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A GENETIC DEMOGRAPHIC STRUCTURE OF YERUKULA TRIBE IN WEST GODAVARI DISTRICT OF ANDHRA PRADESH, SOUTH INDIA

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ABSTRACT

The Yerukulas, a tribal population subsisting traditionally on agriculture, animal husbandry and handicrafts trade, inhabit largely in plains of Southern Indian states specifically, West Godavari District, Andhra Pradesh, Tamil Nadu and Karnataka. The demographic information regarding occupation, economic status, fertility and mortality, age of children etc were collected. The present study on tribal population with moderately high fertility and mortality shows a picture of a growing population. Sex ratio was slightly deviated to the predominance of males. The inbreeding co-efficient for autosomes is 0.0381 and sex chromosomes is 0.0438 among the Yerukula tribe, and the overall inbreeding coefficient is 0.081 which is relatively high due to more number of uncle-niece marriages. Among postnatal deaths, neonatal deaths in non-consanguineous and infantile deaths in consanguineous couples are higher than their counterparts. The index of variability of fertility is higher in non-consanguineous couples and proportion of surviving offspring is higher in consanguineous couples. However, the percent offspring mortality is higher in non- consanguineous couples. Thus, improving socio-economic conditions and creating awareness on medical facilities so as to reduce the fertility and mortality is essential to keep the population growth under control.

KEYWORDS: Demography, Yerukulas, West Godavari District, Andhra Pradesh, South India.

1. INTRODUCTION

Population structure and genetic demography occupy an important place in biological anthropology as the perpetuation of a species has direct bearing with its reproductive success. The nature and size of the population, its relation with environment, mating structure, composition, reproductive fitness, etc. through the operation of micro evolutionary forces, have influence on genetic structure or genetic variation. The importance and application of genetic demographic studies in this direction is ever growing, And a considerable number of studies have been carried out worldwide (Bittles & Smith, 1994; Relethford & Harpending, 1994; Shami & Grant, 1994; Bulaeva & Kurbatova, 1995; Relethford & Miekle, 1994; Grant & Bittles, 1997; Hussain & Bittles, 1998; Relethford & Jorde, 1999, etc).

India provides a unique opportunity to take-up such studies as Indian population is known for its unique cultural and linguistic diversity (Gunjan et al., 2012). Broadly, Indian population can be categorized as the castes, tribes and religious communities. According to the 2001 census, India has more than 84 million tribals which constitute 8.2% of the total population. There are currently about 530 tribal groups in India. India probably has the largest number of tribal communities in the world (Topal & Samal, 2001). These communities are geographically distinct; with each tribe having its own unique customs, traditions, beliefs and practices. A considerable number of studies have been undertaken on Indian tribes (Basu, 1969, 1972; Rakshit, 1972; Saheb & Naik, 1983; Reddy & Reddy, 1984; Deep Kumar, Rao, & Reddy, 1985; Malik & Hauspie, 1986; Prakash & Malik, 1990; Kar, 1993; Kshatriya, Singh, & Basu, 1997; Chachra & Bhasin, 1998; Langstieh & Banrida, 2001; Bhasin & Nag, 2002). It is worth mentioning that some of the studies of this kind have focused on genetic implications of demographic structure (Papa Rao & Mukherjee, 1975; Reddy & Lakshmanudu, 1979; Sanghvi, 1982; Vijayakumar & Malhotra, 1983; Babu & Naidu, 1995, Babu & Kusuma, 2002, etc). From Andhra Pradesh also studies on various genetic demographic variables of both tribal and caste populations have been undertaken during the past few decades (Sanghvi, 1966; Rao & Golla Reddi, 1973; Reid, 1973; Goud & Rao, 1977; Mukherjee, Bhaskar, & Lakshmanudu, 1977; Murthy & Ramesh, 1978; Naidu & Rami Reddy, 1978; Reddy & Lakshmanudu, 1979; Pingle, Mukherjee, & Das, 1981; Rao, Veerraju, Naidu, & Rao, 1981; Reddy & Mukherjee, 1981; Pingle, 1983; Rao & Murthy, 1984; Reddy and Reddy, 1984; Sirajuddin, 1984; Deep Kumar,

Rao, & Reddy, 1985; Rajani Kumari, Sri Kumari, & Rao, 1985; Govinda Reddy, 1986; Reddy & Malhotra, 1988; Babu & Naidu, 1989; Char, Lakshmi, Gopalan, Gowrinath, & Rao, 1989; Yasmin & Mascie-Taylor, 1997; Murty & Rao, 1996; Gaimard & Dilumbu, 1998; Sudhakar, Padma, & Babu, 1998; Ramana, Busi, Vishnupriya, & Murty, 1999, etc).

The present study has been conducted among Yerukula, a tribal population inhabiting largely in plains of Southern Indian states, specifically Andhra Pradesh, Tamil Nadu and Karnataka. They are called as 'Yerukula' in Andhra Pradesh after their women's traditional profession of fortune telling (soothsaying). The Yerukulas subsist traditionally on agriculture, animal husbandry and handicrafts trade. According to 2001 Indian census, the total population of Yerukulas in Andhra Pradesh is 4,37,459 which comprises about 9% of the total tribal population of Andhra Pradesh. The literacy rate of Yerukulas in Andhra Pradesh is 45.4% (highest among the tribal population of Andhra Pradesh) (Census of India, 2001). The Yerukula tribe is divided into a number of endogamous sub-divisions and each such sub-division is named after the commodity, which they traded in and the occupation they adopted. The sub-divisions of Yerukula are Dabba Yerukula (those who make baskets from split bamboo), Eethapullala Yerukula (date twigs-those who make baskets from wild date leaves), Kunchapuri Yerukula (those who make weaver's combs), Parikamuggula Yerukula (soothsayers), Karivepaku Yerukula (hawkers of curry leaves) and Uppu Yerukula (salt hawkers). The traditional occupation of Yerukulas includes basket-making, mat weaving, pig rearing, rope-making, etc. Most of the Yerukulas are settled in the villages/towns and trying to make their way out of the poverty by getting education, which has been denied to them since ages.

2. MATERIALS AND METHODS

A total of 100 Yerukula families residing in and around Narsapuram town, West Godavari district of Andhra Pradesh, India have participated in this study. These families were selected randomly from rural and urban areas. The data were collected through interviewing the eldest female member in the family by using a structured questionnaire. Before initiating the interview, the consent of the participants was obtained by explaining them the purpose of the study. The demographic information regarding occupation, economic status, fertility and mortality and age of children were collected. Also, information about the marriage type, i.e. consanguineous or non- consanguineous marriage was recorded by constructing pedigrees. Based on pedigrees, consanguineous marriages are classified as uncle-niece and first cousin marriages. First cousin marriages are further classified as marriage with father's sister's daughter (FSD) and mother's brother's daughter (MBD). Data on reproductive history of woman, which includes the outcome of each pregnancy, i.e., abortions, still births, live births and postnatal deaths and sex of all children (dead or alive) were collected.

The data was processed and analyzed by using SPSS V.19. In addition to common statistical measures, genetic demographic variables namely net reproductive rate (NRR), child – woman ratio (CWR), index of variability of fertility (IVF), proportion of surviving offspring (PSO), contribution of infertility to variance (ICV) and percent offspring mortality (POM) were calculated using the following formulae.

$$CWR = \frac{No.of\ children\ under\ age\ 5}{N0.of\ women\ ages\ 15-49} \times 1000$$

$$IVF = \frac{\text{Variance of live births (LB) when included 'zero' class mothers}}{\text{Mean number of live births}}$$

$$PSO = \frac{\text{Mean number of surviving offspring}}{\text{Mean number of live births}}$$

$$ICV = \frac{\text{variance of LB when included Zero}^{'}\text{class mothers} - \text{Variance of LB when excluded Zero}^{'}\text{class mothers}}{\text{Variance of LB when included Zero}^{'}\text{class mothers} \times 100}$$

$$POM = \frac{No.of\ child\ deaths}{No.of\ livebirths} \times 100$$

3. RESULTS

3.1 Age and sex composition

Table 1: Age and sex wise distribution and tertiary sex ratio among surviving members of Yerukula.

Age groups	Males		Females		Males + Females		Tertiary sex ratio
	Number	Percent	Number	Percent	Number	Percent	
0-10 years	49	21.12	55	24.01	104	22.56	89.09
11-20 years	57	24.57	62	27.07	119	25.81	91.93
21-30 years	59	25.43	55	24.02	114	24.73	107.27
31-40 years	40	17.24	34	14.85	74	16.05	117.65
41-50 years	18	7.76	18	7.86	36	7.81	100.00
51-60 years	6	2.59	4	1.75	10	2.17	150.00
61-70 years	3	1.29	1	0.44	4	0.87	300.00
Total	232	100.00	229	100.00	461	100.00	101.31

The data revealed that there are 232 male and 229 female members in 100 Yerukula families (Table 1). Relatively large proportions (25.81%) of the people are in the age group 11-20 years, followed by the people who are in the age group of 21-30 years (24.73%). Only 0.87% were in oldage (61-70 years) indicating a gradual decrease of surviving members. More number of females were observed in the age group of 11-20 years and more males were observed in the age group of 21-30 years. The results suggest that the death rate of female might be higher after attaining 50 years or there might have higher male births than female births in that birth cohort. Among the people surviving during the period of survey, females and males are almost equal numbers. The tertiary sex ratio revealed the existence of equal proportion of males and females.

3.2 Birth order

Table 2: Distribution by birth order at birth and secondary sex ratio among Yerukula.

Birth order	Males		Females		Males + Females		Secondary sex ratio
	Number	Percent	Number	Percent	Number	Percent	
First	52	36.88	42	32.81	94	34.94	123.81
Second	41	29.08	42	32.81	83	30.86	97.61
Third	22	15.60	32	25.00	54	20.07	68.75
Fourth	17	12.06	9	7.03	26	9.67	188.88
Fifth	5	3.55	3	2.34	8	2.97	166.66
Sixth	4	2.84	0	0.00	4	1.49	0.00
Total	141	100.00	128	100.00	269	100.00	110.15

Table 2 shows the distribution of secondary sex ratios according to birth order. The maximum number of offsprings delivered by women of Yerukulas are six. But majority of women have two to three children. This tribe shows a considerable variation in secondary sex ratio at different deliveries. In all the deliveries, the incidence of birth of baby boys are more than baby girls. In all the birth orders, the secondary sex ratio is deviating in favour of males. Both secondary sex ratio and tertiary sex ratio show the preponderance of males than females.

The secondary sex ratio of Yerukula is 110.15 males per 100 females.

3.3 Consanguinity, village endogamy and marriage distance

Table 3: Distribution of marriage pattern among Yerukula.

Mating Type	Village endogamy (%)	Village exogamy (%)	Total (%)
Consanguineous	10.00	36.00	46.00
UN	4.00	11.00	15.00
MBD	4.00	16.00	20.00
FSD	2.00	9.00	11.00
Non-consanguineous	8.00	46.00	54.00
Total marriages	18.00	82.00	100.00

UN = uncle-niece; MBD = mother's brother's daughter; FSD = father's sister's daughter = $x^2$1.1889, p > 0.05.

Table 4: Distribution of marriage distance among Yerukula.

Marriage Distance (Kilometers)	Consanguineous couples		Non-consanguineous couples		Total couples	
	Number	%	Number	%	Number	%
0	10	21.74	8	14.81	18	18.00
1 – 10	11	23.91	11	20.37	22	22.00
11 – 20	3	6.52	6	11.11	9	9.00
21 – 30	3	6.52	4	7.41	7	7.00
31 – 40	8	17.39	7	12.96	15	15.00
41 – 50	5	10.87	3	5.56	8	8.00
51 – 60	3	6.52	5	9.26	8	8.00
61 – 70	0	0.00	3	5.56	3	3.00
71 – 80	1	2.17	1	1.85	2	2.00
81 – 90	1	2.17	2	3.70	3	3.00
91 – 100	1	2.17	4	7.41	5	5.00
101 – 110	0	0.00	0	0.00	0	0.00
111 – 120	0	0.00	0	0.00	0	0.00
Total	46	100.00	54	100.00	100	100.00
MMD ± SE (kilometers)	26.15 ± 0.56		34.69 ± 0.57		30.76 ± 0.29	

MMD = mean marriage distance; SE = standard error.
t-value for MMD between consanguineous and non-consanguineous couples is 10.68; p<0.001.

Table 5: Inbreeding coefficients for autosomes and sex linked genes among Yerukula.

Marriage type	No.	Proportion (Ci)	Inbreeding coefficients (Fai) for		Ci X Fai	
			Autosomes	Sex linked genes	Autosomes	Sex linked genes
Consanguineous						
UN	15	0.1500	0.1250	0.1250	0.0188	0.0188
MBD	20	0.2000	0.0625	0.1250	0.0125	0.0250
FSD	11	0.1100	0.0625	0.0000	0.0069	0.0000
Non-consanguineous	54	0.5400	0.0000	0.0000	0.0000	0.0000
Total	100	1.0000			0.0381	0.0438

UN = uncle-niece; MBD = mother's brother's daughter; FSD = father's sister's daughter

The details of village endogamy, exogamy and marital distance are shown in Table 3. It is evident that majority (82%) of men in this tribe prefer a girl from outside the village (village exogamy) to a girl from their village (village endogamy). Among consanguineous marriages, marriages with patrilateral (marrying father's sister's daughter) are observed to be more compared to matrilateral cross cousin marriages (marrying mother's brother's daughter). About 15% of uncle –niece marriages are reported among this tribe. Distribution of marriage distance among Yerukula is presented in Table 4. The mean marriage distance (MMD) is 30.76 SE 0.29 kilometers. However higher proportion of men have acquired their mates within the radius of 10 kilometers. The difference in prevalence of consanguineous and non-consanguineous marriages by village endogamy and exogamy is not significant (2=1.189, p>0.05). However, MMD shows a significant difference between these two groups of couples (t = 10.68, p < 0.001). The inbreeding co-efficient for autosomes is 0.0381 and sex chromosomes is 0.0438 among the Yerukula tribe and the overall inbreeding coefficient is 0.081 which is relatively high due to more number of uncle-niece marriages (Table 5).

3.4 Age of reproductive events in women's life

Table 6: Details of ages at women's reproductive events among Yerukula women.

Age at event	Mean SE (years)	SD SE (years)
Age at menarche	11.99± 0.05	0.52±0.04
Age at marriage	14.04±0.25	2.53±0.18
Age at first conception	16.30±0.23	2.29±0.16
Age at last conception	23.34±0.62	5.76±0.44
Age at menopause	42.38±1.37	5.49±0.97

SD = standard deviation; SE = standard error.

Table 6 shows the details of ages at menarche, marriage, first conception, last conception and menopause among yerukula women. The mean age at menarche among Yerukula girls is 11.99±SE 0.05 years, which is considered as a very early age at menarche. The mean age at marriage is 14.04±SE 0.25 years, revealing that Yerukula girls usually get married approximately after 2-3 years of attaining menarche. The mean age at first conception among Yerukula is 16.30±SE 0.23 years. The difference between the mean ages at marriage and the mean age at first conception reveals that Yerukula girls conceive within two years after marriage. The mean age at last conception among Yerukula is 23.40±SE 0.62 years. The mean age at menopause of Yerukula is 42.38±SE 1.37 years.

3.5 Fertility and mortality differentials

Table 7: Fertility particulars in consanguineous and non – consanguineous couples of Yerukula.

Fertility particulars	Consanguineous		Non-consanguineous	
	Mean	SE	Mean	SE
	46		54	
	3.51	0.26	3.62	0.29
Number of married women				
Conceptions	1.96	0.16	2.04	0.14
Live births	1.80	0.14	1.80	0.14
Male Female Total	3.07	0.19	3.09	0.22
Surviving offspring				
Male Female Total	1.78	0.18	1.77	0.14
	1.16	0.15	1.46	0.12
	2.78	0.18	2.64	0.18
Fertility Indices				
Net Reproductive Rate Child – woman ratio	1.3043		1.1111	
Index of variability of fertility	284.02		284.02	
Proportion of surviving offspring	0.3746		0.8091	
Percent offspring mortality	0.9055		0.8544	
	13.3333		14.6341	

SE = standard error.

The fertility details, in terms of number of conceptions, live births and surviving children per woman among consanguineous and non-consanguineous couples are shown in Table 7. Although non-consanguineous women have more number of conceptions, live births and surviving children than consanguineous women, the differences are not significant. The differences between number of males and females in live births and surviving children assessed through t-tests are also not significant. This table reports few fertility indices. Net reproductive rate, a proportion of number of daughters to number of mothers, is higher in consanguineous than in non-consanguineous couples. The woman-child ratio, a proportion of children in 0-5 years age to women in 15-49 years age, is 284.02. The index of variability of fertility is higher in non-consanguineous couples and proportion of surviving offspring is higher in consanguineous couples. However, the percent offspring mortality is higher in non- consanguineous couples.

Table 8: Mortality particulars in consanguineous and non-consanguineous couples of Yerukula.

Mortality particulars	Consanguineous		Non-consanguineous	
	Mean	SE	Mean	SE
	46		54	
Number of married women				
Prenatal mortality Abortions	1.50	0.35	2.00	0.00
Still births Total prenatal	2.00	0.31	3.00	0.50
Postnatal mortality	1.92	0.27	2.80	0.41
Neonatal Infantile Juvinile				
Total postnatal	1.20	0.17	2.83	0.68
	1.80	0.40	1.00	0.00
Total mortality	1.00	0.00	1.50	0.35
	1.50	0.25	2.18	0.46
	3.42	0.52	4.98	0.87

SE = standard error, χ^2 for difference in total mortality rate between consanguineous and non-consanguineous couples = 6.459: $p > 0.05$.

Table 8 presents the details of mortality among offspring of consanguineous and non-consanguineous couples. In the present study, the mortality is categorized as prenatal and postnatal deaths. The prenatal mortality includes abortions and still births. Miscarriages could not be differentiated from abortions. The postnatal deaths are classified into neonatal, infantile and juvenile deaths, as age specified death rate were suggested to be convenient to know the size of different age groups and growth pattern of population. The mean mortality rates for prenatal are 1.92±SE 0.27 and 2.80±SE 0.41 for consanguineous and non-consanguineous women, respectively. The mean mortality rates at postnatal stage are 1.50±SE 0.25 and 2.18±SE 0.46 respectively. Among postnatal deaths, neonatal deaths in non-consanguineous and infantile deaths in consanguineous couples are higher than their counterparts. The overall mortality rate is slightly higher among non-consanguineous (4.98±SE 0.87) than consanguineous couples (3.42±SE 0.52), yielding a statistically significant difference ($p<0.05$).

4. DISCUSSION

Age and sex are two biologically determined features of any population and they determine the features, structure and trends of demographic change in any population at a given time. The variation in the numerical proportion in different age groups also throw light on the trend of fertility in the population. The Yerukula is a growing population with excess number of children and moderate number of middle-aged people. Lesser proportion of old people (above 61 years of age) indicates that dependant people are relatively few and also the life expectancy may be low in Yerukulas. The sex ratio is an equally important factor which determines the availability of mates and influences fertility, family structure and population growth rate. The secondary sex ratio indicates the number of females:males at birth and the tertiary sex ratio state the ratio among surviving males and females. In Yerukulas, both secondary and tertiary sex ratios showed the preponderance of males over females proving that this is the typical random sample which is imitating the sex ratios of Andhra tribes (Babu & Kusuma, 2002), in which sex ratio is slightly deviating in favour of males. Census of India (2011) reported more number of males than females (940 females per 1000 males). The population of state of Andhra Pradesh also reported similarly (992 females per 1000 males). The overall sex ratio of the tribal population is 990 females per 1000 males (Census of India, 2011). It is interesting to note that majority of Andhra castes and urban populations show slightly higher number of males than females (Babu & Naidu 1989). The depletion of females in the population creates scarcity of suitable brides and the situation may reduce social evils like dowry system.

The degree of consanguinity is relatively high among Andhra tribes. In Yerukulas, the incidence of consanguineous marriages is 46%. The prevalence of consanguineous marriages is highest (73.43%) among Valmiki tribe (Naidu & Babu, 1999) and lowest (6.30%) among Mathura tribe (Pingle, 1983). It is also in the range of other tribal populations of this region i.e. 27.49% Kotia, (Yasmin & Mascie-Taylor, 1997) to 61.84% Konda Reddi, (Veerraju, 1978). The coefficient of inbreeding of a specific consanguineous mating is the chance that both wife and husband derived common genes that are descended from a common ancestor.

The Yerukala reports lower mean menarcheal age (11.99 years) and Jatapu record higher mean menarcheal age (15.09 years) (Rao, Blake, & Veerraju, 1978). The results revealed that Yerukula girls usually get married approximately after 2-3 years of attaining menarche. The highest mean age at marriage (18 years) was reported in Kotia (Yasmin & Mascie-Taylor, 1997) and the lowest mean was 14.04 years in Yerukula (Present Study). It is to be noted that the tribal communities get their children married at an early age than their counter- caste populations living in either villages or urban areas. This might be due to lack of awareness or due to cultural practices of tribal population. The marital distance is an important phenomenon in understanding the dispersal of genes of Mendelian populations. The genetic structure of a population is determined not only by the amount of gene flow in to a population, but also by the extent and size of the geographical area over which genes are

distributed. The present tribe also recorded significantly lesser mean marriage distances among consanguineous couples (26.15 kilometers) than among non-consanguineous couples (34.69 kilometers). The results of marriage distance are also similar to other Andhra tribes (Babu & Kusuma, 2002). It is to be noted that marriage type and distance are sensitive to the time, and people are opting mates at farer places also, due to several socio-economic reason, including employment and migration.

The age of woman at first conception is an important event of her fertility performance since, the women with younger age at first conception leads to higher fertility span which enables more children, if natural reproductive behavior is not altered. Majority of the castes such as Relli (Ramesh, 1992), Chakali, Kummari, Madiga, Mangali (Babu & Naidu, 1989), Vada Balija (Rajeswari, Busi, Murty, Rao, & Narahari, 1992), Koppala Velama (Sudhakar, Padma, & Babu, 1998), etc. from Andhra Pradesh reported slightly higher age at first conception i.e. around 17 years. But the present tribe recorded the lowest mean age at first conception of 16 years. The mean age of last conception in Yerukula tribe is (23.34 0.62 years), an intermediate value between Koppulavelama (20.98 0.81years) (Sudhakar, Padma, & Babu, 1998), the lowest mean age at last conception and Yadava (36.33 7.20 years) (Rajeswari, Busi, Murty, Rao, & Narahari, 1992), the highest mean age at last conception.

The present study when compared with other tribal populations, the mean fertility ranges from 2.80 live births per women (Savara, Rao, Blake, & Veerraju, 1978) to 4.36 Konda Reddi (Veerraju, 1978). Yerukula women possessed the mean fertility in the range of other tribal populations. The mean number of conceptions and live births among non-consanguineous couples show higher values than consanguineous couples. Comparing the fertility details of Yerukula tribe with that of other tribal populations of this region (Naidu & Babu, 1999), the averages of tribal populations (4.07 mean conceptions, 3.84 mean live births and 2.96 mean surviving children) are slightly higher than those of Yerukula. Bogue (1969) indicated that the net reproductive index as intergenerational reproductive index. The net reproductive index is the manifestation of the average number of surviving female children for women. If the value is one or more than one, the population is exactly replacing itself, if the value is greater than one, it indicates that the population is growing itself, and if the value is less than one, the population is not replacing itself. Long term growth indications of fertility and mortality are expressed by net reproductive index. The net reproductive index for Yerukula is 1.8493 which indicates that the tribal population is growing. Similar trend was observed even in other tribal caste populations of Andhra Pradesh (Babu & Kusuma, 2002; Reddy & Malhotra, 1988). However, fertility measured in terms of mean conceptions, live births, and surviving children per woman, the differences between consanguineous and non-consanguineous groups are marginal and statistically not significant.

The present study records higher mortality rates than averages of tribal populations of this region (mean prenatal, post-natal and total deaths per woman are 0.26, 0.82, and 1.08, respectively as reported by Naidu, Babu, Kusuma, & Yasmin Devi, 1995). The mortality rates are slightly higher among non-consanguineous than consanguineous couples. The mortality differences between inbred and non-inbred populations may be explained by Sanghvi's (1966, 1982) hypothesis that the effect of inbreeding will be minimized due to the elimination of lethal and deleterious genes from the gene pool through a long history of consanguinity.

5. CONCLUSION

The present study on tribal population with moderately high fertility and mortality shows a picture of a growing population. Sex ratio was slightly deviated to the predominance of males. The results for mortality suggest that reproductive loss is positively associated with inbreeding in this tribe. The economically poor and illiterate Yerukulas do not adopt birth-control methods and perform early marriages. Thus, improving socio-economic conditions and creating awareness on medical facilities so as to reduce the fertility and mortality is essential to keep the population growth under control.

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