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EVALUATION OF OXIDATIVE STRESS AND ENZYMATIC ANTIOXIDANT ACTIVITY IN BRAIN DURING PREGNANCY AND LACTATION IN RATS

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ABSTRACT

Neural tissue is extremely vulnerable to free radical attack since its membrane lipids are very rich in polyunsaturated fatty acids. During pregnancy and lactation, metabolism is increased due to high-energy demand in many bodily functions. The increased demand for energy renders the brain, the tissue that consumes more oxygen than other organs, highly susceptible to oxidative stress, which is investigated in the present study. Lipid peroxidation was found significantly ($p< 0.05$) higher during both early and late periods of pregnancy but not during lactation. Activities of catalase and superoxide dismuatse were found significantly lowered in late pregnancy that continued till late lactation. A similar reduction in the activities of glutathione peroxidase was also observed during late periods of pregnancy and lactation. The present findings support the fact that there is an overall increase in the oxidative stress in the brain during pregnancy, more during late stages. On the other hand, based on the decrease in lipid peroxidation values and suppressed activities of enzymatic antioxidants, lactation still continues to be in the state of somewhat lowered oxidative stress, representing probably an intermediate stage prior to restoration of normalcy and cyclicity in these animals.

Key-words: Oxidative Stress, Pregnancy, Lactation.

The brain tissue utilizes about one-fifth of the total oxygen the body consumes[1]. The brain is especially rich in iron which plays an important role in the generation of reactive oxygen species in the membrane lipids consisting mainly of polyunsaturated fatty acids[2]. Neurons are particularly vulnerable to free radical attack since impaired defenses or exposure to excess free radicals may lead to neuronal death[3]. Free radical damage in specific regions of the brain

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has been recognized in cases like epilepsy, schizophrenia, Parkinson's disease or Alzheimer's disease[4]. Increased lipid peroxidation is also responsible for altered membrane fluidity[5] in the affected tissue.

Pregnancy is accompanied by an overall increase in the energy demand in different physiological functioning of the body organs. Since brain constitutes the centre of the nervous system and one of the most metabolically active organs, the metabolism of this tissue is expected to be further enhanced during pregnancy. The tissue oxygen utilization and requirement increases the rate of production of reactive oxygen species (ROS)[6]. Unlike many other cells, neurons are generally considered to be incapable of mitosis and the damage to these cells by any means, including ROS, would be devastating and may incur permanent lesions. There are a few limited studies reporting high ROS activity in brain during pregnancy[7]. In order to make an assessment on the status of oxidative stress, the present study was designed to systematically evaluate the lipid peroxidation and enzymatic antioxidant activity in the brain during the periods of pregnancy and lactation, including both early and late stages.

MATERIALS AND METHOD

***Animals*:** Laboratory female rats (Holtzman strain), weighing 150-180 g were used for the study. The animals were maintained under controlled temperature (25 ± 2^0 C) and constant photoperiodic conditions (12 h light: 12 h dark). Food and water were provided *ad libitum*. Following cohabitation, the females were separated from males after spermatozoa were confirmed in the vaginal smear examination. Day 1 of pregnancy was designated as the day in which spermatozoa were first noticed in the vaginal smear. The pregnant females were segregated in cages and kept under observation till delivery. Lactating females along with litters were also maintained till 14 days following parturition.

***Tissue Processing*:** Rats in-group of 10 each were sacrificed on day 7^{th} and 16^{th} of pregnancy and day 3^{rd} and 14^{th} of post-delivery. Samples of tissue from liver and kidney were collected in ice cold normal saline (0.9% NaCl) in petri dishes, cleaned thoroughly of adhering tissues and blood vessels, dried on filter paper, weighed and stored in -70° C till further analysis. For Lpx, tissues were first homogenized (20%) in 1.15-% KCl and the crude homogenate was taken for lipidperoxidation assay. For assays of SOD, catalase and Gpx activity homogenization (20%) was carried out in 0.25-M sucrose at 4^0 C. The homogenate was centrifuged at 600 g for 10 min. at 4^0 C. The supernatant was further centrifuged at 10, 000 g for 20 min. at 4^0 C to obtain post mitochondrial supernatant (PMS). At this stage, one aliquot was separated for estimation of catalase activity. The remaining sample was allowed to pass through a 5 ml sephadex G-25 column. The eluted sample was taken for assay of SOD and Gpx activities. Protein was estimated as described by Lowry et al 1951[8].

***Assay for Lipid Peroxidation*:** The lipidperoxidation products in crude homogenate were measured through the estimation of malanoaldehyde (MDA) levels by the thiobarbituric acid method as described by Ohkawa et al 1979[9].

***Assay for SOD Activity*:** SOD activity was measured in the sephadex G 25 eluted PMS as described by Das et al 2000[10]. Absorbance was measured at 543 nM in spectrophotometer. The activity was expressed as U SOD/ mg protein.

***Assay for catalase/GPX Activity*:** Catalase[11] and GPX activities[12] were measured as described. Values were expressed as Pkat/mg protein for catalase and nMol/min/mg protein for glutathione peroxidase activity.

***Statistical Analysis*:** All data were shown as mean ± Standard error. Data were analyzed by one-way ANOVA followed by Duncan's multiple range tests. Difference was considered significant when $P < 0.05$.

FINDINGS AND DISCUSSION

The findings of the present study indicate that physiological state of pregnancy stimulates a rise in the lipid peroxides in brain as determined by the tissue MDA levels. However, lipid peroxides tend to decrease during the lactation period (Fig. 1). Enzymatic antioxidant activities in the form of Catalase (Fig. 2), superoxide dismutase (Fig. 3), and glutathione peroxidase (Fig. 4) levels remain suppressed during conditions of both pregnancy and lactation.

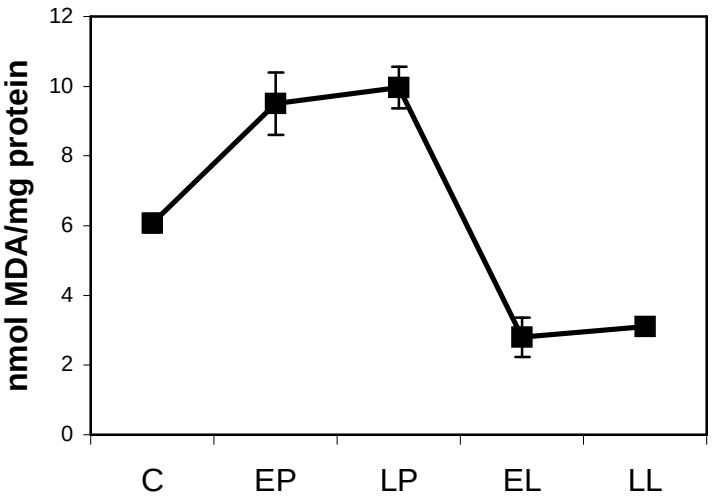

Fig. 1: Brain Malanoaldehyde (MDA) levels in rats. Values represent Mean (± SEM) from non-pregnant (C), early pregnant (EP), late pregnant (LP), early lactation (EL) and late lactation (LL) groups (n =10 per group).

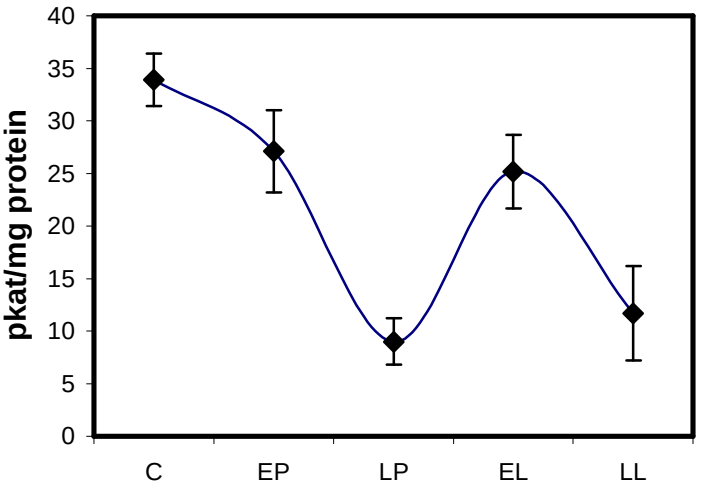

Fig. 2: Brain Catalase activity in rats. Values represent Mean (± SEM) from non-pregnant (C), early pregnant (EP), late pregnant (LP), early lactation (EL) and late lactation (LL) groups (n =10 per group).

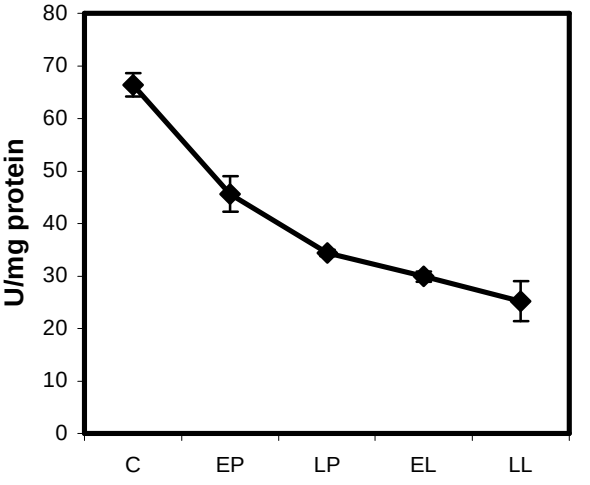

Fig. 3: Brain Superoxide dismutase activity in rats. Values represent Mean (± SEM) from non-pregnant (C), early pregnant (EP), late pregnant (LP), early lactation (EL) and late lactation (LL) groups (n =10 per group).

Lipid molecules react with oxygen free radicals resulting in the formation of lipid peroxides. These oxidized lipid products are reactive and cause damage to cell membrane and to the cell itself[13,14]. Lipid peroxidation once initiated, can be amplified by a radical chain reaction of self-propagation[15,16]. The susceptibility

of brain tissue to oxygen free radicals has already been recognized[3]. As the requirement of oxygen demand increases during pregnancy and lactation, the analysis of oxidative stress in the brain at these times becomes crucial and such information is hard to achieve in large animals or in clinical situations. However, in the present study an attempt was made to collect comprehensive information both on lipid peroxides and activities of enzymatic antioxidants together for the conditions of pregnancy and lactation.

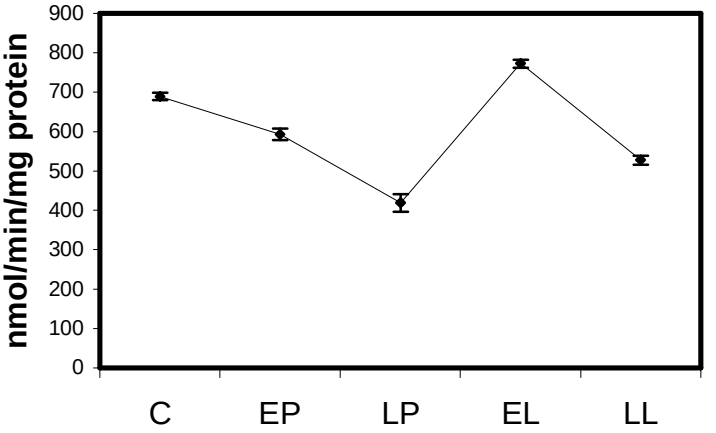

Fig. 4: Brain Glutathione peroxidase activity in rats. Values represent Mean (± SEM) from non-pregnant (C), early pregnant (EP), late pregnant (LP), early lactation (EL) and late lactation (LL) groups (n =10 per group).

Bulk of the iron in the tissues is usually sequestered and therefore, not available for oxidative reactions but it is readily released when cells are injured. The released iron is not readily bound since the cerebrospinal fluid (CSF) is essentially devoid of iron binding capability. Considering the fact that MDA levels are much higher in brain during pregnancy and with a depressed enzymatic antioxidant defense system, the brain tissue justifiably needs considerable attention and supplementation probably from non-enzymatic sources. A very little information is available on these aspects in the brain either during pregnancy or during lactation. Data from a single study reported earlier[17] only demonstrates a similar trend in the rise of lipid peroxides in the brain during pregnancy and after delivery. If an increase in oxidative stress due to augmented oxygen utilization was not accompanied by an increase in the antioxidative defense system, higher levels of cellular oxidative damage would be expected in neuronal tissue, which has a higher vulnerability to oxidative damage than any other organ.

The findings of this study demonstrate a decline in brain SOD and CAT activities during pregnancy that continued till the late lactation period. A little rise

in the suppressed Gpx activity during lactation from the late pregnant levels not withstanding, the overall enzymatic defense system at this time continues to be in the low gear all through.

In a particular tissue, the relationship between the level of oxidative stress and the protective role that the antioxidant enzymes provide is vital for normal functioning although the mechanisms of operation is not as simple as it looks. The fact that during pregnancy, despite the rise in the levels of lipid peroxides in brain the enzymatic antioxidant source failed to come up to the balancing levels, indicates a negative balance in favor of an increased oxidative stress. Similarly, during lactation though lipid peroxides were below non-pregnant control levels, enzymatic antioxidant activities still remained sub-normal levels indicating probably a transition phase prior to the restoration of normalcy and cyclicity in these animals.

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A STUDY OF MALE INVOLVEMENT IN FAMILY PLANNING

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ABSTRACT

Male involvement in regulating family size has been a concern for the health policy makers for quite some time. The role of men in such matters is of great importance because decision-makers in vast majority of the Indian families are males. Their awareness and knowledge are essential prerequisites for taking correct decisions at right time. Therefore, this study was conducted in a Maternity and Gynae hospital of Central Government Health Scheme, R.K. Puram, New Delhi, to assess the level of knowledge of males and their attitude towards family planning.

The study revealed that (i) Nearly one-third of all births is either undesired or unplanned, the major reason being the failure of contraceptive methods or accidental conception during lactation period; (ii) Strong preference for sons compels at least one-third of parents to go in for three or more number of children; (iii) Level of knowledge of various family planning methods like emergency contraceptives and no-scalpel vasectomy is low among the respondents; (iv) Desire to get vasectomy done is low among men; (v) Even after having three or more living children, only half of the men have any intention to adopt a permanent family planning method immediately or in future; and (vi) In half of the families, the husband is the sole decision-maker regarding the number of children.

Key-words: Male involvement, Contraceptive methods.

Male involvement in regulating family size has been a concern for the health policy makers for quite some time. As male parents are also responsible for the rearing of children, it is expected that they should have a role in planning the size of the family, prevent sexually transmitted diseases and other health complications. The role of men in such matters is of great importance in India because the sole decision-makers in a vast majority of the Indian families are males. Especially in the developing countries, women have a little or no say on matters which affect their reproduction or reproductive health. They need the

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consent of their husbands before accessing to health care or using contraception. Both the ICPD held at Cairo in 1994 and the World Conference on Women at Beijing in 1995 highlighted the hitherto neglected area of need of male involvement in family planning and reproductive health in the context of equity in gender relations and responsible sexual behaviour[1,2]. Men's awareness and knowledge are essential prerequisites for taking correct decisions at right time. In developing countries women have long been the subjects of research for fertility and family planning. However, very little research has been focussed on men. Exploring men's reproductive health knowledge is particularly important in a developing country like India where most women have limited control over their lives and completely dependent on husbands and older family members for making decision regarding their health. Poor knowledge of reproductive health issues among men may pose barriers for women to seek care for health problems. Keeping this background in view, the present study has been undertaken with the following specific objectives:

(i) To assess the level of knowledge of males and their attitude towards family planning;
(ii) To analyse whether their knowledge and attitude lead to practice; and
(iii) To find out the knowledge of men about reproduction.

REVIEW OF LITERATURE

The recent survey by the Government of India, NFHS II (1998) depicts that 16 per cent of the currently married women have an unmet need of family planning. The common reasons for their unmet need were inconvenience or unsatisfactory services, lack of information, fears about contraception, side effects, opposition from husbands, relatives, etc.[3]. Studies also show that male involvement enhances both the use of ante-natal care and contraception[4]. A study conducted in rural Uttar Pradesh, India, revealed that majority of men were not aware of their wives' pregnancy, including ante-natal care received by them and pre and post natal complications experienced by them. This was due to limited inter-spousal communication and also involvement of men in matters related to women is also either little or limited[5].

A four-day workshop organized by SIDH, an NGO, brought out certain problems faced by men such as alienation, isolation and ridicule. The workshop suggested that providing more opportunities for men to articulate their problems can lead them to become more sensitive to women's problems[6].

A study conducted among tribal married men in Thane district of Maharashtra proved that majority of them had no concept of family spacing, those who were aware of contraceptive methods had a little knowledge of their correct use. However, 53.75 per cent had a positive attitude and 66.2 per cent wanted to know more about contraceptives, preferably through sources such as radio, television, door-to-door campaign and interpersonal communications[7].

An in depth interview conducted on men in Peru revealed that men thought modern methods would cause damage to their spouses and themselves. Correcting the misinformation was one of the primary goals of a multifaceted mass media campaign that focussed on men[8]. A study conducted in Jordan revealed that 75 per cent of Jordanian Muslim religious leaders, Muslim men and women wanted to know more about family planning[9].

Male Reproductive Health Survey (MRHS) was carried out in Uttar Pradesh to ascertain the sexual and reproductive health needs of men and their wives. This study was proposed to increase the awareness of health service providers on the perception of men[10]. Another study conducted in Uttar Pradesh shows that wives basically agreed with the decisions taken by their husbands. Silent concurrence by women or lack of protest by them was interpreted as having arrived at a joint decision. Women almost never question the decision of their husbands, nor do they enter into any discussion with them[11].

METHODOLOGY

This study was conducted in a 40-bedded Central Government Maternity and Gynae hospital, R.K. Puram, New Delhi, during January – July 1997. On an average, 1300 deliveries take place in this hospital in a year. Mostly, they are CGHS beneficiaries.

The sample consisted of the men whose wives delivered a child during the study period in this hospital. Approximately 650 deliveries took place during the period under study. Out of this, a total of 162 men were randomly selected, of which 7 were not available for the study. Hence, a total of 155 men were included as sample respondents. After having selected the sample respondents, a questionnaire was administered to them for collecting relevant information from them. Then, they were interviewed with reference to their knowledge, attitude, practice of family planning methods and knowledge of reproduction.

FINDINGS

Socio Economic Profile of Respondents

The age group of men ranged from 23 to 48 years old and the median age was 31 years. Majority of the men (72.8%) were in the age group of 25 to 34 years. The age of wives ranged from 20 to 36 years and the median age was 26 years. Majority of the women (79.4 %) were in the age group of 20 to 29 years (Table 1).

So far as the educational level of males was concerned, almost half of the respondents (49.7%) were graduates and above, 36.7 per cent had passed high school and 7.7 per cent studied up to middle school. With reference to female education, it can be seen from Table 1 that they were equally educated like men,

graduates 36.4 per cent followed by high school pass 33.1 per cent. However, more women were illiterates (9.1%) as compared to men (1.3%).

More than half of the respondents belonged to nuclear families (54.8 %). All the respondents, except 2.6 per cent, were working in the government sector. And 20 per cent of the respondents' wives were working in government and private sectors. The average salary of the respondents was Rs.4000/- per month.

Of the 155 men interviewed, 72.4 per cent had one or two children and the remaining (27.6%) per cent of samples had three or four children.

TABLE 1

SOCIO-ECONOMIC PROFILE (N=155)

Age Group (in years)	**Husbands (%)**	**Wives (%)**
20-24	10.3	35.5
25-29	22.5	43.9
30-34	50.3	18.1
35-39	14.8	2.5
40 & above	1.9	-
Educational Status		
Illiterate	1.3	9.1
Primary School	4.5	11.0
Middle School	7.7	10.4
High School	36.7	33.1
Graduate & above	49.7	36.4
Employment Status		
Government	97.4	14.5
Private	2.6	5.9
Others (House wives)	-	79.6
Monthly Income*	**%**	
Less than Rs 3000	32.3	
Rs 3001-5000	34.2	
Rs 5001-8000	21.9	
Rs 8001-10000	9.0	
Rs 10000+	2.6	
Type of Family*		
Joint	44.5	
Nuclear	54.8	
Number of Children*		
One	30.8	
Two	41.6	
Three	21.8	
Four +	5.8	

Median age – men-31 years, wives-26 years
Average income – Rs 4000/-
***Combined**

Knowledge of Men on Reproduction and Birth Control

From Table 2 it is clear that about 76.5 per cent of the men had the correct knowledge of conception. However, nearly 40 per cent could not say what determines the sex of the child. 49 per cent of men had correct knowledge of safe period in menstrual cycle in relation to conception.

TABLE 2
LEVEL OF KNOWLEDGE OF MEN ON REPRODUCTION

Knowledge	Per cent (N=155)
Process of conception	76.5
Determinant of sex of baby	59.6
Safe period for intercourse	49.1

Knowledge of Men about Contraceptives

Correct knowledge of contraceptives among the men is a basic prerequisite for its effective use. Data presented in Table 4 reveal that condom was found to be the most widely used method (53.8%). However, only 39.8 per cent of them had the correct knowledge of using it (Table 3). Though emergency contraceptives help to prevent abortion and unwanted birth, it was known to only 16.7 per cent of the men. Table 3 further reveals that female sterilization was most popular (62.2%) followed by vasectomy (53.2%) and oral pills (49 %) among the men. However, the knowledge of men about Copper T as a protective measure from pregnancy was also high (61.5%) but its side effect was known to 41 per cent only. Unfortunately, the knowledge of men about NSV is comparatively poor (28.2%).

TABLE 3
CORRECT KNOWLEDGE OF MEN ABOUT CONTRACEPTIVES

Contraceptive Methods	**Percentage**	
	Men with 3 and more children	All Men (N=155)
Natural	27.5	39.1
Condom	37.4	39.8
Copper T	57.5	61.5
Periodicity of use of Cu T	50.0	44.2
Side effect of Cu T	40.5	41.0
Oral Pills	48.9	49.0
Emergency contraceptive	11.9	16.7
Vasectomy	47.6	53.2
Female Sterilisation	63.3	62.2
NSV	19.0	28.2

Use of Contraceptives

Condom was the most popular method (53.8%) among the men followed by natural method (22%). The failure rate of both methods is also high, 21 per cent and 22.6 per cent respectively (Table 4). Use of copper T and oral pills seems to go up with the number of childbirths. 30.9 per cent of men with 3 or more children in comparison to 7.9 per cent of men with at most 2 children responded that their wives had used copper T. Similarly, 16.6 per cent of men with 3 or more children in comparison to 7 per cent of men with at most 2 children said that their wives had ever used oral pills. In case of oral pills, reported failure rate was 13.3 per cent which was mainly due to its irregular intake by the women.

TABLE 4

FAMILY PLANNING METHODS EVER USED BY COUPLES

Methods	**Percentage of Men using Contraceptives**			
	Men having at most 2 children	Men having 3 and more children	Total N=155	Reported failure rate
Natural	23.8	19.0	22.0	22.6
Condom	53.9	54.7	53.8	21
Copper T	7.9	30.9	14.1	4.5
Oral Pills	7.0	16.6	9.6	13.3

Reasons for having Three or More Children

Though men have a fair knowledge about various contraceptive methods, many of them opt for more than two children. Strong son preferences and failure of contraceptives were the major factors responsible for having 3 or more children- quoted by 28.5 per cent and 31.9 per cent of the respondents respectively (Table 5). However, the men preferred three or more children for reasons such as (i) old-age support (15 %), (ii) survival of the children (7,8%), (iii) desire for a big family (7%), (iv) to have a female child (5%) and pressure of in-laws (4.8%).

TABLE 5

REASONS FOR HAVING THREE OR MORE CHILDREN (%)

Desire for a male child	28.5
Failure of contraceptive method used or Conceived during lactational amemorroea	31.9
For old age support	15.0
To have a female child	5.0
To ensure enough children survived	7.8
Desire for a big family	7.0
Pressure of in-laws	4.8

Desire for Adoption of Family Planning Methods

In response to a specific question- Do you intend to use any FP method now?, 129 out of 155 respondents (83.1%) opined 'yes' and also specified a method desired by them while 11.7 per cent said 'no' and 5.2 per cent could not respond (Table 6). Attempt was also made to study the intention to use the contraceptive methods by the men after first, second and third childbirth. It is clear from the Table 6 that 73.2 per cent wanted to use some modern methods of spacing after their first child birth (Condom-42.4%, Copper T 21.2% and Oral Pills 9.6%).

53.4 per cent of the men preferred to use some modern spacing methods after second child birth (Copper T 26.7%, Condom 25% and Oral Pills 1.7%). However, 28.3 per cent preferred methods like Abdominal Sterilisation, Vasectomy and Lap Sterilisation after their second child birth (Table 6). 53.5 per cent of the men preferred Abdominal Sterilisation for stopping the childbirth after having three or more children. It means, the men who had three or more children, did not want to take risk in using any of the modern spacing methods.

TABLE 6

INTENTION OF MEN TO USE CONTRACEPTIVE AFTER BIRTH OF A CHILD

Method	Percentage of men intending to use the methods			
	After 1st child	After 2nd child	After 3 and more	Total men
Natural	3.8	3.3	2.3	3.2
Condom	42.4	25.0	18.7	29.0
Copper T	21.2	26.7	4.6	18.7
Oral Pills	9.6	1.7	2.3	4.5
Lap sterilization	0.0	5.0	0.0	1.9
Abdominal Sterilization	0.0	18.3	53.5	21.9
Vasectomy	1.9	5.0	4.6	3.9
None	15.3	10.0	9.3	11.7
Not decided yet	5.8	5.0	4.6	5.2
Total	100	100	100	100
N= 155	52	60	43	N= 155

Intended Size of Family

Answering to a specific question, Do you think it is essential to have a male child?, 48 per cent of the respondents said that a male child is compulsory to complete the family. Among them, one fourth of them said that they would like to try two times at least and the remaining would try 3 to 4 times to get a male child. While answering the ideal gap between the children, nearly half of the respondents felt that at least there should be a gap of three to four years between one child and the next.

The actual and desired number of children of the respondents are given in Table 7. 86.7per cent of men with one child wanted two children. The actual number of children and the number of children desired by 83.3 per cent of the men remained the same. It indicates that they have adequate knowledge about different contraceptive methods to limit the family size. It can also be seen from Table 7 that 44 per cent of the men also actually wanted to have three children which they had. Further it can be concluded that 38.7 per cent of men preferred two children followed by one child by 34.2 per cent. However, 28.5 per cent of the men preferred to have three or more children.

To a question asked on 'Who is the decision maker in deciding on family size?', 46 per cent of the respondents stated that they took the decision in consultation with their spouses and 36.5 per cent of the men took decisions on their own.

TABLE 7
ACTUAL VS. DESIRED NUMBER OF CHILDREN (%)

Actual	One child	Two	Three	Four+	Total
One	9.4	86.7	3.7	0	34.2
Two	0	83.3	16.6	0	38.7
Three	2.9	50.0	44.1	3.0	23.2
Four+	0	50.0	12.5	37.5	5.3
Total	3.8	75.5	18.1	2.6	100

DISCUSSION

An attempt has been made in this study to understand the level of knowledge, attitude and practice of FP methods among the men who are the beneficiaries of the Central Government Health Scheme (CGHS), residing in an urban area. Nearly one-third of all births is undesired or unplanned, the study revealed. The probable reason could be that the failure of contraceptives or the men are not having enough knowledge about the use of contraceptives. Strong son preference compels at least one-third of parents to go in for three or more number of children. This is due to traditional customs and beliefs of the men, though they are educated as compared to the respondents studied by an author in Uttar Pradesh[11]. Level of knowledge of various family planning methods, particularly the no-scalpel vasectomy is poor among the men. This indicates that men take a little interest in knowing about various contraceptive methods. Even, the men are not interested in vasectomy method also. This reflects a feeling that involvement of men in family planning programme is limited. The adoption of family planning methods among the men is low. This further supports the view that their involvement in family planning programme is limited. In half of the families, the husband is the sole decision maker regarding the number of children under the study. This is nothing unusual. Our country being a male dominated one, the women particularly the less educated ones do not take part in the

decision making process in general. In order to make the family planning programme a success, a systematic effort may be made by the government to educate both men and women to understand their responsibilities in every matter, including childbirth.

POLICY IMPLICATIONS

i. Since nearly one-third of the births is accidental, educating men in proper use of contraceptives would reduce birth rate.

ii. A significant number of men still need to be motivated to adopt permanent methods of family planning after achieving the desired family size.

iii. There is a real need to provide precise knowledge on vasectomy (which seems to be lacking a lot among the men) and dispel misconceptions about it.

iv. Counselling services may be provided to men to enhance their knowledge and bring about attitudinal change for better utilization of family welfare services.

CONCLUSION

The study reveals that (i) Nearly one-third of all births is either undesired or unplanned, the major reason being the failure of contraceptive methods or accidental conception during lactation period; (ii) Strong preference for sons compels at least one-third of parents to go in for three or more number of children; (iii) Level of knowledge of various family planning methods like emergency contraceptives and no scalpel vasectomy is low among the respondents; (iv) Desire to get vasectomy done is low among men; (v) Even after having three or more living children, only half of the men have any intention to adopt a permanent family planning method immediately or in future; and (vi) In half of the families the husband is the sole decision-maker regarding the number of children.

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CHANGING KNOWLEDGE, ATTITUDE AND PRACTICE OF FAMILY PLANNING METHODS IN AN ECONOMY UNDER TRANSITION

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ABSTRACT

In this paper, an attempt has been made to present the data on knowledge, attitude and practice of family planning methods in Mongolia, using the data from the Second Demographic Survey, conducted by the Population Teaching and Research Centre (PTRC), Mongolia. Wherever possible a comparison with the data of the first Demographic Survey, 1994 has also been attempted in this paper. The analysis reveals that the level of current contraceptive use in Mongolia even after eight years of its transition to market economy is low. Further, almost no change has been observed in the use of modern contraceptives in Mongolia during 1994-96. However, there has been a significant increase in the knowledge of the women about the use of modern contraceptive methods. 60 per cent of the women in the age group of 15-49 years expressed their desire to use any contraceptive method in the future, the analysis revealed.

Key-words: Knowledge, Attitude, Practice, Contraceptive use.

Mongolia with great geographical diversity is situated in the heart of the Asian continent. Mongolia is divided into 21 aimaks (provinces) and three big cities with Ulaanbaatar as the Capital. It has a geographical area of 1.57 million square kms. and 2.4 million people. Mongolia was having extremely low population growth rate during the first five decades of the present century but during 1970s and 1980s it experienced high growth rate. Like many other ex-communist countries, Mongolia also started it's transition to market economy from centrally planned economy since 1989. Because of the troubles experienced during the transition period, the perceptions of the Mongolian people about the desired family size, use of contraceptive methods, overall reproductive intentions, etc. changed significantly. Before 1989, the use of family planning methods was very low in Mongolia. However after 1989 the use of modern contraceptive methods increased resulting in the reduction of the fertility in the country.

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In the study of demographic trends in any country, particularly those with high population growth rate, the levels of knowledge about family planning and use of the family planning methods remain very important demographic issues. A positive attitude towards family planning is one of the basic prerequisites for contraceptive use in the society. The information on the use of various methods of contraception is of particular importance to policy makers, programme managers and researchers for formulating future programme strategies.

In Mongolia, there has been no regular system of collection of data on the contraceptive prevalence rate. To fill this gap, the Population Teaching and Research centre (PTRC) conducted the first ever Demographic Survey in Mongolia during October-November, 1994 to provide information on the trends and levels of fertility, mortality, use of contraceptive methods, etc. To know the changes taking place in the country after 1994, the PTRC again conducted the Second Demographic Survey in Mongolia during June-July, 1996. In this survey detailed information was collected on different aspects of the use of contraceptive methods such as women's knowledge of modern and traditional contraceptive methods as well as their sources, attitude of the husband/partner regarding the use of family planning, the level of contraceptive use and the timing of contraceptive initiation, failure rate of contraceptive methods, etc. Most of the information was also collected according to various background characteristics to understand the differentials in the knowledge, attitude and practice of family planning methods.

An attempt has been made in this paper to present the data on knowledge, attitude and practice of the family planning methods in Mongolia using the data from the Second Demographic Survey conducted by the PTRC in 1996. Wherever possible a comparison with the data of the first Demographic Survey, 1994 has been also attempted.

Sources of Data

Data used in this paper pertain to the second large scale Demographic Survey in Mongolia conducted by the PTRC during June-July 1996. The survey covered 1600 households spread over six provinces and the capital city of Ulaanbaatar. A multi-stage stratified random sampling method was adopted to collect data from different households. All the women in the age group of 15-49 years were included in the survey for collecting information on the family planning and other demographic characteristics. Stratification was done by residence, i.e. remote rural, som (district) centres, aimak centres and Ulaanbaatar. In all, about 1810 eligible women were interviewed in the survey.

FINDINGS

Knowledge of Family Planning Methods and Sources

To know the extent of knowledge about various contraceptive methods, the women respondents were asked whether they had ever heard of any contraceptive method which a couple can use to delay or avoid pregnancy. The interviewers enumerated various contraceptive methods one by one and asked the respondents to state whether they knew any of the methods. In case, the women could not understand the method, a short description of the method was also given by the interviewers and then women were asked whether they knew the method.

Table 1 presents the relevant results. The maximum number of the women (88.2%) knew about the IUD and 81per cent knew about rhythm method. Among the other modern contraceptive methods, about 70 per cent of the women knew about pill and 76 per cent about condom. The knowledge of other modern contraceptive methods such as injection, diaphragm/foam/jelly (D/F/J), male and female sterilization was comparatively low. Only about 2.5 per cent of the women had knowledge about norplant. Among the traditional methods, washing and withdrawal were known to 54.2 per cent and 31.9 per cent of women respectively.

The knowledge of all the contraceptive methods was uniformly low in the age group of 15-19 years as compared to other age groups. The concerned authorities in Mongolia may have to make serious attempts to provide information to the women who are in the age group of 15-19 years to avoid the bad consequences of adolescent sex.

With regard to the place of residence, the knowledge of the respondents about various contraceptive methods, except IUD, was the lowest in remote rural areas and the highest in Ulaanbaatar. This may be due to less access of women to the media sources and the literature about the contraceptive methods in remote rural areas as compared to Ulaanbaatar.

A significant variation in the knowledge of women about contraceptive method was found according to their educational level. The knowledge of women educated upto grade 8. However, the contraceptive knowledge of employed women was found to be higher as compared to unemployed women. The knowledge of women about all the modern contraceptive methods has increased in the year 1996 as compared to 1994 survey. Substantial increase was observed for the methods like pill, injections, D/F/J and male and female sterilizations. A slight decrease was observed in the traditional methods of washing and withdrawal.

TABLE 1

PERCENTAGE AND NUMBER OF WOMEN AGED 15-49 YEARS WHO HAVE EVER HEARD OF MODERN OR TRADITIONAL CONTRACEPTIVES, BY BACKGROUND CHARACTERISTICS, MONGOLIA, 1996

	Modern Methods								Traditional		
Background Characteristics	Pill	IUD	Injection	D/F/J	Condom	Ster. (F)	Ster. (M)	Nor-plant	Rhythm	Withdrawl	Washing
Age											
15-19	40.9	62.5	25.6	7.8	61.6	16.3	2.9	0.2	55.5	6.3	18.5
20-24	73.1	91.8	56.3	23.6	80.8	37.9	13.5	2.2	84.3	31.9	53.6
25-29	82.4	97.6	65.1	38.3	85.4	50.2	23.4	4.1	90.2	42.4	67.8
30-34	79.7	98.9	66.3	41.7	79	54	23.6	3.6	88.8	49.3	73.2
35-39	81.5	97.2	65.3	44	83.3	58.3	20.8	2.3	90.7	42.1	68.5
40-44	82	98.2	63.5	49.1	80.8	50.9	20.4	3.6	92.2	34.7	67.7
45-49	72.8	87.7	50.6	43.2	63	53.1	17.3	4.9	84	30.9	58
Residence											
Remote Rural	53	82.4	34.2	15.4	52	25.7	6.1	0.6	67	15	32.4
Som Centre	73.2	88.7	51.1	30.4	79.5	46	18	1.4	82.4	30.4	55.9
Aimag Centre	74.8	90.1	68	35.4	86.2	46	20.1	1.5	86.4	37.8	61.5
Ulaanbaatar	83.9	93.7	68.9	48.1	94.5	52.7	21.6	8.4	91.6	51.3	73.8
Education											
None	33.3	85.7	38.1	14.3	47.6	28.6	0	0	61.9	19.1	28.6
Grade 1-3	41.2	68.2	29.4	7.1	34.1	18.8	3.5	1.2	42.4	5.9	27.1
Grade 4-8	52.9	76.4	36.3	14.6	60	27.3	6.8	0.2	67.6	12.2	31.9
Grade 9-10	73.7	91.6	56.6	27	84.9	38.2	11	2.2	86.6	29.4	56.2
Professional	74.7	96.7	48.9	32.4	76.4	43.4	17	1.1	85.7	32.4	56
College	90.2	98.6	78.6	52.5	94.2	65.2	34.1	4.4	95.3	56.5	79.7
Higher	96.4	100	80.6	73.3	98.2	73.9	38.8	10.9	99.4	78.2	93.9
Head of households											
Male	70.7	88.9	54.8	31.1	77.5	42.6	16.3	2.4	81.7	32.5	55
Female	65.6	82.8	45.9	28.7	67.9	35.4	12.9	3.8	74.6	26.8	47.9
Working Status											
Employed	73.5	91.9	57	36.5	74.1	45.6	19.2	2.8	83.3	38.2	59.1
Unemployed	66.7	84.6	50.4	25.1	78.8	37.9	12.6	2.3	78.4	25.4	49.2
Total 96	70.1	88.2	53.8	30.8	76.4	41.8	15.9	2.5	80.9	31.9	54.2
Total 94	59.3	90.9	31	25.4	75.9	---	---	0	77.6	43.4	61.6

Approval/Disapproval of Family Planning by Husband/Partner

In the survey, all the women either currently married or living together were asked: 'Do you think that your husband/partner approves or disapproves of couples using a method to avoid pregnancy?'. The relevant data of the survey are presented in Table 2. In all about 81per cent of the husbands/partners approved the use of family planning methods whereas about 12 per cent disapproved it's use for controlling pregnancy. About 6.7 per cent of the women did not know about the attitude of their husbands/partners. The percentage of the women reporting disapproval of family planning by their husbands/partners was the highest (42.9%) in the age group of 15-19 years followed by remote rural areas (18%), women with either no education (22.2%) and lower level of education, i.e., upto grade 8 (about 16.7%). The disapproval of family planning

was the lowest in Ulaanbaatar and the husbands/partners of women educated upto college and higher. These differences may be mainly due to access to sources of information and attitudinal change due to higher education. The higher education also brings with it the better career prospects which requires spending more time at the place of work than in the house which forces them to have limited number of children for which the use of family planning is necessary.

For the successful implementation of family planning programme, about 12 per cent of the people who opposed the use of family planning methods may have to be convinced about the necessity of using family planning methods. Because, about 40 per cent of the births in Mongolia in the recent past were associated with less than two years of birth intervals which has high risk of infant and maternal mortality.

It is also clear from Table 2 that there has been almost no change in the percentage of husbands/partners opposing the family planning between the two surveys, 1994 and 1996. However, the percentage of women reporting that they don't know about the attitude of the husbands/partners has reduced by half and the percentage of husband/partner approving the use of family planning has increased proportionately.

TABLE 2

PERCENTAGE DISTRIBUTION OF WOMEN MARRIED OR LIVING TOGETHER BY THE PERCEPTION OF THEIR HUSBAND/PARTNER'S ATTITUDE TOWARDS FAMILY PLANING BY RESIDENCE AND EDUCATION, MONGOLIA, 1996

	Perception of husband's/partner's attitude				
Character	Approves	Disapproves	Don't know	Total	No. of Women
Age					
15-19	50	42.9	7.1	100	14
20-24	80.8	13.8	5.4	100	167
25-29	81.8	11.6	6.6	100	242
30-34	85.3	11.6	3	100	232
35-39	79.8	10.6	9.6	100	188
40-44	81.3	10.8	7.9	100	139
45-49	71.9	15.6	12.5	100	64
Residence					
Remote Rural	72.5	18	9.5	100	294
Som Centre	82.4	10.1	7.4	100	336
Aimag Centre	85.5	10.5	4.1	100	220
Ulaanbaatar	86.2	9.7	4.1	100	196
Education					
None	77.8	22.2	0	100	9
Grade 1-3	61	24.4	14.6	100	41
Grade 4-8	71.2	16.7	12	100	233
Grade 9-10	83	11.6	5.4	100	259
Professional	79.7	14	6.3	100	143
College	86.7	8.9	4.4	100	226
Higher	91.9	5.9	2.2	100	135
Total 96	81	12.3	6.7	100	1046
Total 94	75.2	12.5	12.3	100	1231

Ever Use of Contraceptive Methods

The use of contraceptive methods is one of the most important proximate determinants of fertility. The fertility level decreases in proportion to the use of efficient contraceptive methods. To know the extent of the use of contraceptive in Mongolia, two surveys were conducted by PTRC, one in 1994 and another in 1996, since there is no other source of information available in Mongolia to give an idea about the issue.

In the survey, all the eligible women who knew at least one method were asked whether they had ever used the known method. This was further probed by asking whether they "ever used anything or tried in any way to delay or avoid pregnancy". Table 3 reflects the percentage distribution of women who have ever used any contraceptive methods by their current age. This table shows that about 54.8 per cent of the women had used a contraceptive method in the past. The ever use of modern and traditional methods was 42.7 per cent and 39.6 per cent respectively. It may be clarified here that some women might have used more than one method in the past. Therefore, the total of the percentages of modern and traditional methods may not add to the total ever use. Among the modern method, IUD was the most preferred method (32.9%) followed by condom (13.2%) and pill (8%). The use of other modern contraceptives such as injections, norplant, male and female sterilisation was almost insignificant, 1 per cent or even less. Among the traditional methods, maximum percentage (32.5) of women used periodic abstinence followed by washing (18.4%) and withdrawal (5.8%) (Table 3).

With regard to the age distribution of ever users, the use of both modern and traditional contraceptives in the age-group of 15-19 years was less than 5 per cent. Women in this age group generally preferred periodic abstinence (2.7%) followed by IUD (1.7%). The lower use in this age group may be attributed to some extent the less knowledge about contraceptive methods as seen in Table 1. The ever use of modern contraceptives was the highest (72.5%) in the age group of 30-34 years but for traditional it was 62 per cent in the age-group of 35-39 years.

Current Use of Contraceptive Methods

While asking the question regarding the current use of contraceptive methods, women were asked to specify only one method. In case they were using one modern method and one traditional method together, interviewer recorded only modern method. As may be seen from Table 4, about 36.2 per cent of the women were using some contraceptive methods at the time of the survey. The share of modern and traditional contraceptives were 26 per cent and 10 per cent respectively. As in the case of ever user, IUD among the modern contraceptives and periodic abstinence among traditional contraceptives were the most commonly preferred contraceptives.

TABLE 3

PERCENTAGE DISTRIBUTION OF WOMEN WHO HAVE EVER USED ANY CONTRACEPTIVE METHODS ACCORDING TO AGE, MONGOLIA, 1996

Contraceptive Methods	Age (years) 15-19	20-24	25-29	30-34	35-39	40-44	45-49	Total	No .of women
Any method	4.4	42.6	73.2	82.6	82.9	81.4	72.8	54.8	991
Any modern method	2.2	26.7	56.3	72.5	69.9	65.3	50.6	42.7	773
Pill	0.2	5.5	10.9	13.8	13.9	14.4	4.9	8.2	149
IUD	1.7	15.7	40.3	57.6	58.8	54.5	44.4	32.9	596
Injections	0.2	0.8	2.7	0.7	1.9	0.6	0	1.1	19
Norplant	0	0.6	0.3	0.7	0.5	0.0	0	0.3	6
Diaphragm/foam/jelly	0	0.8	2	5.1	3.7	4.2	1.2	2.2	39
Condom	0.7	9.9	19.0	22.5	19.9	17.4	11.1	13.2	238
Female sterilisation	0	0	0	1.1	0.9	2.4	1.2	0.6	10
Male sterilisation	0	0	0	0	0	0.6	0	0.1	1
Any traditional method	3.7	31.9	54.2	55.1	62	59.3	50.6	39.6	717
Rythm/Periodic Abstinence	2.7	24.5	44.8	43.8	51.4	50.3	49.4	32.5	588
Withdrawal	0.5	7.4	10.2	6.2	7.9	5.4	2.5	5.8	104
Washing	0.7	12.9	23.1	29.7	30.1	32.3	17.3	18.4	333
Not ever used	95.6	57.4	26.8	17.4	17.1	18.6	27.2	45.3	819
No. of women	411	364	295	276	216	167	81	----	1810

A substantial decline was observed in the use of traditional contraceptives from 35.7 per cent in 1994 to 10.2 per cent in 1996 (Table 4). A small rise of about 1 per cent was observed in the use of modern contraceptives (25 to 26%). The main reasons for the decline in the traditional method may be the canvassing of the questionnaire more vigourously where the use of traditional method was probed further. Another reason may be that in 1994 the respondents might have got some information about the traditional method and were using but due to high failure rate of these methods along with information about other modern contraceptive methods might have prompted them to stop the use of traditional methods. For example, a substantial decline in the washing method from 16.5 per cent to 1.5 per cent may be attributed to the increased knowledge of the women respondents about the ineffectiveness of this method for preventing pregnancies.

If only currently married women, which includes those living together, are considered, the contraceptive prevalence rate becomes 57.3 per cent as compared to 36.2 per cent for all women. The prevalence rate for modern and traditional contraceptives increases from 26 per cent to 41.2 per cent and 10.2 per cent to 16.1 per cent respectively. Among the currently married women, the use of IUD and periodic abstinence was 33.1 per cent and 13.1 per cent respectively (Table 4).

TABLE 4

PERCENTAGE DISTRIBUTION OF WOMEN WHO WERE CURRENTLY USING ANY CONTRACEPTIVE METHOD ACCORDING TO AGE AND MARITAL STATUS, MONGOLIA, 1996

Contraceptive Methods	Age 15-19	20-24	25-29	30-34	35-39	40-44	45-49	No. of Women	Total % 1996	1994
All WOMEN										
Any method	2.4	25.5	48.8	65.2	61.1	47.3	23.4	657	36.2	60.7
Any modern method	1.9	17	33.9	48.5	46.8	33.5	12.3	471	26	25
Pill	0.2	1.1	2.7	2.2	3.2	1.8	0	29	1.6	0.9
IUD	1.7	13.2	25.4	40.6	38.9	26.9	9.9	379	20.9	19.4
Injections	0	0.8	2	0.7	1.4	0	0	14	0.8	0
Norplant	0	0.3	0	0.4	0.5	0	0	3	0.2	0
Condom	0	1.7	3.7	4	1.9	2.4	1.2	37	2	3.5
Female sterilisation	0	0	0.0	0.7	0.9	2.4	1.2	9	0.5	0.6
Any traditional method	0.5	8.5	14.9	16.7	14.3	13.8	11.1	186	10.2	35.7
Rythm/periodic Abstinence	0.5	6.9	12.2	14.1	11.6	9.6	11.1	152	8.4	17.4
Withdrawal	0	0.5	0.3	0.4	0.5	0.6	0	6	0.3	1.9
Washing	0	1.1	2.4	2.2	2.3	3.6	0	28	1.5	16.5
No.of women	10	93	144	180	132	79	19	657	1810	2017
CURRENTLY MARRIED WOMEN										
Any method		42.9	45.5	54.1	72.4	67	52.5	29.7	599	57.3
Any modern method		42.9	30.5	37.6	54.3	51	36.7	15.6	431	41.2
Pill		0	2.4	3.3	2.2	3.7	1.4	0	26	2.5
IUD		42.9	22.8	28.1	45.7	42	29.5	12.5	346	33.1
Injections		0	1.2	2.1	0.9	1.6	0	0.0	12	1.15
Norplant		0	0.6	0	0.4	0.5	0	0.0	3	0.3
Condom		0	3.6	4.1	4.3	2.1	2.9	1.6	35	3.4
Female sterilisation		0	0	0	0.9	1.1	2.9	1.6	9	0.9
Any traditional method		0	15	16.5	18.1	16	15.8	14.1	168	16.1
Rythm/periodic Abstinence		0	12.6	13.2	15.5	12.8	10.8	14.1	137	13.1
Withdrawal		0	1.2	0.4	0.4	0.5	0.7	0	6	0.6
Washing		0	1.2	2.9	2.2	2.7	4.3	0	25	2.4
No. of women		6	76	131	168	126	73	19	599	1046

*Relevant data are not available in 1994 survey

Socio-Economic Differentials in the Current Use of Contraceptives

Table 5 and 6 present the socio-economic differentials in the current use of modern and traditional contraceptives. The use of modern method was the highest in som centres (31.5%) followed by aimag centres (30%) and Ulaanbaatar (21.6%) (Table 5). However, the use of traditional methods was the highest in Ulaanbaatar (16.1%) and the lowest in remote rural areas (5.8%) (Table 6). Almost a similar trend was observed in DSM, 1994 also. The use of IUD has slightly increased in som and aimag centres and marginally decreased in Ulaanbaatar as compared to 1994.

Another major difference in the level of use of both modern and traditional contraceptive was found according to the educational level of the mothers. The use of both modern and traditional contraceptives was almost double for the women with educational level of professional and above as compared to those with less than 10th grade of education. Among the less educated women, the IUD was more popular modern contraceptive and in case of women with higher education, other contraceptives such as pill, condom, etc. were popular modern contraceptives in addition to IUD. The use of traditional method was found to be very low (about 3%) for women up to 8th grade

TABLE 5

PERCENTAGE DISTRIBUTION OF WOMEN WHO ARE CURRENTLY USING MODERN CONTRACEPTIVE METHODS ACCORDING TO BACKGROUND CHARACTERISTICS, MONGOLIA, 1996

Background characteristics	Any modern method	Pill	IUD	Injection	Norplant	Condom	Ster(F)	No. of women
Residence								
Remote Rural	23.7	0.8	21.5	0.6	0	0.4	0.4	117
Som Centre	31.5	1.8	26.8	0.4	0.2	1.9	0.4	175
Aimag Centre	30	2	23	1.4	0	2.9	0.6	104
Ulaanbaatar	21.6	2.3	12.6	1.2	0.6	4	0.9	75
Education								
None	19	0	19	0	0	0	0	4
Grade 1-3	27.1	1.2	23.5	0	0	2.4	0	23
Grade 4-8	20.1	0.7	18.4	0.7	0	0.2	0	109
Grade 9-10	20.1	1.5	15	0.9	0.2	1.9	0.6	108
Professional	34.6	2.2	30.2	0	0	1.1	1.1	63
College	39.1	2.9	29	1.1	0	4.7	1.5	108
Higher	33.9	2.4	23.6	1.2	1.2	5.5	0	56
Head of households								
Male	28	1.7	22.7	0.8	0.1	2.2	0.5	448
Female	11	1	7.6	0.5	0.5	1	0.5	23
Working Status								
Employed	32.6	1.9	26.5	0.8	0.2	2.4	0.8	297
Unemployed	19.3	1.3	15.2	0.8	0.1	1.7	0.2	174
Total	26	1.6	20.9	0.8	0.2	2	0.5	471

education as compared to about (27%) for women with higher education (Table 6). The use of both modern and traditional contraceptives has decreased in Ulaanbaatar in 1996 as compared to DSM, 1994, the decrease being substantial from 47.9 per cent to 16.1 per cent in traditional methods.

The level of use of both modern and traditional contraceptives was also found to be more among the women in male-headed household and those employed. The employed women had less time for taking care of the children as such they may be using contraceptives to limit their total fertility.

TABLE 6

PERCENTAGE DISTRIBUTION OF WOMEN BY TRADITIONAL CONTRACEPTIVE METHODS CURRENTLY BEING USED ACCORDING TO BACKGROUND CHARACTERISTICS, MONGOLIA, 1996

Background characteristics	Any tradit. methods	Rhythm	Withdrawal	Washing	No.of women
Residence					
Remote Rural	5.8	5.4	0.2	0.2	29
Som Centre	9.7	8.6	0.4	0.7	54
Aimag Centre	11.4	8.7	0.2	2.5	47
Ulaanbaatar	16.1	11.8	0.6	3.7	56
Education					
None	4.8	4.8	0	0	1
Grade 1-3	2.4	2.4	0	0	2
Grade 4-8	3.3	2.5	0.4	0.4	18
Grade 9-10	9	6.9	0	2.1	48
Professional	11.5	9.9	0	1.6	21
College	18.5	16	0.7	1.8	51
Higher	27.3	21.8	1.2	4.3	45
Head of households					
Male	10.9	8.8	0.4	1.7	175
Female	5.3	4.8	0	0.5	11
Employed	12.9	10.5	0.4	2	117
Unemployed	7.7	6.4	0.2	1.1	69
Total	10.3	8.4	0.3	1.6	186

Source of Supply of Modern Contraceptive Methods

In order to evaluate the relative importance of various types of family planning service delivery system, all the current users of modern contraceptives were asked the source of supply of their contraceptive method. For the purpose of the survey, the sources of supply were defined as the place from where they can get the contraceptive method. For example, the women can purchase the IUD from a shop and then go to a doctor to get it inserted. In this case, the

source of supply was taken as the shop. Overall, government hospital and medical and family planning centre (MFP) supplied about 82 per cent of all the modern contraceptives. Only one percent got contraceptives from private hospitals and this was only for pill and IUD (Table 7).

TABLE 7
PERCENTAGE DISTRIBUTION OF CURRENT USERS OF MODERN CONTRACEPTIVE METHODS BY THE SOURCE OF SUPPLY OF CONTRACEPTIVES, MONGOLIA, 1996

	Modern Contraceptives							
Source of Supply	Pill	IUD	Injections	Condom	Ster(F)	Norplant	Total	No.of women
Govt.Hosp/MFP	55.2	87.3	100	32.4	100	100	81.7	385
Private Hos	6.9	0.8	0	0	0	0	1.1	5
Pharmacy	34.5	10	0	59.5	0	0	14.9	70
Shop	0	1.1	0	5.4	0	0	1.3	6
Abroad	3.4	0.3	0	0	0	0	0.4	2
NA	0	0.5	0	2.7	0	0	0.6	3
Total	100	100	100	100	100	100	100	---
No.of women	29	379	14	37	9	3	---	471

Prospective Users and Non-Users of Contraception

To know the intentions of the respondents about the future use of family planning methods, all the women respondents were asked a question whether they intend to use any method of family planning in future. The women who replied 'yes' were further probed to find out their preferred contraceptive method. While for 'no', the reason for not using the method was asked. Each woman was asked to mention only one most important reason for not using the contraceptive in future. As per this survey, about 60 per cent of the women respondents (1086) expressed their intentions to use and remaining 40 per cent (724) did not intend to use any method in future.

Reasons for Not Using Contraception in Future

As may be seen from Table 8, about 46 per cent of the women who expressed the desire not to use the family planning method were not sure about the reasons for their intention. About 17.6 per cent of the women felt that it would be difficult for them to get pregnant because they are close to the end of reproductive period. For about 8.6 per cent of the women, their fatalistic attitude towards the children was responsible for their expressed intention. About 7.5 per cent of the women did not want to use the contraception because they wanted children. About 5 per cent also enumerated the lack of knowledge about contraceptives as the main reason for not using contraception. It is interesting to

note that only four out of 722 women stated that either they themselves or their partners opposed the use of family planning methods.

TABLE 8

PERCENTAGE DISTRIBUTION OF WOMEN WHO DO NOT INTEND TO USE CONTRACEPTIVES IN FUTURE BY THE MAIN REASONS ACCORDING TO AGE, MONGOLIA, 1996

	Age (years)								
Main reasons	15-19	20-24	25-29	30-34	35-39	40-44	45-49	Total %	No. of women
Wants children	1.9	35.2	38.9	14.8	7.4	1.9	0	7.5	54
Lack of knowledge	16.2	21.6	10.8	21.6	18.9	8.1	2.7	5.1	37
Partner opposed	0	0	0	100	0	0	0	0.3	2
Side effects	28.6	7.1	14.3	28.6	7.1	14.3	0	3.9	28
Health corncerns	8	0	8	16	32	32	4	3.5	25
Hard to get methods	0	12.5	12.5	62.5	12.5	0	0	1.1	8
Difficult to get pregnant	0.8	2.4	0	0.8	7.1	43.3	45.7	17.6	127
Oppose to family planning	50	0	0	0	50	0	0	0.3	2
Fatalistic	11.3	11.3	19.4	17.7	22.6	12.9	4.8	8.6	62
Infrequent sex	2.6	0	7.9	21.1	34.2	23.7	10.5	5.3	38
Inconvenient	16.7	0	33.3	16.7	33.3	0	0	0.8	6
Undecided	72.1	21.3	1.8	1.5	1.8	1.5	0	46.1	333
Total	37.1	15.4	7.6	8.5	9.3	12.9	9.3	100	722

Maximum percentage of women who expressed their intention of not using the contraceptive in future were in the age group of 15-19 years (37.1%). This may be due to the fact that more than 90 per cent of these women are not married and as such their response may not be even realistic also. About 15 per cent of the women in the age group of 20-24 years and 13 per cent in the age group of 40-44 years also did not intend to use the contraceptives in future. The percentage of women who are still undecided was the highest (72.1%) in the age group of 15-19 years (Table 8).

Table 9 presents the distribution of women who did not intend to use any contraception in future by various background characteristics. This percentage was the highest (30.8) in som centres followed by remote rural areas (27.9%). The percentage was substantially low 16 per cent in Ulaanbaatar. In the male-headed households, about 85 per cent of the women do not want to use any contraceptive as compared to only 16 per cent in female-headed households.

TABLE 9

PERCENTAGE DISTRIBUTION OF WOMEN WHO DO NOT INTEND TO USE CONTRACEPTIVES IN FUTURE ACCORDING TO DIFFERENT BACKGROUND CHARACTERISTICS, MONGOLIA, 1996

Background characteristics	Age (years) 15-19	20-24	25-29	30-34	35-39	40-44	45- 49	Total	No. of Women
Residence									
Remote Rural	35.6	20.8	9.4	5.5	7.9	11.4	9.4	27.9	202
Som Centre	40.8	11.2	7.2	9.9	6.7	13.5	10.8	30.8	223
Aimag Centre	37.2	13.1	6.6	9.3	13.1	13.1	7.7	25.3	183
Ulaanbaatar	31.9	17.2	7.8	9.5	10.3	14.7	8.6	16	116
Education									
None	26.7	6.7	13.3	6.7	6.7	20	20	2.1	15
Grade 1-3	46.2	0	1.9	0	7.7	25	19.2	7.2	52
Grade 4-8	56.7	12.4	4.7	4.0	6.6	7.3	8.4	38.0	275
Grade 9-10	39.7	26.1	10.1	7.0	7.5	7	2.5	27.5	199
Professional	3.3	23	13.1	18.0	14.8	21.3	6.6	8.4	61
College	2.7	9.6	11.0	17.8	13.7	26	19.2	10.1	73
Higher	0	6.3	8.3	22.9	20.8	25	16.7	6.6	48
Head of households									
Male	37.8	15.7	8	8	9.3	12.6	8.7	84.5	612
Female	33	13.4	6.3	10.7	8.9	15.2	12.5	15.5	112
Working Status									
Employed	15	18.5	8.3	12.5	14.4	19.2	12.1	43.2	313
Unemployed	53.8	12.9	7.3	5.4	5.4	8.3	7.1	56.8	411
Total	37	15.3	7.7	8.4	9.3	13	9.3	100	724

Preferred Contraceptive for Future Use

As mentioned above, about 60 per cent of all the eligible women expressed their intentions to use a contraceptive method in future. Table 10 presents the data regarding the preferred contraceptive method by the women. About 42 per cent of the women want to use IUD. Perhaps, their responses were influenced by the present pattern of use of contraceptive where IUD is the most prevalent method. The next preferred method was periodic abstinence (19%). In DSM, 1994 also IUD and periodic abstinence were the most preferred contraceptives. However, significant increase was observed in case of injections (2% to 14.8%) and pill (4% to 9.8%). These data reveal that either the future users don't want to try new methods in more number or the adequate information about the new method is not available to them.

The pill, condoms and periodic abstinence were mostly preferred by the younger women in the age group of 15-29 years, whereas, IUD was preferred more by older women in the age group of 25-39 years. The choice of withdrawal

and washing was almost uniform in all the age groups except in the age group of 45-49 years where it was not preferred at all. The injections were also preferred almost uniformly in the age group of 15-19 years and 35-39 years. Preference for injection in the age groups of 40-44 years and 45-49 years was very low.

TABLE 10

PERCENTAGE DISTRIBUTION OF PREFERRED CONTRACEPTIVE METHOD AMONG WOMEN WHO INTEND TO USE CONTRACEPTIVE IN THE FUTURE TO AGE, MONGOLIA, 1996

	Age								
Contraceptive methods	15-19	20-24	25-29	30-34	35-39	40-44	45-49	Total	No.of women
Pill	20.8	32.1	17	16	10.4	2.8	0.9	9.8	106
IUD	8.8	22.1	26.9	21.4	12.9	7	0.9	42.1	457
Injections	13.7	18.6	19.3	24.2	19.9	3.1	1.2	14.8	161
Diaphragm/ Foam/Jelly	40	20	0	20	0	20	0	0.5	5
Condom	20.8	18.8	22.9	20.8	8.3	6.3	2.1	4.4	48
Female Sterilisation	0	9.1	9.1	27.3	27.3	18.2	9.1	1	11
Rhythm/Periodic Abstinence	19.4	28.2	18	14.1	11.2	6.8	2.4	19	206
Withdrawal	14.3	42.9	14.3	14.3	0	14.3	0	0.6	7
Washing	10.8	18.9	27	13.5	18.9	10.8	0	3.4	37
Norplant	0	20.5	18	25.6	18	18.0	0	3.6	39
Undecided	22.2	11.1	0	22.2	33.3	11.1	0	0.8	9
Not intend to use	37	15.3	7.7	8.4	9.3	13	9.3	66.7	724
Total	13.2	23.3	22	19.8	13.7	6.7	1.3	100	1086

CONCLUSION

The analysis reveals that the level of current contraceptive use in Mongolia even after eight years of its transition to market economy is low. Further, almost no change has been observed in the use of modern contraceptives in Mongolia during 1994-96. However, there has been a significant increase in the knowledge of the women about the use of modern contraceptive methods. 60 per cent of the women in the age-group of 15-49 years expressed their desire to use any contraceptive method in the future, the analysis revealed.

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HISTORY AND DEVELOPMENT OF ANALYTICAL CHEMISTRY IN LIFE SCIENCES WITH REFERENCE TO IMMUNOASSAY IN MEDICINE

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ABSTRACT

In this paper, the author has made an attempt to review the importance of analytical chemistry, particularly, the history and development of immunoassay in the field of life sciences. Each period starts with a breakthrough in analytical methodology, followed by the development of novel assays with improved sensitivity and specificity for the detection and quantification of analytes. The development of immunoassay based on antigen-antibody reaction has brought revolution in the field of clinical chemistry. The development of immunoassay has greatly facilitated the bio-chemical and clinical investigations that led to the generation of new knowledge related to various diseases and their mechanisms. Therefore, immunoassay has got an important role in diagnosis and monitoring of diseases on routine basis in the pathological laboratories.

Key-words: Immunoassay, Analytes, Antigen-antibody.

The application of analytical chemistry to enhance medical knowledge began in the late nineteenth century. The earlier workers looked upon themselves as chemical pathologists. They were mainly interested in elucidating the chemistry of the disease so as to improve the knowledge about the nature and etiology of the disease. It was only much later, the result of chemical analysis of biological fluids, especially in urine, was applied to the recognition and differentiation of disease in an individual patient. This was the beginning of an era of clinical biochemistry.

The value of good analytical methods in the advancement of science is well established. Five Nobel Prizes have been awarded to investigators who developed techniques capable of opening up new fields in analytical chemistry. Ultimately, a rapid expansion has taken place in this field. Examples of such work include:

(i) the 1972 Nobel Prize was awarded to Christian B. Afinsen, Sanford Moore, and William H. Stein for their work on the structure and activity of ribonuclease;

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(ii) the 1977 Nobel Prize was awarded to Rosalyn S. Yallow, Roger C.L. Guillemin and Andrew V. Schally for their work on developing a radioimmunoassay for thyrotropin releasing hormone.

(iii) the 1980 Nobel Prize was awarded to Paul Berg, Walter Gilbert and Frederick Sanger for their work on the development of rapid DNA sequencing;

(iv) the 1984 Nobel Prize was awarded to Neils K. Jerne, Georges J.F. Köhler and Ceaser Milstein for illuminating the cellular bias of immunology engendering the development of monoclonal antibodies;

(v) the 1993 Nobel Prize was awarded to Michael Smith and Karry B. Mullis for their work on developing polymerase chain reaction technique.

Immunoassay is a classic example of a discovery, based on a natural phenomenon (immunity) and used advantageously in a completely different context. To this end, the antibody, designed by nature to defend against viruses, bacteria and parasites, is used as a unique analytical reagent. Because of these two attributes, the antibody becomes a dream analytical reagent, which is difficult to surpass. This technology was later termed as immunodignostics.

Analytical Techniques

Qualitative and quantitative analytical techniques are of tremendous importance in all disciplines of life sciences, such as, medical; veterinary; agriculture; forensic; military and environmental. These techniques are used for the detection, identification and measurement of concentration in a wide variety of biologically important molecules. These analytical techniques can be classified into three general categories:

(i) Biological techniques or 'Bioassays', based on physical and/or chemical methods;

(ii) Non-covalent binding techniques, based on one reactant to another; and

(iii) Ligand binder or binding assays techniques.

The salient features of these analytical techniques are briefly described below:

Biological Technique or Bioassay

In Bioassay procedures, the activity (stimulus) of any key bio-molecule, such as hormone, is measured. The biological system which receives the stimulus may be a whole multi-cellular organism, may be an animal or a plant, isolated organs or tissue from multi-cellular organism and whole cells or microorganisms[1,2,3]. The response measured as a change in some aspects of biological system may be positive or negative.

Bioassay has a variety of inherent limitations. These are mainly related to specificity, reproducibility, sensitivity and ease of performance. The bioassay depends on measuring the biological effect of test substance and cannot provide any information about its chemical nature. But these assays enabled many of the hormones to be isolated and chemically characterized. Bioassays, therefore, are used when no suitable alternative assay method is available. However, in hormone preparations consisting of proteins, they still have relevance.

Physical and Chemical Methods

The classical bio-chemical techniques involving the use of spectrophotometry, gas chromatography (GC), mass spectrometry (MS), high performance liquid chromatography (HPLC), paper and thin layer chromatography (PC and TLC), and electrophoresis techniques coupled with ultraviolet (UV) or fluorescence detection methods are widely used for identification and quantification of biologically important compounds. These basic analytical tools exploit the physical and/or chemical characteristics of a compound, which are used both in research as well as in diagnostic industry as a confirmatory method. However, the cost of equipment, consumables, the level of experience and skill required for this analysis often become difficult to use in rapid diagnosis of various diseases in the clinical fields. Moreover, such methods are often tedious, laborious and may require elaborate sample clean-up and concentration procedures. Although not suitable for screening tests, HPLC, GC and GC-MS methods are often used as confirmatory tools for the presumptive positive samples that are initially screened by some kind of immunoassays.

Binding Assays or Ligand Binder Assays

Binding assays comprise a variety of methods, which utilize the specific reaction between a ligand and a binding protein. Basic principle of a binding assay is a reversible reaction between a ligand (L) and its binding protein (BP) that obeys the law of mass action as follows:

$$L + BP \underset{K_2}{\overset{K_1}{\rightleftharpoons}} L - BP$$

The ligand combines with the binding protein to form the L-BP complex at the rate of constant K_1. At equilibrium, the L-BP complex disassociates with a rate of constant K_2 to form free ligand and binding protein. In the immunodiagnostic field, the ligand is often referred to as an antigen, hapten or analyte.

Binding assays represent a general principle, which includes many related techniques, but neither specifies the nature of the binder nor the methods used for determining the distribution of ligand between the bound and free phases. Determination of the distribution of the ligand between bound and free

phases usually depends on the physiochemical separation of these phases. The distribution is followed by the incorporation of 'tracer' consisting of small amount of lablled ligand. It is also possible to use labelled binder as a tracer rather than a labelled ligand. Such assays are known as metric assays. The label is a material, which can be measured, precisely in very small quantities such as a radioisotope compound as in radioimmunoassay or immunoradiometric assay or fluorescence as in fluroimmunoassay or immuno-fluorometric assay or an enzyme in enzyme immunoassay or immunoenzymo-metric assay. Finally, the separation of the phases is not essential, if the characteristic of the tracer in the bound and free phases is sufficiently different. The separation of the phases is required, if there is no difference in the bound and free phases of tracer.

Immunoassay is the most common form of binding assay. In fact, of all the methods described above, immunodiagnostics have developed into extremely versatile analytic techniques with a diverse range of protocols. In comparison to other analytical methods, an immunoassay provides a rapid, economical, highly sensitive and specific analysis that is relatively simple to perform and interpret. Immunoassays were first applied, with exceptional success to the determination of hormones. The study of which was previously based on the use of bioassays. This leads to a revolution in endocrinology and the introduction of new tests in the diagnosis and monitoring of endocrine disorders. Furthermore, immunoassay applications expanded to an area such as therapeutic drug monitoring, measurement of enzymes, tumor markers, lipoproteins, vitamins, antigens associated with infectious agents, detection and quantification of antibodies. The developments in immunoassay are depicted in Table-1.

Today, non-isotopic detection system offers an equal or superior sensitivity and has mostly replaced the classical radioisotope label for routine use. In parallel with the growth of non-isotopic immunoassays, new conjugation chemistries, use of avidin-biotin and nucleotide-polymerase chain reaction system, were designed and applied for the labelling and detection of immunoreactants (antibodies or antigens). Immunoassay for measuring concentration of free hormones has come to routine use.

TABLE 1
DEVELOPMENTS IN IMMUNOASSAY

Year	Scientist	Finding
1939	Heidelberger	Quantitative antigen-antibody precipitation test and antibody purification.
1941	Coon's et al	Fluorescence labelled antibodies for antigen localization in lymphoid tissue.
1945	Coomb's et al.	Use of red cell as an indicator in immunoassay.
1921-1945	Landsteiner	Antibodies can be produced against low molecular weight compounds hapten).
1957-1959	Erlanger et al.	Antibody generation against steroid hormones.
1957-1960	Yalow and Berson	Development of insulin radioimmunoassay based on competitive inhibition (first generation assays.
1960	Ekins	Competitive protein binding assay for thyroxin.
1962	Hunter and Greenwood	Chloramine-T-method for $^{131}_{I}$ labelling to protein hormones.
1966	Nakane and Pierce	Labelling of antibodies with enzyme for immunochemical localization of antigen.
1966	Avrameas and Uriel	
1967	Catt and Tregear	Adsorption of protein to solid surface.
1968	Miles and Hales	Introduction of radiolabelled antibodies in immunoassay (Non-competitive, second generation immunoassay).
1969	Abraham	Development of radioimmunoassay for estradiol.

1971	Engvall and Perlmann	Development of heterogeneous enzyme immunoassay (EIA) or enzyme linked immunosorbent assay (ELISA).
1971	Van Weemen and Schuurs	
1971	Avrameas and Guilbert	
1972	Rubenstein et al.	Development of homogeneous assay for morphine.
1975	Köhlar and Milstein	Development of monoclonal antibodies.
1977	Yalow, Schally and Guillemin	Development of immunoassay technique.
1983	Jerne, Köhler and Milstein	Development of monoclonal antibody generative technique
1993	Smith and Mullis	Development of polymerase chain reaction technique.

*Diamondis and Christopoulos 1996[4], Brian law 1996[5],
*Deshpande 1996[6], Aslam and Dent 1998 [7].

Finally, the development of non-isotopic, immunnoassay along with the increased demand for higher assay throughout resulted in the designing of fully automated immunoassay systems with random access capability.

As compared to bioassays, which provide the estimates of concentration of an analyte based on its biological activity or function; immunoassays are 'structural' assays, which assess only a part of the antigen's structure or its 'antigenic determinants. Therefore, the values obtained by a bioassay may be considerably lower than those determined by an immunoassay method. Nevertheless, for several clinically important protein or peptide analytes (including hormones, lipoproteins, oncoproteins, pathogen antigens and specific antibodies), as yet, there are no alternatives for immunoassays[8].

Current Efforts and Future Prospects in the Field of Immunoassay:

It involves:

(a) the development of multi-analyte immunoassay, where a panel of clinically related analytes can be determined simultaneously,
(b) the design of immunosensors suitable for real time monitoring,
(c) the development of assays with even lower detection limit, so that more analytes will become accessible,
(d) the transfer of successful non-isotopic technologies to DNA hybridization assays, and
(e) the utilization of recombinant DNA technology in the production and engineering of antibody molecules with novel properties (e.g. catalytic antibodies).

CONCLUSION

The development of immunoassay based on antigen-antibody reaction has brought revolution in the field of clinical chemistry. The development of immunoassay has greatly facilitated the bio-chemical and clinical investigations that led to the generation of new knowledge related to various diseases and their mechanisms. Therefore, immunoassay has got an important role in diagnosis and monitoring of diseases on routine basis in the pathological laboratories.

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ESTIMATION OF FECUNDABILITY OF MIGRATED COUPLES UNDER INDUCED ABORTION

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ABSTRACT

Data used for the study have been taken from the findings of the survey conducted by the Family Planning Association of India in 1998. 121 females were considered as sample respondents because their husbands were found migrated from before first-birth to the second-birth. Studies have revealed mobility/migration has impact on fertility. A number of probability distributions have been derived to study the fertility behaviour of the migrated couples based on the number of births as well as the birth intervals. Therefore, an attempt has been made in this paper to derive a probability model with the estimation of fecundability of migrated couples under induced abortion in a closed birth interval.

Key-words: Fecundability, Birth interval, Migrated couples.

A number of probability models has been proposed for open birth intervals by Leridon[1], Pathak[2,3], Singh and Yadava[4], Pandey[5] and others. These models have been framed for the couples where both the partners are permanently residing at home. Under these probability models, quantitative aspects of human reproduction are described with the assumption that the human fertility is being affected by most of the biological and social factors. Migration, especially in developing countries, plays an important role in changing the socio-economic conditions, culture and fertility level of the people.

A number of probability distributions has been derived to study the fertility behaviour of migrated couples based on the number of births during a specified period of time[6,7]. The birth interval models for changes in the pattern of fertility based on number of births have also been considered[8]. Mishra et. al.[9] have derived a probability model for first birth interval and estimated the fecundability of migrated couples. Singh et. al.[6] studied the fertility behaviour of migrated couples by considering the visit of a husband to his wife once a year. Further, Sharma[10] developed the probability model for migrated couples in case of open birth interval. Mukherjee et. al.[11] have derived a probability distribution for the last closed birth interval. Here the authors have made an attempt to fit the

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model by adopting constant, linear and quadratic form of risk function. Yadava et. al.[12] have derived a procedure for the estimation of fecundability of migrated couples based on the data of closed birth intervals.

With the better availability of MTP services, now couples may have the choice of abortion in case of unwanted conception. Keeping this in view, the present study has been designed to derive a probability model with the estimation of fecundability of migrated couples under induced abortion in a closed birth interval.

Procedure for Estimating Fecundability and its Application

Let p (=1-q) denote the fecundability, i.e., probability of conception to a female in one menstrual cycle, if the female is exposed to the risk of conception. Here time is discrete and its unit is a month. Now consider a cohort of females with experience of sufficiently large marital duration having at least (i+1), (i ≥1) births and they have migrated before the i^{th} birth. Let their husbands visit randomly for a constant period, say for y months. Further, let us assume that all those females will be susceptible to risk of conception during the visit of their husbands in the second year who were not susceptible in the first year during the visit of their husbands after the i^{th} birth and this assumption also holds good for subsequent years.

Let S be the proportion of females exposed to the risk of conception and α, be the proportion of females responsible for foetal losses. Again let β be the proportion of females who decided for an abortion.

Then the probability of conception in a year would be given by

$$p^* = \sum_{j=1}^{y} p\, q^{j-1} \qquad (1)$$

where j =1,2,3,4…. and y is the upper limit of visit of a husband and the fecundability during the stay of the husband when he visits his wife taken as $\sum_{j=1}^{y} pq^{j-1} = p^*$ i.e. probability of conception in a year, assumed to be constant for each and every year.

Now the proportion conceived during the first year after i^{th} birth will be the product of proportion of females susceptible to the risk of conception and probability of conception in a year i. e. Sp*.

So αSp^* = Proportion of females whose conception resulting in foetal loss.
Similarly, βSp^* = Proportion of females whose conception resulting in abortion loss.

Therefore, proportion of conceived females whose $(i+1)^{th}$ birth resulted in the live birth in the first year visit of their husbands is,

$Sp^* - \alpha Sp^* - \beta Sp^* = (1 - \alpha - \beta)\, Sp^*$ (2)

Now the proportion of females susceptible to risk of conception in second year after i^{th} birth =

Proportion of females not susceptible in first year (1– S)
+ Proportion of females not conceived out of susceptible (S – Sp*)
+ Proportion of females whose conception resulted foetal loss αSp^*
+ Proportion of females whose conception resulted abortion βSp^* i.e.

$= (1-S) + (S - Sp^*) + \alpha Sp^* + \beta Sp^*$
$= 1 - Sp^* + \alpha Sp^* + \beta Sp^*$

Similarly, proportion of females resulted in $(i+1)^{th}$ live birth in the second year after i^{th} birth is

$(1 - \alpha - \beta)\ (1 - Sp^* + \alpha Sp^* + \beta Sp^*)\, p^*$ (3)

Proportion of females susceptible to risk of conception in third year at the time of visit of their husbands after i^{th} birth =

Proportion of females not conceived out of susceptible during second year
+ Proportion of females whose conception resulted in foetal loss out of conceived females in the second year
+ Proportion of females whose conception resulted in induced abortion

$= [(1 - Sp^* + \alpha Sp^* + \beta Sp^*)\, p^* - (1 - Sp^* + \alpha Sp^* + \beta Sp^*)\, p^*]$
$+ \alpha (1 - Sp^* + \alpha Sp^* + \beta Sp^*)\, p^* + \beta(1 - Sp^* + \alpha Sp^* + \beta Sp^*)\, p^*]$
$= (1 - Sp^* + \alpha Sp^* + \beta Sp^*)(1 - p^* + \alpha p^* + \beta p^*)$

Therefore, the proportion of females conceived in third year
$= (1 - Sp^* + \alpha Sp^* + \beta Sp^*)(1 - p^* + \alpha p^* + \beta p^*)\, p^*$
Hence, proportion of females resulted in foetal loss in third year
$= \alpha (1 - Sp^* + \alpha Sp^* + \beta Sp^*)(1 - p^* + \alpha p^* + \beta p^*)\, p^*$
and proportion of females resulted in abortion loss in third year
$= \beta (1 - Sp^* + \alpha Sp^* + \beta Sp^*)(1 - p^* + \alpha p^* + \beta p^*)\, p^*$

Hence, proportion of females resulted in $(i+1)^{th}$ live birth in the third year after i^{th} birth

$= (1 - \alpha - \beta)\ (1 - Sp^* + \alpha Sp^* + \beta Sp^*)(1 - p^* + \alpha p^* + \beta p^*)\, p^*$ (4)

Similarly, the proportion of females whose conception will result in $(i+1)^{th}$ live birth after i^{th} birth in fourth year is

$= (1 - \alpha - \beta)(1 - Sp^* + \alpha Sp^* + \beta Sp^*)(1 - p^* + \alpha p^* + \beta p^*)^2\, p^*$ (5)

and the proportion of females whose conception will result in $(i+1)^{th}$ live birth after i^{th} birth in fifth year is

$= (1 - \alpha - \beta)(1 - Sp^* + \alpha Sp^* + \beta Sp^*)(1 - p^* + \alpha p^* + \beta p^*)^3\, p^*$ (6)

and so on.

Now to evaluate the theoretical closed birth intervals of the females conceived during the visit of their husbands in different years after the i^{th} birth under the assumption that every conception results in live birth with α proportion of foetal losses and β proportion of losses due to induced abortion after sex determination test in every conception is given below.

It may be assumed that some females may conceive at the beginning of year or in middle or even in the end of the year depending on the risk of susceptibility of females and times of visits of their husbands. So, the assumption that number of females conceived during a year may be considered as distributed normally and subsequently it may also be considered that on an average, a female conceives in the middle of a year. So, closed birth intervals for the conceptions in different years may be considered by taking six months for conception and nine months as gestation period.

Year of conception	Length of closed birth interval after i^{th} birth
I First year	1.25 year (conception in 6 months and 9 months gestation)
II Second year	2.25 year (conception in 18 months and 9 months gestation)
III Third year	3.25 year
IV Fourth year	4.25 year
V Fifth year	5.25 year and so on

In general, if conception occurs in the X_i year after i^{th} birth, then the length of closed birth interval is equal to $(X_i+0.25)$ years, for $X_i = 1,2,3\ldots\ldots$

Thus, the theoretical average length of closed birth interval (which is expected to be observed in the population) is given by

$$1.25(1-\alpha-\beta)\,Sp^*$$
$$+2.25\,(1-\alpha-\beta)\,(1-Sp^*+\alpha Sp^*+\beta Sp^*)\,p^*$$
$$+3.25\,(1-\alpha-\beta)\,(1-Sp^*+\alpha Sp^*+\beta Sp^*)\,(1-p^*+\alpha p^*+\beta p^*)\,p^*$$
$$+4.25\,(1-\alpha-\beta)\,(1-Sp^*+\alpha Sp^*+\beta Sp^*)\,(1-p^*+\alpha p^*+\beta p^*)^2\,p^*$$
$$+5.25\,(1-\alpha-\beta)(1-Sp^*+\alpha Sp^*+\beta Sp^*)(1-p^*+\alpha p^*+\beta p^*)^3\,p^*+\ldots\ldots$$

$$= 1.25\,Sp^*\,(1-\alpha-\beta)+\frac{(1-Sp^*+\alpha Sp^*+\beta Sp^*)\,(1+1.25p^*-1.25\,\alpha p^*-1.25\,\beta p^*)}{p^*\,(1-\alpha-\beta)} \quad \text{---(7)}$$

Probability Mass Function for Closed Birth Interval of Migrated Couples

Let X denote the length of closed birth interval. It may be considered as a random variable which may take values 1.25, 2.25, 3.25 …….., then its probability mass function based on the assumptions mentioned above is given by

$$g(X) = \begin{cases} (1-\alpha-\beta)Sp^* & \text{if } X=1.25 \\ (1-\alpha-\beta)\,(1-Sp^*+\alpha Sp^*+\beta Sp^*)(1-p^*+\alpha p^*+\beta p^*)p^* & \text{if } X=2.25,3.25,\ldots\ldots \end{cases} \quad (8)$$

$$\text{where } p^* = \sum_{j=1}^{y} pq^{j-1}$$

Estimation of Parameters

The parameters S, p, α and β are estimated by using the method of moments technique. For it, the first and second theoretical moments are equated to observed sample moments, i.e.

First moment is given by :

$$E(X) = \sum_{i=1}^{y} x_{j^*} p_{xj}$$

$$E(X) = 1.25(1-\alpha-\beta)Sp^* + \frac{(1-Sp^*+\alpha Sp^*+\beta Sp^*)\,(1+1.25p^*-1.25\alpha p^*-1.25\beta p^*)}{p^*(1-\alpha-\beta)} \quad (9)$$

And second order moment becomes:

$$E(X)^2 = \sum_{i=1}^{y} x_j^2 p_{xj}$$

$$E(X)^2 = (1.25)^2\,(1-\alpha-\beta)\,Sp^* + (1-Sp^*+\alpha Sp^*+\beta Sp^*)\left[5.06 + \frac{(1-p^*+\alpha p^*+\beta p^*)}{[p^*(1-\alpha-\beta)]^2}(2+3.5\,p^*(1-\alpha-\beta))\right] \quad (10)$$

Here we have got four parameters S, p*, α and β to be estimated. If we presume $p^*(1-\alpha-\beta) = T$, then equations (9) and (10) reduce to:

$$E(X) = 1.25\,ST + \frac{(1-ST)(1+1.25T)}{T} \quad (11)$$

$$E(X)^2 = (1.25)^2\,ST + (1-ST)\left[5.06 + \frac{(1-T)}{T^2}(2+3.5\,T)\right] \quad (12)$$

Application

Data used for this study have been taken from the findings of the survey conducted by Family Planning Association of India in 1998. 121 females were selected as respondents because their husbands were found migrated from before first-birth to till the second-birth. The value of α has been taken to vary between 0.05 and 0.10. While β has been assumed to be 0.025 when α = 0.05 and β = 0.05 when α = 0.1. Estimated values of fecundability (p) for different values of α, β and S and for y = 2 months have been depicted in Table 2.

For y = 2 months, $p^* = p + p(1-p)$ ……. from equation (1).

To find the value of p* i.e. level of fecundability, equation (7) is compared with the observed average length of closed birth interval. Different values of level of fecundability associated with different values of α, β and S are shown in Table 1.

TABLE 1

ESTIMATED VALUES OF FECUNDABILITY (P) FOR DIFFERENT VALUES OF α, β AND S AND Y = 2 MONTHS

Different value of S	p*		Estimates of Fecundability (p)	
	α = 0.05, β= 0.025	α =0.10, β= 0.05	α = 0.05, β= 0.025	α = 0.10, β= 0.05
	Y = 2 months			
0.15	0.48966	0.53287	0.28562	0.31653
0.20	0.47882	0.52107	0.27807	0.30795
0.25	0.46845	0.50978	0.27092	0.29984
0.30	0.45851	0.49897	0.26414	0.29216
0.35	0.44899	0.48861	0.2577	0.28488
0.40	0.43986	0.47867	0.25157	0.27797

Now to estimate the values of S and $p^*(1-\alpha-\beta)$, elaborating equations (11) and (12) as shown below:

$$E(X) = 1.25(ST) + \frac{(1 - ST)(1 + 1.25T)}{T} \quad \text{where } T = p^*(1-\alpha-\beta)$$

$$= \frac{(1 + 1.25T - ST)}{T}$$

Substituting the value of E(X), we have

$$3.3078 * T = 1 + 1.25T - ST$$

$$S = (1/T) - 2.0578 \qquad (13)$$

From equation (12)

$E(X)^2 * T^2 = 1.56\ ST^3+1.56T^2+1.5T+ 2-1.56T^3S-1.5T^2S-2TS$

Simplifying and substituting the value of S from equation (13),

$E(X)^2 * T^2 = 1.56T^2 + 1.5T+ 2-1.5T^2\ (1/T-2.0578)-2T(1/T-2.0578)$

$= 4.6467\ T^2+ 4.1156T$

Putting the value of $E(X)^2$

$13.7843\ T^2 = 4.6467\ T^2 + 4.1156T$

$T = 0.4504, 0$

Ignoring T = 0 and substituting the value of T(= 0.4504) in equation (13), we have S = 0.1626.

With the help of computed S and T, the expected values of number of migrated couples according to the length of closed intervals are computed with the help of equations (2) to (6) which are given in Table 2.

TABLE 2

OBSERVED AND EXPECTED DISTRIBUTION OF FEMALES ACCORDING TO TIME FROM FIRST BIRTH TO SECOND BIRTH WHOSE FIRST BIRTH IS AFTER MIGRATION

Time (in years)	Average in years	No. of couples	
		Observed	**Expected**
0.75 - 1.75	1.25	12	8.86
1.75 – 2.75	2.25	41	50.51
2.75 – 3.75	3.25	28	27.76
3.75 – 4.75	4.25	18	15.26
4.75 – 5.75	5.25	12	8.38
≥ 5.75	6.25	10	10.23
	Total	**121**	**121.00**

S = 0.1626, T = p*(1-α-β) = 0.4504 and χ^2 = 4.9663

After establishing the validity of the model, we may calculate the value of β (proportion of induced abortion) using data on closed birth interval and fixed value of fecundability. The high value of β may reveal the possibility of sex-selected abortion in the specific population group/area.

The value of χ^2 comes out to be 4.966. The tabulated value at 5 per cent level of significance and 3 degree of freedom was χ^2 (0.05) = 7.815. Thus the χ^2 was insignificant at 5 per cent level of significance. This reflects that the observed pattern of first closed birth interval is described well by the proposed model. This implies that females under study were highly consistent with the first closed birth interval.

CONCLUSION

Mobility/migration has impact on fertility in addition to a number of biological and social factors. Hence, various authors have attempted to derive the probability distributions according to number of births and birth intervals among the migrated couples. Realising the significance of migration in fertility level, the authors have derived a probability model with the estimation of fecundability of migrated couples under induced abortion in a closed birth interval.

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