Variation in Selection Intensities among the Western Coastal Populations of India

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Abstract

Selection is continuously occurring on the living beings and the fittest who are able to reproduce will survive. To measure this selection, the data from 954 women was obtained who belong to different ethnic groups of Gujarat and Maharashtra and various index and components were computed using Crow`s Index and Johnston and Kensinger`s Index. The Crow`s total index value was found to be 0.539. The mortality component was found to be 0.130 and fertility component was found to be 0.363. The contribution of fertility component was greater than the mortality component according to Crow`s Index. Value of total selection index computed using Johnston and Kensinger`s Index is 0.639. The index of selection due to pre-natal mortality and post-natal mortality was observed to be 0.064 and 0.130 respectively. Therefore, it is found that among coastal populations of Gujarat and Maharashtra the selection trend is more due to fertility component than mortality component.

Introduction

Ever since Darwin, the role of natural selection in shaping the various characteristics of life and reproduction across different generations has been central to understanding variation in life and its extent. Natural selection is one of the major forces which cause changes in the genotypic frequencies of a population. Researches have proved that it is a natural force which increases the chance of survival of the fittest and adaptable ones.

Karl Pearson in 1907, examined that Darwinian Theory has application to civilised man and the heavy exemption from life does not means inefficiency (Pearson, 1912). Fitness is important demographic property, a function of reproduction and deaths variables in a population. It has been found that reproductive success in humans depends upon the total amount of progeny that parents contribute to the proceeding generations (Jacquard, 1969). In larger populations, there is a larger gene pool, meaning that it would take more time for natural selection to show its affect and cause fixation of alleles than in a smaller population. However, it is difficult to show direct evidence of such selection by experiments and to measure selection intensity directly. Natural selection does not only depend on the fluctuating fertility, but also depends upon the differential survival of the off-springs up to the reproductive age (Reddy et.al., 1987; Lasker & Kaplan, 1995).

To measure the natural selection effect and its impact, Crow (1958) has provided an index to measure intensity of selection. This index mainly depends on two components first is Intensity of fertility (If) and second is Intensity of mortality (Im). So, this index allows the changes in the fitness to be determined by calculating specific birth and death rates. The Crow index would measure actual selection only, if there is complete heritability and genetic factor solely determine birth and death rate (Jorde and Durbize, 1986), whereas

index of value zero indicates no changes in fitness (Livingston and Spuhler, 1965). Later on, this index was improvised by Johnston and Kensinger (Johnston and kensinger, 1971) to measure the third component called prenatal mortality and this index is known as Johnston and Kensinger Index.

Worldwide study on natural selection have shown that socio-economic and socio-cultural environment of a population have major impact on the fertility and mortality components and afterwards on selection (Crow 1958; Spuhler 1962; Johnston and Kensinger 1971; Tripp- Reimer 1980; Jorde and Durbize 1986; Sarkar et al. 1994; Kapoor et al. 2003; Gautam, 2009).

In India, the studies over different population groups have shown that natural selection is playing an important role in demonstrating fertility and mortality differentials among different populations in various environments (Gosh 1970; Murthy and Ramesh 1978; Basu et al. 1988; Barua 1976; Kapoor and Patra 1998; Chengal Reddy and Lakshanudu 1979; Kapoor and kshatriya 2000; Rao and Murty 1984; Gautam 2006, 2009; Reddy and Chopra 1990). India also has a huge

coastal boundary divided into Eastern Coastal Zone and Western Coastal Zone with a varying risk factor like cyclone, tsunami, flooding etc. The coastal vulnerability is induced both by human related causes like rise in greenhouse gas (Nicholls et al. 1999; Varekamp 1999) and natural factors like season change. So far, the study among the coastal part of India (Odisha and Goa) is conducted by Kapoor et al. in 2012 which reveals that mortality is predominant factor contributing to selection intensity among coastal populations (Kapoor et al., 2012) whereas fertility is predominant factor among Non-coastal populations (Singh and Kapoor, 2015). Hence, the present investigation was to determine the variation in selection intensities among populations of two states of western coast of India i.e., Gujarat and Maharashtra. This study will also supplement the previous study among the various coastal populations of India and the world.

Methodology

The data for the present study was collected in different phases during year 2017 to 2019, from 81 villages of Gujarat and Maharashtra. These villages
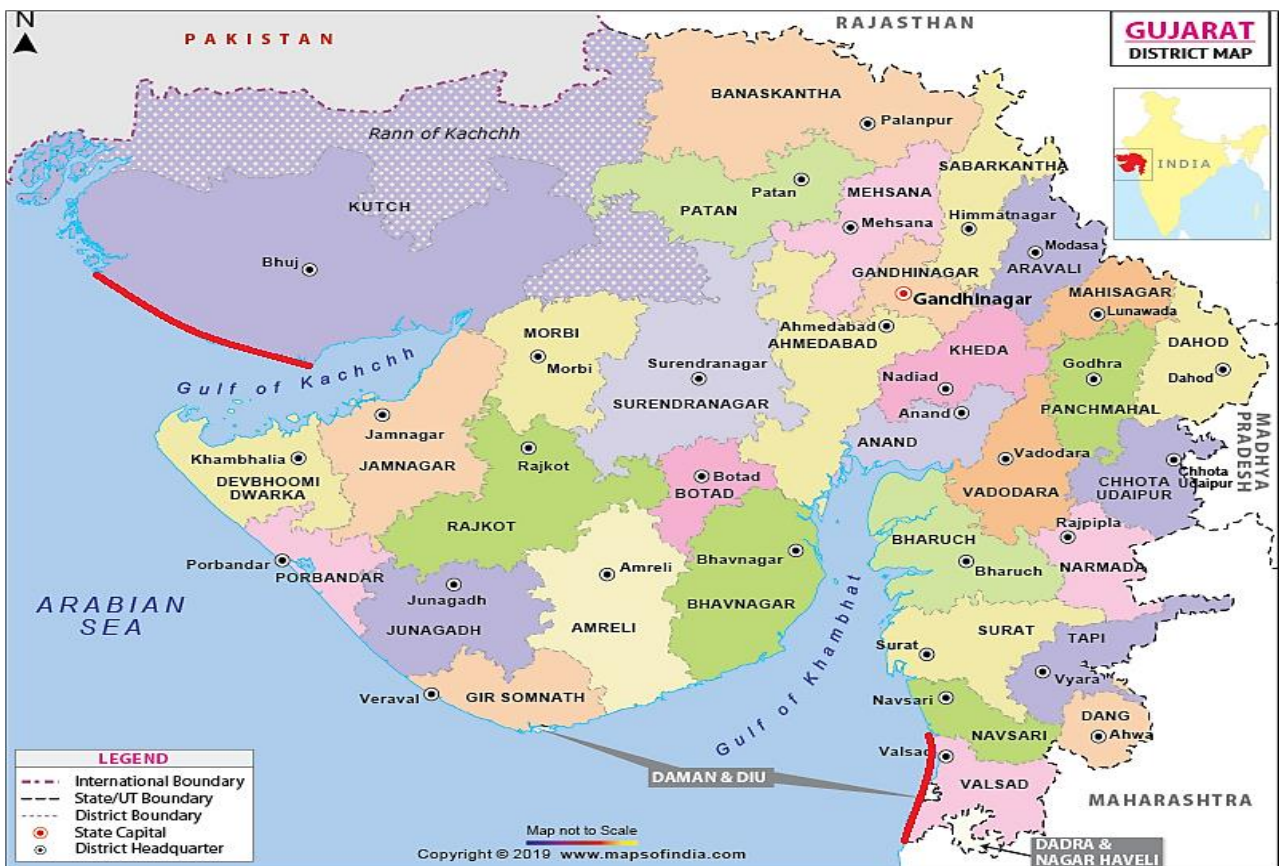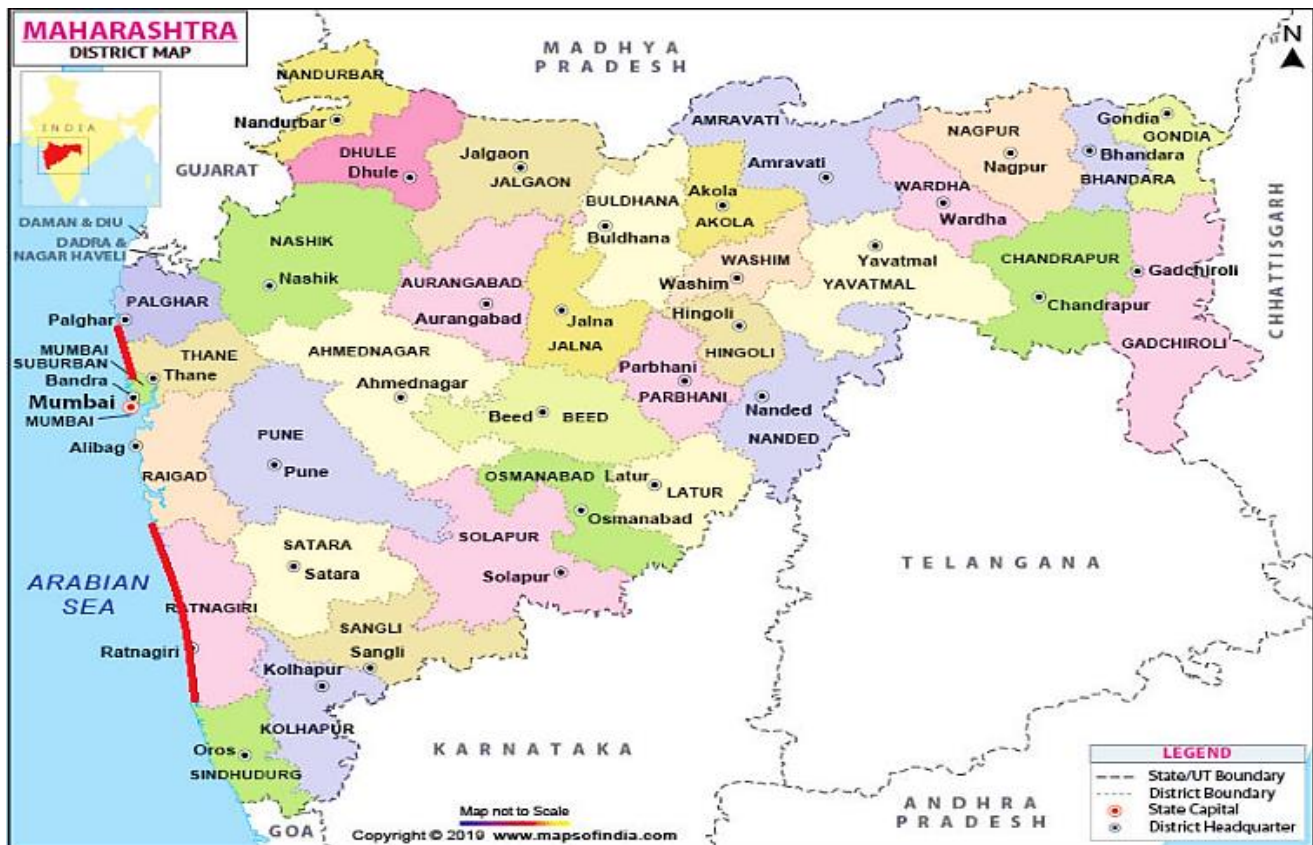
Figure 1 & 2: Study Areas in Gujarat & Maharashtra (Shown in Red Boundary), Source: Maps of India

belong to Kutch and Valsad districts of Gujarat and Ratnagiri and nearby villages of Mumbai districts of Maharashtra (Figure 1 & 2). Demographic data were collected from 954 women aged 40+ years (considered to have completed their fertility) on fertility (pregnancies, live births etc.) and mortality (still births, abortion, child death before 15 years of age etc.). Ethical clearance was obtained from appropriate authorities prior to the commencement of the study. Subjects were informed about the objectives of the study and written consent was obtained from them.

The selection intensity has been computed by using internationally accepted original method devised by Crow in 1958 and later modified formulae by Johnston & Keisinger in 1971.

Results and Discussion

Data on various demographic parameters were collected and tabulated (Table 1). The data involves 954 mothers who experienced 3207 pregnancies during their reproductive life span. Among these pregnancies

3017 were successful birth and 190 were pre-natal deaths. The post-natal death counts 329 of total successful pregnancies. The methodologies devised by Crow (1958) and Johnston & Kensinger (1971) were used to determine total selection indices. The proportion of pre-reproductive deaths varied from 0.162-0.073 and proportion of pre-embryonic deaths varied from 0.096-0.028 (Table 3). The proportion of survivor from birth to reproductive age was highest among Bhoi of Maharashtra (0.927) and lowest among Muslim of Gujarat (0.838). Overall the total index of selection was highest (0.617) among the Machhawa of Maharashtra and lowest (0.388) among the Macchiyaras of Gujarat. In Maharashtra the lowest total index of selection was among Bhoi (0.418) and in Gujarat the highest total intensity of selection was among Koli (0.596) (Table 2). Among all these mentioned populations the selection was operating due to fertility component rather than mortality component. The fertility component contributed more than 70% in total index of selection in all populations,

TABLE 1: Demographic variables Utilizes in calculation of index of total selection for Gujarat and Maharashtra population

Area	Ethnic Groups*	Occupation*	Number of mothers with completed fertility	Total number of pregnancies	Number of children ever born (live births)	Prenatal deaths	Post-natal deaths
Gujarat	Macchiyaras	Fishing/Business	132	477	457	20	36
	Muslim (Mavdari-Bhuj)	Fishing/Boat Makers/Shopkeepers/Miscellaneous works	74	247	234	13	38
	Koli	Miscellaneous jobs including Fishing	113	332	310	22	35
	Bhoi	Miscellaneous jobs including Fishing	107	358	322	36	42
Maharashtra	Manzi/Macchi	Fishing/Business	130	453	435	18	48
	Bhoi (Ratnagiri)	Fishing/Business	130	425	413	12	30
	Koli	Fishing/horticulture	96	337	318	19	30
	Malhar	Fishing and Shop keeping	76	264	247	17	28
	Machhawa	Fishing	96	314	281	33	42
		Total	954	3207	3017	190	329

*Fishing communities are substantially dependent on fisheries resources for their livelihood which are majorly influenced by a wide range of natural, climatic and human factors. These communities are indulged into a wide range of fishing activities including capturing of fishes, their culturing, processing and preserving to selling of fishes and their products in local markets.. However, a high degree of dependency on coastal and marine resources makes these communities vulnerable to changes in resource availability and conditions. In order to reduce their higher dependency on fishing sector and to sustain their livelihood, these communities have also adopted altered livelihood activities like small-scale business, shop-keeping, shrimp collection, boat making and other miscellaneous jobs.

Table 2: Selection intensities (based on live births and pre-reproductive mortalities- Crow, 1958)

Area	Ethnic Groups	Occupation	Proportion of pre-reproductive deaths P_d	Proportion of survivors from birth to reproductive age P^a_s	Index of selection due to mortality I_m	Index of selection due to fertility I_f	Total index of selection I_t	Mean number of live births X	X^2	Variance of live births	% Fertility Component	% Mortality Component
Gujarat	Macchiyara	Fishing/Business	0.079	0.921	0.086	0.279	0.388	3.460	11.972	3.340	77.982	22.018
	Muslim (Mavdari-Bhuj)	Fishing/Boat Makers/Shopkeepers/Miscellaneous works	0.162	0.838	0.194	0.319	0.575	3.160	9.986	3.190	66.298	33.702
	Koli	Miscellaneous jobs including Fishing	0.113	0.887	0.127	0.416	0.596	2.740	7.508	3.120	78.636	21.364
	Bhoi	Miscellaneous jobs including Fishing	0.130	0.870	0.150	0.357	0.560	3.010	9.060	3.230	73.214	26.786
Maharashtra	Manzi/Macchi	Fishing/Business	0.110	0.890	0.124	0.297	0.458	3.350	11.223	3.330	72.893	27.107
	Bhoi (Ratnagiri)	Fishing/Business	0.073	0.927	0.078	0.315	0.418	3.180	10.112	3.190	81.283	18.717
	Koli	Fishing/horticulture	0.094	0.906	0.104	0.599	0.765	3.310	10.956	6.560	86.389	13.611
	Malhar	Fishing and Shop keeping	0.113	0.887	0.128	0.308	0.475	3.250	10.563	3.250	73.077	26.923
	Machhwa	Fishing	0.149	0.851	0.176	0.375	0.617	2.930	8.585	3.220	71.505	28.495

Table 3: Selection intensities (based on pregnancies and Pre-reproductive mortalities including embryonic mortalities-Johnston and Kensinger, 1971)

Area	Ethnic Groups	Occupation	Proportion of pre-reproductive deaths P_d	Proportion of survivors from birth to reproductive age P^a_s	Proportion of embryonic (prenatal) deaths P_{ed}	Proportion of survivors to birth P^b_s	Index of selection due to embryonic mortality I_{ame}	Index of selection due to post-natal mortality I_{amc}	Index of selection due to fertility I^a_f	Total index of selection I	Mean number of live births X	X^2	Variance of live births	Fertility Component %	Post-natal Mortality Component %	Embryonic mortality component %	Total mortality component %
Gujarat	Macchiyara Muslim (Mavdari-Bhuj)	Fishing/Business	0.079	0.921	0.042	0.958	0.044	0.086	0.279	0.449	3.460	11.972	3.340	71.216	19.040	9.744	28.784
	Koli	Fishing/Boat Makers/Shopkeepers/Miscellaneous works	0.162	0.838	0.053	0.947	0.056	0.194	0.319	0.663	3.160	9.986	3.190	62.366	29.252	8.382	37.634
		Miscellaneous jobs including Fishing	0.113	0.887	0.096	0.904	0.107	0.127	0.416	0.766	2.740	7.508	3.120	69.458	16.616	13.926	30.542
	Bhoi	Miscellaneous jobs including Fishing	0.130	0.870	0.073	0.927	0.078	0.150	0.357	0.682	3.010	9.060	3.230	66.530	21.989	11.480	33.470
Maharashtra	Manzi/ Macchi	Fishing/Business	0.110	0.890	0.051	0.949	0.053	0.124	0.297	0.536	3.350	11.223	3.330	66.851	23.161	9.988	33.149
	Bhoi (Ratnagiri)	Fishing/Business	0.073	0.927	0.028	0.972	0.029	0.078	0.315	0.460	3.180	10.112	3.190	76.641	17.039	6.320	23.359
	Koli	Fishing/horticulture	0.094	0.906	0.056	0.944	0.060	0.104	0.599	0.871	3.310	10.956	6.560	81.176	11.963	6.862	18.824
	Malhar	Fishing and Shop keeping	0.113	0.887	0.064	0.936	0.069	0.128	0.308	0.576	3.250	10.563	3.250	65.878	22.182	11.941	34.122
	Machhwa	Fishing	0.149	0.851	0.073	0.927	0.079	0.176	0.375	0.745	2.930	8.585	3.220	65.780	23.604	10.616	34.220

although it varied from 62.37 among Muslim of Gujarat to 81.18 among Koil of Maharashtra. As mentioned in Table-2 the overall contribution of fertility component is 75.70% while of mortality component is 24.30%. The reduction in mortality component was may be due to diseases occurring among the coastal populations. The total selection index was reported to be moderate among these populations, as average total selection index for Indian population was reported to be 0.585 (Gautam, 2009).

The high post-natal mortality in the studied populations may be due to the poor health care (Shyam et al., 2014) and environment provided to them. Environmental conditions contributing high post-natal mortality include inadequate facilities for proper living and more emphasis on the ante-natal care than post-natal care (Mavalankar et al., 2009). Furthermore, the negligence from various vaccinations, unhealthy post-natal care practices, gender related neglect of healthcare seeking due to high expenditure of specialized healthcare services can also be a cause of this high rate of post-natal mortality (Shah and Dwivedi, 2013; Dabade et al., 2013; Chaudhari and Virmani, 2016).

The contribution of fertility component to total selection index in current study is higher than the earlier study of coastal populations study by Kapoor et al in 2012. Their study among the populations of Goa and Odisha shows the fertility component contribution of 66.23% while present study estimate is of 69.54% (Table-3). Similarly, there is a decrease in the embryonic mortality component contribution (9.92%) as compared to their study (13.95%) and there is slight increase in the post-natal mortality component contribution (19.82%-earlier to 20.54%-present). Since both the studies were conducted among the coastal populations so the risk on the life must be same through natural calamities, although the quality of life can be affected by their local government agenda or the policies and facilities available to them in last few years. So, the overall increase in fertility component and decrease in embryonic mortality component shows the continuous increase in the health services in the present study area despite the fact that both area differs so, there must be chance that the variations can be area dependent, but

if we consider the progress of coastal areas on overall basis then the increase is efficient and valid.

Conclusion

The study shows that the contribution of fertility component in total selection is more than mortality component. As, this show an inversion from the general past trend of selection among coastal populations and similarity with non-coastal populations. This must be due to improved health care, proper sanitation, reduction or protection from natural hazards etc. Further, a re-analysis of all the studied coastal area after fixed time must be required to trace out the actual selection pattern.

Acknowledgements

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