older, this proportion rapidly increases, until it affects, as expected, most of the women at the end of the considered fertile period.

In spite of the relatively small proportion of women who have infertility problems at the ages when Mexican women reproduce the most, this limitation can represent a problem which deserves attention because of the different affectations provoked by infertility in some women in the period when they have the biological capacity to give birth.[20]

Another of Stover's adjustments to Bongaarts method is the calculation of this infertility index. In accordance with the obtained results (table 5), this index has an inhibiting effect on fertility scarcely significant, between 9 and 10 percent, however, it is slightly superior in the southern region, which is worth noticing, if it is considered that the proportion of sexually active women in the age structure is younger in the south than in the national average and even younger than in the northern region,[21] so infertility should be lesser.

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[18] For the calculation of the infertile women, the following were considered: sexually active women who declared themselves as infertile, the ones who having frequent sexual intercourses for the last year without using contraceptive methods have not become pregnant, as well as the ones undergoing menopause.

[19] In all the fertile period, infertile women proportion is larger in the southern region with 12.1 percent in the said situation, the northern region has an intermediate situation in this respect with 10.3 percent and the central region the lowest proportion with 8.8 percent of the sexually active infertile women, similar proportion to the national average.

[20] Besides the methodological point of view, infertility consideration is necessary to minimize the overlapping that can arise among women who are infertile and those who use sterilization as contraceptive method (Del Popolo *et al*, 2003).

[21] From the total of sexually active women, those younger than 30 years of age represent 51 percent at national level, 54 percent in the southern region and 48 percent in the northern region.

Post partum infertility

There are factors which reduce the possibility of a new pregnancy after a child is born, among these we can find lactation, amenorrhea and postpartum sexual abstinence, in such manner that these factors are determinant on the infertility period women have after a child's birth. This is also known as postpartum infertility[22] (Welti, 1998).

Lactation notoriously decreases the probability of women to ovulate, especially in the first moths after the birth of the child, so that amenorrhea can last as long as breastfeeding does.

In agreement with the latter it can be stated that lactation's length is related to the exposure to pregnancy risk, the intervals between pregnancies and the fertility level, since it can influence the suppression of menstruation, in a fashion that lactation's length, and related to it amenorrhea, seem to have an effect on postpartum infertility, this effect seems to be greater than sexual abstinence, according to the evidence some authors found (Chackiel and Schokolnik, 2003).

Another aspect that should be considered, besides lactation's length, is the intensity of it, for it is stated (Del Popolo, 2003) that the inhibiting power for a pregnancy emergence appears to be greater when breastfeeding is exclusive, i.e., when the child is only fed with mother's milk, something more likely to take place after childbirth. This could explain why to equal lactation's lengths correspond uneven amenorrhea periods, for instance, among the Mexican central and southern regions, which needs to be corroborated with studies focused on this topic.

Another aspect worth noticing in the duration of the postpartum sexual abstinence, which has similar values at a national level and in the northern region similar to the rest of the studied Latin American countries, for which the average abstinence duration was between 1.9 and 3.0 months (Del Popolo *et al*, 2003), nonetheless in the central and southern regions it is slightly superior, yet the causes can not be determined with the elements provided by the available information sources.

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[22] Postpartum infertility is defined as the time after the childbirth, when a woman is not exposed to pregnancy risk, either because there is no ovulation or restrains herself from sexual intercourse.
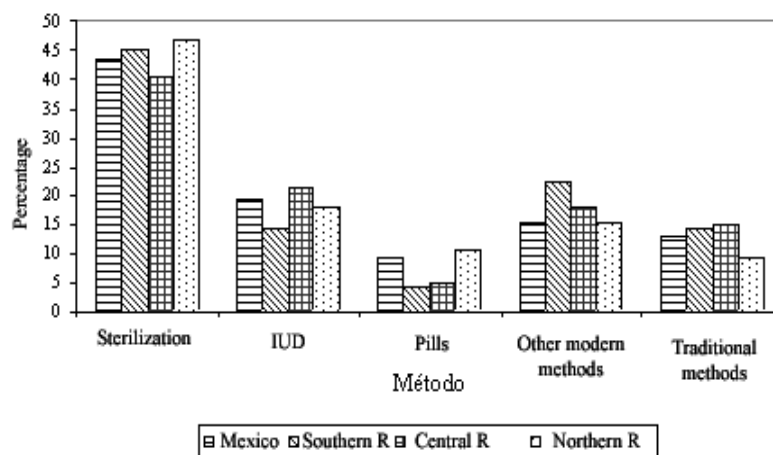
TABLE4
CONTRACEPTION INDEX, MEXICO AND ITS REGIONS, 2003

Mexico and its regions	Contraception index (Cu)
Mexico	0.41
Southern region	0.54
Central region	0.49
Northern region	0.36

Source: estimations from Ensar, 2003.

GRAPH 3
DISTRIBUTION OF THE SEXUALLY ACTIVE WOMEN
WHO USE CONTRACEPTIVE METHODS, BY SORT OF METHOD USED,
ACCORDING TO RESIDENCE REGION

Source: Ensar, 2003.

Southern region is the one which has the largest values in the three intervening variables in postpartum infertility, however, this is the region with the highest fertility levels, on the contrary, the shortest amenorrhea, sexual abstinence and lactation's lengths take place in the north, where fertility is lower (table 6), this indicates the lesser relevance, for the descent of the fertility of the postpartum infertility in contexts of universal contraception, as it is the case of the northern States and at lesser extent, those of the central region.

When estimating the postpartum infertility index a sheer contrast in these indexes' values among the northern States can be seen, where its signification is almost null and those of the south, where the fertility's inhibiting effect due to this variable reaches 19 percent (table 10), this corresponds to the statement of a lengthy lactation, therefore a postpartum amenorrhea also lengthy, it is characteristic of the more traditional or rural regions and tends to decrease at the extent in which socioeconomic development or urbanization process increase.

TABLE 5
STERILITY INDEX. MEXICO AND ITS REGIONS, 2003

Mexico and its regions	Sterility index
Mexico	0.91
Southern region	0.88
Central region	0.91
Northern region	0.90

Source: estimations from Ensar, 2003.

Induced abortion

Abortion, with some exceptions, is legally punished in Mexico, so the information on the issue is frequently unavailable or incomplete, for it is difficult to seize or infer from some data source. In such manner that the use of indirect methods to estimate the incidence of this practice becomes indispensable, since it is pointed that abortion significantly acts as a fertility determinant (Ferrando, 2003).

According to the information from the 2003 Survey of Reproductive Health, out of the total of women once pregnant, 19.4 percent has had at least one abortion along their reproductive life, there is an average of 1.32 abortions for these women, although it is not possible to precise how many of them have been induced.

The same source indicates that as women grow old so does the proportion of this event, reaching its peak value in the 40 to 44 years of age group, where it almost reaches 41 abortions in 100 women once pregnant.

At regional level, fertility determinants' behavior seems to be somewhat paradoxical, for in the northern region, where contraceptive prevalence reaches the highest levels and where it is presupposed that the modern methods are available and much widely accessible than in other regions, is where the incidence of abortion among women once pregnant is larger (table 8).

By age, it is noticeable that in the group of youngest women it is observed a similarly high abortion rate in the southern and northern regions; nevertheless, the uneven socio-demographic conditions of both regions allow supposing that those coinciding levels can be explained in a different manner in each region.[23]

In most of the cases, the levels of induced abortion —isolated from the allegedly spontaneous— are not considered in fertility studies because the necessary information does not exist or the existent is not reliable to perform a direct estimation, and even though it is supposed this practice can have a very important role among some population groups where it has a higher acceptance level (as in youths)[24] the lack of more empirical elements limits its analysis and the determination of its effect as reductive determinant of fertility. Because of this, it is proposed to perform an indirect estimation by means of a functional relation among the observed fertility —in this case the TFR—, the indexes previously estimated —sexuality index, contraception, sterility and postpartum infertility— and the total or potential fertility[25] —PF— (see annex).

TABLE 6
AVERAGE DURATION OF THE VARIABLES WHICH DETERMINE POSTPARTUM INFERTILITY, MEXICO AND REGIONS, 2003

Region	Average duration (months)		
	Amenorrhea	Sexual abstinence	Lactation
Mexico	3.9	3.1	4.0
Southern	6.1	3.9	4.1
Central	4.4	3.8	4.2
Northern	2.9	3.1	3.8

Source: estimation from Ensar, 2003.

[23] Whereas in the north the period between the beginning of sexual intercourses and the marital unions is longer and the exposure to an unwanted pregnancy in youths grows, in the south it can influence a larger use of traditional methods with a poorer protection for the appearance of unwanted births, thus a possible abortion.
[24] In a research on abortion from the 1991 Survey of Reproductive Health data, Leopoldo Núñez found out that when the pregnancy is an unwanted one or when the woman does not feel responsible or mature to have a child, a higher level of acceptance of induced abortion is observed in the youngest groups.
[25] Paying attention to a Stover's suggestion the total or potential fertility was given a value of 21.

The results from the estimation of the abortion index are presented in table 9, where it is possible to infer that the country's potential fertility is reduced in a relatively important proportion as a result of the voluntary interruptions of pregnancies, which seems to be a high value,[26] what is out of the range of the abortion variation suggested by Stover, i.e. 0.7 to 1. On the contrary, the rest of the indicators are indeed very similar to those obtained for the four Latin American countries where the referred model was applied with all the specifications suggested by Stover.

In respect to the selected regions in the present study it is seen (table 9) that in the northern and southern regions the reductive effect's value is around 30 percent, a significantly inferior value in respect to the national average and even higher in respect to that of the central region.

It is noticeable the abortion's reductive effect would not be superior in the northern States, however, it most be considered that the attainment of this index in an indirect manner enables other values —such as contraception or sexual activity, among others— to influence on the fertility reductive effect by induced abortion would be inferior in this region, this does not contradict the fact that the number of pregnancies' interruptions would be more important in the northern region of the country. Proving this hypothesis certainly requires deeper research.

TABLE 7
POSTPARTUM INFERTILITY INDEX. MEXICO AND ITS REGIONS

Mexico and its regions	Postpartum infertility index
Mexico	0.89
Southern region	0.81
Central region	0.87
Northern region	0.93

Source: estimations from Ensar, 2003.

[26] The consideration of only sexually active women for the estimation of these indexes, can influence on the attainment of higher values than the possible presented values in this respect by authors who consider to other women with a lesser pregnancy exposure risk degree or in this case of abortion; also the value given to potential fertility for the calculation of the index, as it will be further appreciated, could be conditioning the high value.

Due to the relatively high values which seem to represent the induced abortion rate estimated through the modifications proposed by Stover using a potential fertility of 20 children per woman, it was also calculated the model with a total fertility of 15.3, which is the total fertility intermediate value stated by Bongaarts. Then the indicators related to pregnancy interruption turn out to be closer to the expected values, even though these suggest a greater relevance of the abortion as fertility inhibitor than in the rest of the Latin American countries which took place in the ECLAC project.

In agreement with what the aforementioned indicators suggest, it is worth noticing that in a study with data from the Enfes/87 there is an exercise where all women in reproductive ages are considered for the application of the proximate determinants method, or the Bongaarts' method, with the extreme potential fertility values this author states —from 13 to 17 children per woman— from here, the total abortion rate would be found within a variation range from 0.24 to 0.48 induced abortion per woman in reproductive age.

Following the adjusted procedure (Stover), with a potential fertility of 15.3 to 21 children per women and using information from sexually active women of 16 years of age and older, who are the ones with a greater exposure degree than the ones in reproductive ages in the appearance of a pregnancy and to an induced abortion, abortion rate would be found within the range from 0.33 to 0.77 per sexually active women.

TABLE 8
ABORTIONS PROPORTION OF WOMEN ONCE PREGNANT, BY AGE,
ACCORDING TO RESIDENCE REGION

| Age group | Abortions per 100 women | | |
	Southern region	Central region	Northern region
15-19	7.40	4.61	6.92
20-24	7.73	9.99	18.74
25-29	15.23	16.65	22.86
30-34	18.65	23.27	27.24
35-39	24.08	26.00	30.43
40-44	24.75	42.96	38.18
45-49	27.23	29.34	36.27
Total	18.54	23.81	28.19

Source: estimation from Ensar, 2003.

Regional comparison of the proximate determinants

When comparing the effects of the different intermediate variables through the estimated indexes (tables 10 and 11) contraception is distinguished as the variable with the largest fertility's inhibiting effect, both at national level as in the central region, yet particularly in the north of the country, where a reduction of more than 60 percent in observed, a value superior to the national average.

Sexuality patterns in the different regions also have a significant impact, mainly in the southern region, because this is the most important determinant; whereas in the rest of the regions it has the second place.

Induced abortion is presented as the second determinant in importance for all the analyzed territories, however, due to the probably overestimated values obtained, particularly for the national level as well as for the central region, it was also calculated, as previously referred, for a total or potential fertility of 15.3, for which more moderate values were obtained in the abortion index, presented in table 11.

Finally, postpartum amenorrhea and sterility are the determinants with the lesser weight, and they are only significant in the south of the country.

Conclusions

The information used in this work and the analysis method allow reinforcing, or in other cases, questioning the existent criteria on how women in Mexico and in different regions of the country regulate their fertility to reach the levels observed in this variable of demographic change.

The high contraceptive prevalence and the effectiveness of the utilized contraceptive methods explain why fertility currently has relatively low levels in Mexico and its regions, particularly in the northern States, where a larger proportion of women use modern contraceptives. Nonetheless, in some groups of women, such as the youngest and at certain extent in the residents from the southern States some limitation in the use-effectiveness of contraception is observed.

TABLE 9
INDUCED ABORTION INDEX, MEXICO AND ITS REGIONS, 2003

Mexico and its regions	Induced abortion index (Ca)
Mexico	0.60
Southern region	0.70
Central region	0.56
Northern region	0.69

Source: estimations from Ensar, 2003.

The beginning of sexual life at earlier ages than marital unions seems to increase the risk of pregnancy at the start of the reproductive period, thus the possibilities of a more dramatic descent of fertility, as well as unwanted births and induced abortions, in some States with a higher advance in the demographic transition, this could be counteracted with a better sexual education.

Postpartum amenorrhea has only relevance as inhibitor of the fertility in the south of the country, this enable us to suppose that with growth, breastfeeding period gradually reduces.

The practice of induced abortion becomes evident in the country as a fertility determinant of major importance, the recurrence of it could be significantly increasing with the increment of sexuality at early ages and the extension of regulations which make the birth of a child undesirable for these women, so it is advisable to take the necessary measures to avoid induced abortions and the birth of unwanted children.

TABLE 10
FERTILITY AND INTERMEDIATE VARIABLES.*
MEXICO AND SELECTED REGIONS, 2003

Rates and indexes	National total	Residence region		
		I	II	III
Observed fertility TFR[1]	2.3	3.05	2.53	2.55
Potential fertility TF[2]	20.8	20.9	20.9	21.1
Sexual activity index Cx	0.53	0.54	0.56	0.59
Contraception index Cu	0.41	0.54	0.49	0.36
Sterility index Cf	0.91	0.88	0.9|	0.90
Cu * Cf	0.38	0.48	0.44	0.32
Postpartum infertility index Ci	0.89	0.81	0.87	0.93
Induced abortion index[3] Ca	0.60	0.70	0.56	0.69
Percentage of reduction[4] of potential fertility by:				
Sexual abstinence	46.7	46.0	44.5	40.6
Contraception	58.6	45.8	51.4	64.4
Infertility	8.8	12.1	8.8	10.3
Contraception combined with sterility	62.2	52.3	55.7	68.1
Postpartum amenorrhea	11.0	19.0	13.0	7.0
Induced abortion	40.5	30.0	44.0	31.0

* With modifications proposed by Stover.
[1] TFR = total fertility rate, children per woman.
[2] TF = potential fertility, children per woman.
[3] Estimated from the algorithm with TFR, TF and Cx, Ci, Cu, Cf.
[4] It is the value of the Cx, Cu, Cf, Ci and Ca indexes minus one multiplied by a hundred.
Source: Own elaboration from Ensar 2003.

TABLE 11
FERTILITY AND INTERMEDIATE VARIABLES.*
MEXICO AND SELECTED REGIONS, 2003

Rates and indexes	National total	Residence region		
		I	II	III
Observed fertility TFR[1]	2.23	3.05	2.53	2.55
Potential fertility TF[2]	15.0	15.3	15.1	15.3
Sexual activity index Cx	0.53	0.54	0.56	0.59
Contraception index Cu	0.41	0.54	0.49	0.36
Sterility index Cf	0.91	0.88	0.91	0.90
Cu * Cf	0.38	0.48	0.45	0.32
Postpartum infertility index Ci	0.89	0.81	0.87	0.93
Induced abortion index[3] Ca	0.83	0.96	0.77	0.94
Percentage of reduction[4] of potential fertility by:				
Sexual abstinence	46.7	46.0	44.0	41.0
Contraception	58.6	46.0	51.0	64.0
Infertility	8.8	12.0	9.0	10.0
Contraception combined with sterility	62.2	52.5	55.4	67.6
Postpartum amenorrhea	11.0	19.0	13.0	7.0
Induced abortion	17.0	4.0	23.0	6.0

* With modifications proposed by Stover.
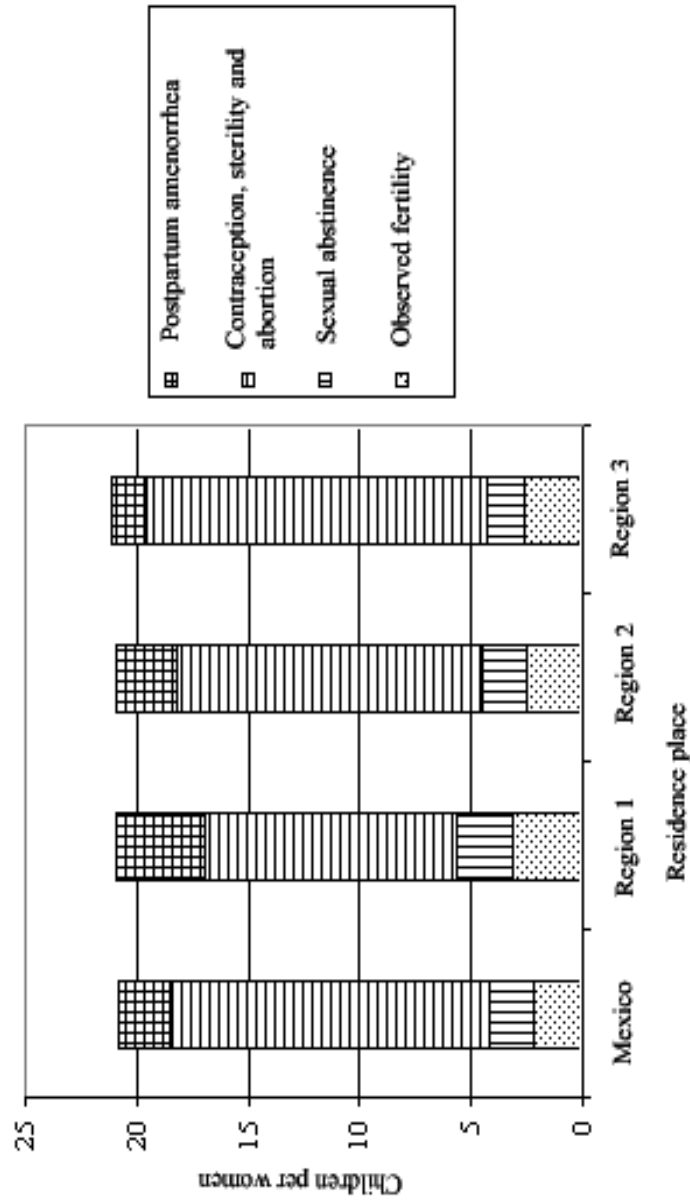[1] TFR = total fertility rate, children per woman.
[2] TF = potential fertility, children per woman.
[3] Estimated from the algorithm with TFR, TF and Cx, Ci, Cu, Cf.
[4] It is the value of the Cx, Cu, Cf, Ci and Ca indexes minus one multiplied by a hundred.
Source: Own elaboration from Ensar 2003.

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GRAPH 4

FERTILITY AND INTERMEDIATE VARIABLES*. MEXICO AND SELECTED REGIONS, 2003

Source: Own elaboration from table 10.
*modified model proposed by Stover, and using a TF of 15.3 children.

GRAPH 5

FERTILITY AND INTERMEDIATE VARIABLES*. MEXICO AND SELECTED REGIONS, 2003
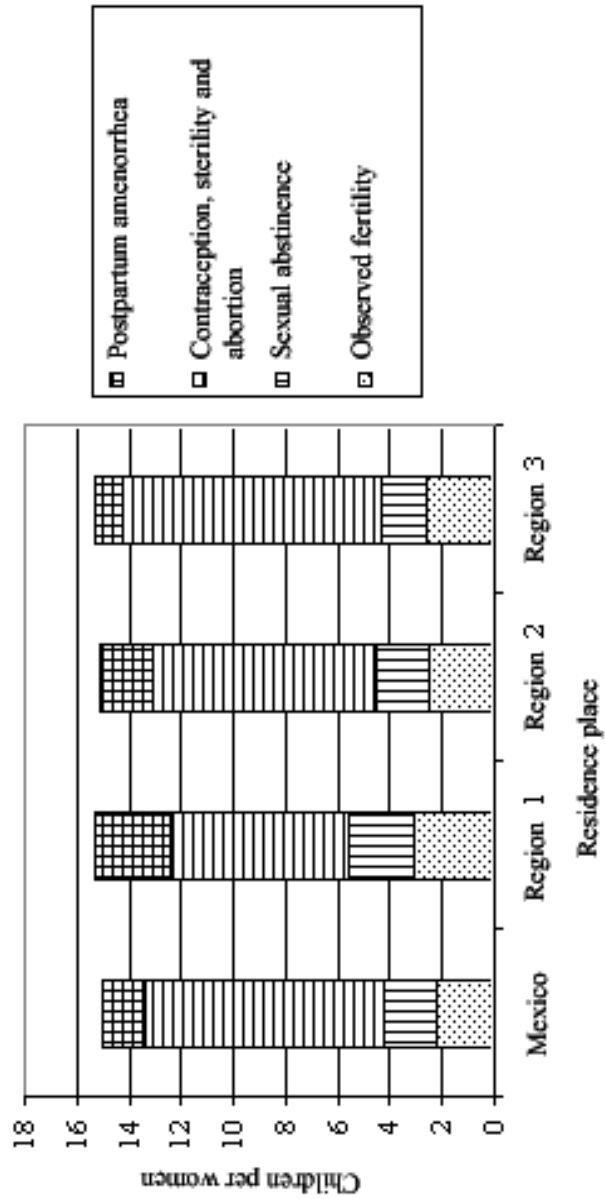
Source: Own elaboration from table 11.
* modified model proposed by Stover, and using a TF of 15.3 children.

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Methodological annex

Total Fertility Rate (TFR) will be calculated: this rate is a summary measurement that has the purpose to sum up the reproductive experience of a set of women and allow the comparison among countries regions of a country, without the limitation of the women's age structure effect.

TFR is defined as the number of average children that each women from a hypothetical women's cohort would have. The women are considered as unexposed to death risk from the beginning of their reproductive period until the end of it, besides at the moment when reproduction commences are exposed to fertility rates by age of the moment of the study population.

It is expressed as follows:

$$TGF^t = \sum_{15}^{49} {}_5 f_x^t * 5$$

Where:

TFRt is the fertility rate for a determinate time period

$$\sum_{15}^{49} {}_5 f_x^t * 5$$ represents the sum of the specific fertility rates of the women from 15 to 49 years of age multiplied by five.

$${}_n f_x^t = \frac{{}_n B_x^t}{{}_n F_x^t} X 1000$$

Where:

$${}_n f_x^t$$ are specific fertility rates of women between «x» to «x+n» years of age during a given period (year t).

$${}_n F_x^t$$ represents the average feminine population between «x» to «x+n» for a given period (t)

$${}_n B_x^t$$ represents the number of births in a certain time period of the women between «x» and «x+n» years of age.

The intermediate values considered in the Bongaarts model are nuptiality or sexual activity, contraceptive use, postpartum infertility and induced abortion.

The model identifies four different fertility levels represented by their respective indicators and where each one of them considers the impact of the variables previously mentioned:

1. Total fertility rate: the average of children per woman in a population, which results from the interaction of the intermediate variables.

2. Marital fertility rate: if all of the women in reproductive ages married, the TFR would increase to a level of marital fertility since there is no effect of being single or not.

3. Natural rate of marital fertility (NR): if all of the women in reproductive age married, did not use any kind of contraceptive method ad besides did not practice induced abortion, fertility would increase to a level of natural rate of marital fertility.

4. Total fertility rate (TF): if the absence of singleness or no-union, contraceptive methods and induced abortions was added the lack of breastfeeding and postpartum abstinence, then fertility would increase to its maximum possible (Del Popolo *et al*, 2003).

In accordance with this model, the following formula will indicate us the value of the total fertility rate considering the previous aspects:

TGF = FT x Cm x Ca x Cc x Ci

Where

TFR is the total fertility rate observed in a determined moment

TF is the total fertility

Cm is the index of marriage

Cc is the index of contraception

Ca is the index of induced abortion

Ci is the index of postpartum infertility

The information from the survey is sufficient to apply this method to the analysis of fertility. However, in respect to the changes that have taken place in the population, it becomes necessary to perform some modifications to the previous model, which were proposed by Stover in 1988.

This modifications are mainly referred to three changes to the original model: the first includes sexually active women, in place of married or united women, as an indicator of pregnancy exposure; second, removing the infertile women from the contraceptive index, and; third, removing the women who use contraceptive methods as well as those women who undergo amenorrhea within six months after the childbirth.

In order to perform the mentioned modifications, firstly we have to define our sexually active women, since the marriage index (Cm) is replaced by the index of sexual activity (Cx). Hence, it is considered that sexually active women as those who are in fertile ages and have had sexual intercourses in the last month, adding those who are currently pregnant and those who are in postpartum abstinence, since the latter have been exposed to pregnancy risk recently. In this manner the index of sexual activity Cx is:

$$Cx = \frac{\sum f(x)}{\sum f(x)*s(x)}$$

Where

S(x) is the proportion of women of x years of age who are sexually active according to the previous definition.

On the sterility index (Cf) we have that, with the current surveys and in this case with Ensar 2003, it can be obtained in a direct manner the infertile or sterile women. Then it is proposed to directly utilize the complement of sterile women's proportion that will be obtained from the following formula:

Cf = 1 - f

Where:

f is the proportion of sterile sexually active women.

We define as sterile, women undergoing menopause and those who declare to be infertile.

The last modification proposed is removing the sterile women from the contraception index, besides that these women are now included in the sterility index, as well as removing the women who undergo amenorrhea and those who use contraceptive methods. Hence, the index would be obtained as follows:

Cu= 1- (u-a)*e

Where u is the prevalence of contraceptive methods use of the sexually active women in reproductive age, which comes from:

$$u = \sum_m u(m)$$

Where $u(s)$ is the proportion of women who use contraceptive methods; m is the average effectiveness of the use of contraceptive methods and,

$$e = \frac{\sum u(m) * e(m)}{u}$$

Where:

$e(m)$ is the effectiveness of the m method.

Postpartum fertility index is calculated according to the original model stated by Bongaarts, as follows:

Where:

$$Ci = \frac{20}{18.5 + i}$$

i is the average postpartum length.

When postpartum infertility can not be estimated in a direct manner, an approximate value can be obtained in function of the lactation length from the following algorithm:

1.5+ (0.56*average lactation length).

For the index of induced abortion, as it can not be directly obtained with the information from the survey; it is obtained as complement and the following algorithm is applied:

$$Ca = \frac{TGF}{TF * Cs * Cu * Cf * Ci}$$

The simplified model is then:

TFR= FT*Cs*Cu*Cf*Ci*Ca; hence, we can analyze how each one of the intermediate variables act on fertility's behavior.

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