Extensive studies on consanguinity and its impact on reproductive behaviour and infant disorders have been well documented for the past several years (Freire-Maia, 1957a, b; Morton, 1961; Rao & Inbaraj, 1979 a,b; Khlat & Khowry, 1991; Bittles, 1998; Yassin, 2000; Krishnamoorthy and Audinarayana, 2001). In the earlier reports, the socio-economic status of spouses served as prime means for the occurrence of consanguinity. However, the recent reports highlighted that the status of consanguinity has declined in most of the communities of developed and developing countries through time. Global attempts in the study of consanguinity which are relevant to the present study are briefly reviewed here region/country wise.

NORTHERN AMERICA

UNITED STATES

The occurrence of marriage between related spouses is comparatively lower in the United States than in other countries (Morton, 1961; Freire-Maia, 1982; Christensen, 1998). The reasons for the negligible consanguinity are the growth of population, urbanization and increased awareness about the occurrence of detrimental effects of the phenomenon coupled with Church ban on close-kin marriages. However, in certain isolated communities such as the Dunkers of Pennysylvania (Glass et al., 1952), the Hutterites of South Dakota and Minnosota (Crow & Mange, 1982) in the American Gypsies of Massachusetts
(Thomas et al., 1987) and in the Old Order Amish in Pennsylvania (Khoury et al., 1987a,b,c), fairly high rates of related marriages occur. Among the Mennonites in Kansas, there was no evidence of significant relationship between inbreeding and the effects on reproductive parameters (Moore, 1987). Further, in United States consanguinity prohibition laws have been enacted considering related marriages as criminal offences in eight of its states and illegal in further 31 states (Ottenheimer, 1990). Dortsen et al. (1999) have shown that inbreeding has a net positive effect on neonatal and post neonatal mortality. Recently Mathias et al. (2000) have reported that inbreeding in the Tangier Island population in Virginia is consistent with the isolated nature of its population, and its temporal trend reflected patterns in emigration and break down in isolation over time. It is noted that in more than half of the states of the United States, marriage between first cousins is prohibited by law and the Roman Catholic Church and the Orthodox Eastern Church have strict rules on consanguinity (The Columbia encyclopedia, 2000). Among the members of the Utah Mormon population, the rate of consanguinity was low while significant increase in pre-reproductive mortality was seen among the offspring of first cousin marriages (22%) and among the offspring of closer unions (32%) (Jorde, 2001).

CANADA

Freire-Maia (1968) observed 1.5% consanguinity with the patterns like first cousin, first cousin once removed and second cousin in the
Canadian population. Fraser and Biddle (1976) have ascertained families in Montreal through probanda with genetic diseases, and they reported the existence of consanguinity in terms of first cousin and second cousin marriages and their relative risk of reproductive disorders. It was also observed that there was no noticeable level of consanguinity in certain minority populations in the regions of Newfoundland (Bear et al., 1988). In Quebec, there was low rate of consanguinity (1.3%) with the patterns such as uncle-niece, first cousin, first cousin once removed and second cousin (De Braekeleer and Ross, 1991).

In the countries like Puerto Rico and Cuba, the data collected based on Roman Catholic dispensation record during 1954-1957 registered prevalence of related marriages by first cousin, first cousin once removed and second cousin, and the rate of consanguinity was 3.3% and 0.8% in the respective countries (Freire-Maia, 1957a, 1968).

CENTRAL AMERICA

Studies in Central America showed prevalence of consanguinity ranging from 0 to 4.9%. Freire-Maia (1968) has initiated investigations on consanguinity in most of the countries in the Province of Central America. Considerable percentage of closely related marriages with the patterns like first cousin, first cousin once removed and second cousin was observed in Costa Rica, El Salvador and Honduras.

In Mexico there was low rate of consanguinity (0.3-1.3%) with preference for first cousin, first cousin once removed and second cousin
types of marriages. The observations made during 1956-1964 exhibited a
trend in Panama to prefer related marriages in terms of first cousin alone
with a low percentage (1.7%) of consanguinity (Stevenson et al., 1966;

SOUTHERN AMERICA

BRAZIL

Consanguinity studies with great variations in inbreeding rates in
different parts of Brazil were well documented (Freire-Maia, 1957 b, 1968;
De Fonseca and Freire-Maia, 1970; Liascovich et al., 2001). Wide
heterogeneity of factors like socio-economic levels, cultural practices and
degrees of ruralization in different groups of people were considered to be
responsible for this variation. A house to house survey made by Freire-
Maia (1958) in Brazil confirmed the preference of consanguinity through
first cousin marriages and subsequent inbreeding effects like prenatal and
postnatal mortality. Marcallo et al. (1964), while studying inbreeding effects
on mortality and morbidity in South Brazilian population have reported
that genes producing embryo and foetal deaths are smaller in number than
those leading to mortality in childhood.

In Southern Brazil, the inbreeding rates were inconsistent among
places and diminished with time (Freire-Maia and Krieger, 1963; De
Fonseca and Freire-Maia, 1970). Certain surveys (De Fonseca and Freire-
Maia, 1970) confirmed the differential distribution of inbreeding levels and
it was reported that the levels were severalfold higher than the estimate for
American Catholics.
De Araujo and Salzano (1974) have noticed a significant negative correlation between inbreeding rates and marital distance in Sao Paulo of Brazil and also reported negative effect of marital distance on prenatal mortality and morbidity in two Brazilian populations. Freire-Maia and Takehara (1977) have reported increased rates of abortion, still birth and infant-juvenile mortalities in the inbred families of Japanese Nationals in this country. The Whites in Brazil with high rate of consanguinity showed only marginal increase of still birth and pregnancy wastage, while their Negro counterparts showed notable increase in both effects (Azevedo et al., 1980). The observations of Freire-Maia (1984) on the effects of mortality and precocious mortality highlighted excess risk among incestuous children (31.6%) and children of uncle-niece families (17.8%), whereas this was very low for the children of first cousin, first cousin once removed and second cousin groups of families. Prenatal mortality was found to be 15% in consanguineous group as against 12% in the nonconsanguineous, while the level of postnatal mortality in first cousin families (16%) was double than that of the control group (Freire-Maia and Frota-Pessoa, 1984). Richieri-Costa et al (1986, 1987) have reported the occurrences of Coffin syndrome, ectodactyly and cleft lip palate in the Brazilian children born to different consanguineous couples. Freire-Maia (1990) has observed the relative and attributable risks in the selected Brazilian population and emphasised that consanguinity in the country would result in only a negligible increase in inbreeding damage. A study (Kaku and Freire-Maia, 1992) among the Brazilian whites and non-whites revealed a low relative
risks for morbidity and moderately high attributable risks. This was pointed out to be an indication of lowering of abnormality rate in the absence of inbreeding. Liascovich et al. (2001) have reported that the mean consanguinity rate was 0.96% with significantly higher values in Brazil and Venezuela. Further, first cousin matings were predominant and there was positive correlation between low paternal education and occupation levels with consanguinity.

CHILE

Several studies revealed low rate of consanguinity with first cousin, uncle-niece, first cousin once removed and second cousin types among the population of Chile (Stevenson et al., 1966; Freire-Maia, 1968). In the study made by Lazo et al. (1978) in the population of Valparaiso, they have attempted to determine the effect of certain variables such as social, economic and cultural ones which influence consanguineous marriages with space and time. Their data showed the rate to be decreasing with time. There was urban-rural difference, the former registering the lower rate. Judicial and chronological motives for dispensation were more frequent in the urban zone which resulted in low inbreeding rate, while geographic and economic status in the rural areas caused increased consanguinity. Certain observations noticed no difference in the age at marriage and the length of fertility period between the consanguineous and nonconsanguineous couples (Lazo et al., 1978). Another study by Lazo et al. (1996) has revealed a declining trend of consanguinity rate and coefficient of inbreeding with time.
ARGENTINA

The earlier observations made in the population record (1954-57) of Roman Catholic dispensation noticed inbreeding rates around 1% with uncle-niece, first cousin, first cousin once removed and second cousin types of marriages (Freire-Maia, 1957a, 1968). The data from the Baptismal books of the Parochial Church of Humanuaca from 1734 to 1810 revealed the prevalence of consanguinity and estimated the values of 'F'. There is a tendency for $F$ and its components to increase through time (Dipierry et al., 1991). Consanguinity studies made during 1980-84 showed decline in the rate of closely related marriages with prevalence of the first cousin type (Castilla et al., 1991). Rittler et al. (2001) have observed a significant association of parental consanguinity for congenital anomalies like hydrocephalus, post axial hand polydactyly and bilateral cleft lip.

OTHER SOUTH AMERICAN COUNTRIES

The data collected from the population record based on Roman Catholic dispensation in the countries such as Boluvia, Columbia, Ecuador, Uruguay noticed the presence of consanguinity ranging from 0.6 to 6.3% with uncle-niece, first cousin, first cousin once removed and second cousin patterns (Freire-Maia, 1957a, 1968). Steveneson et al. (1966) have reported a negligible increase in consanguinity (2-4.4%) through preferring first cousin type in the countries like Boluvia and Columbia. While first cousin marriage was predominant in the whole South American sample, second cousin type was the commonest in Costa Rica (Freire-Maia, 1968).
Orioli et al. (1982) have reported parental consanguinity in seven South American countries, Argentina, Peru, Brazil, Chile, Ecuador, Uruguay and Venezuela with the coefficient of inbreeding ranging from 0.00040 to 0.00070. Jorde and Pittsnen (1991) observed the level of inbreeding in Finland to be due to first cousin marriage and the average kinship coefficient was varied from to 0.00011 to 0.00020.

EASTERN AFRICA

Tanzania is the only country located in the eastern part of Africa which is dominated by Muslims. Tanner's (1958) study revealed that cousin marriages (60.6%) are common in the Muslim community mainly for conservation of family property and lower dowry. Parallel type of first cousin marriages are followed while matrilateral cross type is forbidden. Among the cousin marriages, about 89% of the women married before the age of 20. The Tanzanian data on the rate of fertility and child mortality had no difference between the consanguineous and nonconsanguineous families. Further, there was slightly higher proportion of fertility among the consanguineous group.

NORTHERN AFRICA

Demographic and consanguinity survey made among the North African countries such as Algeria, Egypt, Sudan and Tunisia have revealed the high rate of closely related marriages (18.3-69.8%) with first, second, and double cousin patterns of consanguineous unions (Bittles, 1998).
The Algerian population revealed fairly high consanguinity rates (22-25%) with a high preference for first cousin type. The studies also showed the adverse effect of consanguinity like infant mortality, congenital defects and diseases (Benallegue and Kedji, 1984).

Studies carried out in Egypt by Badr, 1972; Hafez et al., 1983; and Scheidel, 1997 revealed very high consanguinity rates (61-70%) with coefficient of inbreeding ranging from 0.0329 to 0.0338. Among different cousin marriages followed, first cousin pattern was predominant, especially the patrilateral parallel type. The frequency is reported to be much higher in the rural areas, particularly among the illiterates. Mortality and morbidity were reported to be higher among the progenies of related couples (Bittles et al., 1991; Mokhtar et al., 1998).

The population of Sudan comprise innumerable geographical tribes, among whom the Arabs showed higher rate of inbreeding (Saha and El-Sheikh, 1988) than the indigenous Negroids. The most common related marriage is the first cousin type, the parallel type predominating as in the Muslims of most other countries. Consanguinity effects showed no significant difference from the nonconsanguineous groups. However, infant mortality was higher in inbred (Saha et al., 1990).

Studies in the other African Muslim countries like Nigeria, Morocco and Tunisia revealed that intermarriage and consanguinity are the biological and socio-economic phenomena in the population of the region, which have been found to affect fertility and cause higher mortality and
morbidity (Scott-Emuakpor, 1974; Bittles, 1992). A declining trend of consanguinity rate was noticed in Morocco and Tunisia. There was clear urban-rural differences, with the rural registering higher rates. Patrilateral parallel cousin marriage was the most common type in these regions. In a recent study, the incidence of Hirschsprung disease, mental retardation, and microcephaly were observed in the offsprings of consanguineous family (Brooks et al., 1999).

SOUTHERN AFRICA

In South Africa, data were collected from the hospital records in the cities like Cape town, Johannesberg and Pretoria. The rate of inbreeding was comparatively lesser than in all other African countries. However, first cousin marriages were common as in other parts of Africa (Stevenson et al., 1966). Demographic, socio-economic and educational status of population in the selected urban areas were attributable to less preference for related marriages.

WESTERN AFRICA

Studies on consanguinity made in Guinea and Nigeria showed high rate of related marriages with preference to first and second cousin type of consanguinity. It was found that consanguineous marriages are associated with socio-economic status of the population (Scott-Emuakpor, 1974).
EUROPE

In general, marriages between close relatives are very low in Europe. Most studies among the European populations have shown evidence of a clear decline in inbreeding tendency (Sheets, 1980; Pettener, 1985). McCullough and O. Rourke (1986) have noticed a geographic pattern of inbreeding in the Northern parts showing the lowest rate and those in the South the highest. They have also found the decline of inbreeding rate to be due to increased mobility, industrialization and other socio-economic changes.

EASTERN EUROPE

Consanguinity data collected from civil and hospital populations revealed a low rate of consanguinity (0.1-0.8%) preferably first and second cousin types in the countries like Czechoslovakia (Stevenson et al., 1966) and Hungary (Czeilel et al., 1976).

WESTERN EUROPE

Earlier attempts on French populations correlated the relationship between consanguineous marriages and certain demographic and genetic phenomena (Sutter and Tabah, 1952; 1953). Studies of Cavalli-Sforza et al. (1966) have observed a negative effect of migration on consanguinity rate. Tchen et al. (1977) noticed a decline of first cousin marriages. Although a declining trend appears in recent years, an increase in the inbreeding rate was observed in French Pyrenees due to genetical and cultural isolation (Serre et al., 1985). Crognier (1985) who made an
elaborate study among the rural isolates in France, pointed out that increased migration from the rural areas to the towns had effected significant demographic and social changes, which in turn modified the genetic structure of the population. He contended that the breakdown of the rural isolate character must be responsible for the decline of consanguinity rate in the group. In the populations studied in North-Eastern France evidenced that parental consanguinity is still a factor of reproductive disorder and infant mortality (Stoll et al., 1999). The estimates of inbreeding derived from pedigrees and frequency of consanguineous marriages recorded between 1763 and 1972 in rural villages of the French Jura evidenced a decrease in the mean inbreeding coefficient rates (Vernay, 2000). Verloes et al. (2001) observed the incidence of autosomal recessive syndrome with multiple physical anomalies due to consanguinity.

NORTHERN EUROPE

Extensive studies on prevalence of consanguinity have been made in the countries like United Kingdom, Ireland, Norway, Scotland and Sweden. As per the surveys made on hospital, residential and civil populations, the rate of consanguinity was less than 1% in most of the countries of Northern Europe which was mostly of first cousin type (Coleman, 1980; Magnus et al., 1985; Bundey et al., 1990). While Morton (1958) reported foetal growth retardation to be due to parental consanguinity, Schork (1964) did not find such an effect. Roberts et al. (1979) made a sample survey in Okney by using all available records for
assessing the inbreeding rates of the normal population and found that the rates were higher than those of the hospital group as well as of the rural population. Hospital data on the Pakistani Nationals in Birmingham (Honeyman et al., 1987) showed inbreeding to be affecting foetal growth when it was associated with poor growing conditions. Chitty and Winter's (1989) studies in different Ethnic groups in the United Kingdom based on hospital data showed that the rate of mortality and recessive congenital malformations were more among the Pakistani Nationals than those among the other Europeans and this was pointed out to be due to high consanguinity rate and low social status of the Pakistanis in the country.

Studies carried out in different populations of Ireland exhibited a wide range of consanguinity rate (0.5-72%) with a preference for first cousin marriages (Flynn, 1986; Barry and Kirke, 1997). Uncle-niece and double first cousin marriages are also practised. Higher child mortality and higher rates of congenital malformation are found to be associated with the inbred group.

Saugstad (1977) studied consanguineous marriages in Norway and observed that high inbreeding levels were associated with rural residence. Results of inbreeding studies based on hospital records since 1967 by Magnus et al. (1985) showed significant increase of mortality and congenital abnormalities among the progenies of consanguineous marriages especially first cousin parents and this is claimed to confirm the effect of deleterious genes on reproductive outcome. Further Stolenberg et al. (1998) noticed
that the risk of birth defects was largely attributable to low maternal and or paternal education among the consanguineous families. Stolenberg et al. (1999a, b) revealed the risk of recurrence of birth defects to be higher for the offsprings of first cousin parents than for those with nonconsanguineous parents.

Notable contributions on consanguinity in the population of Sweden were made by many workers (Book, 1957; Smith, 2001). Results of the studies carried out by Book (1957) on a geographically isolated population from the North Sweden showed no significant difference in parental fertility and mortality of live-born children between consanguineous and nonconsanguineous families. Despite low frequency of abortion and still births in cousin families, the total mortality was high in the closely related marriage group besides intellectual impairment among children. Studies by Fernell (1998) have showed that consanguinity plays a major role towards the incidence of Rett Syndrome and mental retardation. Smith (2001) noticed prevalence of first cousin and absence of second cousin marriages with the mean coefficient of inbreeding of 0.0002.

SOUTHERN EUROPE

The occurrence of consanguinity was greater in Southern Europe especially in Portugal (Freire-Maia, 1957a) and Spain (Varela et al., 1997) than other parts of Europe. High incidence of first cousin marriage occurs in urban areas while uncle-niece type more prevalent in Northern Spain. Abelson (1979, 1980) has suggested that besides population
density and social conditions of the Spaniards, demographic parameters would also be considered for assessing the probable levels of homozygosity. Results of Calderon (1989) on the population of Toledo region showed that the most frequent type of consanguineous marriage in the region is second cousin followed by first cousin, while uncle-niece marriages were very rare. Further the reports have evidenced a decline in the rate of consanguinity through time (Calderon et al., 1998). They contended that this early fall in the level of inbreeding might be due to industrial development and the resulting loss of importance of land ownership.

In Italy low rate of consanguinity which ranged from 0.5-2.33% was reported in many regions (Fraccaro, 1957; Danubio et al., 1999). Marriages were mostly of first cousin and second cousin types. Studies made by Fuster et al. (2001) in Gredos mountain range (Spain) showed a low frequency of uncle-niece marriage (0.21%). There was also a decline in the rate of inbreeding with time. Baccetti et al. (2001) reported the occurrence of genetic sperm defects and subsequent infertility in males of consanguineous families.

**ASIA**

Asia is the largest continent in the world which comprises both developed and developing countries. Consanguinity studies made in different countries were grouped and presented based on the geographical directions/locations of the countries.
EASTERN ASIA

CHINA

The country with the highest population in the world comprising innumerable communities dwelling in both urban and rural areas. Studies by Du et al. (1981) have shown that consanguinity rate varied from 0 to 14.6% in different populations. The population of the city Beijing and the communities such as Tibetan and Korean had little and or no prevalence of consanguineous marriages. However, very high rate (58.2%) was reported by Wu (1987) with a coefficient of inbreeding of 0.0431. Among the different cousin marriages preferred first cousin, first cousin once removed and second cousin were predominant in China. Later studies have reported the incidence of consanguineous marriages as varying from 2.14-27.4% in different communities (Zhang 1992). There is significant difference in the incidence of inbreeding and eventual reproductive disorders with respect to different communities and their geographic distribution in China. In general, it was observed that inbreeding in this country is attributable to demographic and socioeconomic status and communal diversity of the population (Zhang 1992; Bittles, 1998). The studies have also shown significantly higher incidence of mortality and morbidity like deafness, albinism, and cleft-lip/cleft-palate in the consanguineous offspring (Gong et al., 1994; Yan et. al., 1994).

JAPAN

Extensive studies on consanguinity have been carried out in Japan because of high rates of related marriages coupled with family registration
system (Ohkura, 1960) and high rate of fecundity (Fujiki et al., 1968). It has been postulated that inbreeding has no effect on interval between marriage and first birth as there was no evidence of recessive lethal components influencing at early zygote stage in several inbreeding groups (Morton, 1958). It was also pointed out that foetal survival depended more on maternal effect rather than on the foetal zygote (Schull, 1959). Neel and Shull (1962) have pointed out that the inbreeds have a negligible effect of inbreeding on mortality and morbidity, and this is considered to be due to lesser accumulation of deleterious genes as a consequence of high inbreeding levels in the past centuries. Fujiki et al. (1968) found higher rates of consanguinity in the mountaineous villages than those in islands and they did not observe any effect of inbreeding on fertility and mortality. Several studies (Tanaka, 1977; Tanaka et al., 1967) have reported adverse effects of maternal inbreeding on fertility, mortality and morbidity. Yamaguchi et al. (1975) observed significantly higher rate of infant mortality among the inbreeds in the Fukuoka population due to the action of recessive lethals in the first six years. Imaizumi et al. (1975) have reported matrilateral parallel cousin marriages as the most common among the isolated population in the western part of Japan. Several studies (Imaizumi, 1978, 1988; Imaizumi and Kaneko, 1997) revealed a declining trend of consanguinity in Japan, and the frequency of consanguinity has been correlated with various factors like marital distances between birth places of spouses, socio-economic and geographical factors. Despite rapid decline of inbreeding in the country, in general, consanguinity rate was found to remain significant in many
small villages due to adherence to the traditional social values (Imaizumi, 1987; Fujiki et al., 1992). They have also pointed out that the rate of certain genetic disorders are likely to remain high or even increased in some societies due to socially prescribed mating systems.

SOUTH EASTERN ASIA

Consanguinity studies carried out in the South Eastern Asian countries noticed a low to moderate level of inbreeding with high preference for first cousin marriages. Comparatively, the rate of inbreeding was lower in Philippines (0.4%) followed by Malaysia (7.6%) (Stevenson et al., 1966).

WESTERN ASIA (MIDDLE EAST)

Countries in the Western part of Asia and or in the Middle East of the world were predominant with Muslim communities. Consanguinity has been found to be a very common phenomenon in almost all the countries. In this region, extensive investigations have been made in Israel, Turkey and Saudi Arabia.

Israel is known for fairly high incidence of related marriages. Among the Samaritan community Gini’s (1933) initial studies revealed high rate of abortion. This was pointed out to be due to strict and prolonged inbreeding in this country. The Moroccan Jewish community registered high rate of consanguinity (Fried and Davies, 1974). In this group uncle-niece marriages were fairly common and among their children abnormality due to autosomal recessive genes was higher. Several studies showed a wide range of consanguinity which varied from 24.2-48.7% (Bashi, 1977;
Freundlich and Hino, 1984; Jaber et al., 1994). The commonest type of marriage was that between patrilateral parallel first cousins and double first cousins (Bashi, 1977; Jaber et al., 1997, 1998). Freundlich and Hino (1984) have noted prevalence of consanguineous marriages to be higher in the younger generations, especially in the rural areas. The recent investigation made among the Arabs highlighted significantly high incidence of major reproductive abnormalities in the villages as the parental relationship was very close as compared to urban area (Jaber et al., 1994, 1997) and further suggested prenatal diagnosis among the consanguineous Arab woman might be a tool to avoid inbreeding disorders (Jaber et al., 2000).

In Turkey, early studies revealed high rate of inbreeding (24.40 - 31.60%) in different parts of the country (Sayli, 1969). Later studies revealed still higher frequencies, the highest being close to 50% (Ulusory and Tunck bilek, 1987; Basaran et al., 1988). Vogel and Motulsky (1982) have observed high consanguinity rate in the urban areas but Guz et al. (1989) have observed higher frequencies in the rural areas than in urban. Uncle-niece marriage is forbidden in Turkey by Civil Law and religious rules.

Baki et al. (1992) and Tunck bilek and Koc (1994) have reported strong preference for first cousin type. Studies in this region have revealed positive correlation between consanguinity and pre-reproductive mortalities like abortion, still birth, infant mortality and sterility (Basaran et al., 1989; Baki et al., 1992; Tunck bilek and Koc, 1994). Basaran et al. (1989) have
proposed that factors such as population structure, ethnic groupism, religious and socio-economic status would be attributable to incidence of related marriages in Turkey. Demirel et al. (1997) have reported that the number of children with an abnormality was high in consanguineous marriages, while the frequency of spontaneous abortion, still birth and infant death remained the same. Some studies have revealed that a negative association was observed between consanguinity and the level of education (Demirel et al., 1997).

Studies made in Saudi Arabia (Chaleby and Tuma, 1987; Serenius et al., 1988; Al-Husain and Al-Bunyan, 1997) reported that consanguineous marriages are strongly favoured in the country with the rates ranging from 18.9-55.0%. The most frequent type of related marriage was that between first cousins followed by second cousins (Serenius et al., 1988). Wong and Anokute (1990) studied the effect of consanguinity on pregnancy outcome and reported that prenatal, infant and neonatal deaths were the most deleterious outcomes among the inbred offspring. Al-Husain and Al-Bunyan (1997) have pointed out that the level of consanguinity still remain high and the communities preferred double first cousin and first cousin once removed unions besides first and second cousin marriages. Alkuraya and Kilani (2001) have pointed out the necessity of prenatal diagnosis and public awareness about genetic risk of consanguinity.

Fairly high rates of consanguineous marriages were reported in the United Arab Emirates (UAE) where the rates vary from 39-51% (Bener et al., 1996; Abdul Razzaq et al., 1997). Al-Gazali et al. (1997) have
reported consanguineous marriages with high preference for parallel patrilateral type of first cousin and double first cousin marriages. It was observed that there was statistically significant higher reproductive wastage and congenital defects and diseases among the inbred group (Al-Gazali et al., 1995, 1999).

KUWAIT

El-Alfi et al. (1968); Al-Awadi et al. (1985); Khlat and Khoury (1991) and Radovanovic et al. (1998) noticed a fairly high rate of consanguinity. Roberts and Pembrey (1979) stated the effect in inbreeding to be influenced by duration of practising consanguineous marriages. Observations on the effects of inbreeding on reproductive wastages (Al-Awadi et al., 1986) have shown high incidence of prenatal and neonatal losses among the consanguineous group. Several workers reported high incidence of certain new syndromes and congenital malformations in Kuwait's population as a result of homozygosity of autosomal recessives expressed by inbreeding (Teebi, 1994). The manifestation of asthma in Kuwait inbred children due to consanguineous marriages has also been reported (Hijazi and Haider, 2001).

In Jordan, Cook and Hanslip (1966) have reported 52.1% of related marriages with high preference for first cousin marriage. Studies by Khoury and Massad (1992) and Al Salem and Rawashdeh (1993) revealed a range of 51-64% of consanguinity. Uncle-niece and aunt-nephew marriages were totally absent in Jordan. In most studies, consanguinity had only
negative correlation with occupational status, literacy and age at marriage of woman. Moreover, women were more prone towards consanguineous unions for their safety and conservation of family ties. Genetic disorders influenced by consanguinity were not significant in most Muslim groups and it was assumed to be the impact of long term inbreeding in progressive elimination of recessive genes. Al-Salem and Rawashdeh (1993) had observed that one third of the marriages were consanguineous among the Aabbd Tribe in Jordan. Al-Qudah (1998) reported that the high rate of parental consanguinity was responsible for the common neuronal migrational disorder like lissencephaly in Jordan.

Several studies carried out in different communities of Lebanon (Khlat and Khudr, 1986; Khlat et al., 1986; Khlat, 1988a,b, 1989) revealed a fairly high rate of consanguinity which varied from 16.50-29.60%. In all the communities, first cousin marriage was predominant with a strong preference for the patrilateral parallel type. They also reported that the consanguinity was negatively correlated with occupational status, literacy level and age at marriage of women. Khlat (1989) also observed that total pregnancies, number of live births and living children were significantly higher in consanguineous families. In the Muslims of this region, deleterious effects generally known in consanguineous families were not significant. Consanguinity studies carried out in Bahrain showed 10.6-45.5% of consanguinity (El-Shafei et al., 1986; Al-Naser, 1994; Al-Arrayed, 1994) and that consanguinity was one of the factors that increased the risk of congenital malformations. Al-Naser (1994) studied
the effect of consanguineous marriages on infant and child mortality in Bahrain, and he recorded the rate of consanguinity as 45.5% with a coefficient of inbreeding of 0.0166.

Inbreeding studies carried out in Iraq showed 17.4-57.1% of consanguinity (Al-Hamamy et al., 1986; Hamamy and Al-Hakkak, 1989), and here the rate of congenital malformations was highly correlated to rate of consanguinity. Studies in the Sultanate of Oman revealed a high degree of consanguinity with a high coefficient of inbreeding, F=0.0204 (Rajab and Patton 2000).

CENTRAL ASIA

In Central Asia, studies on inbreeding have been undertaken among isolated population in the countries like Uzbekistan (Ginter et al., 1980), Tajikistan (Goltzova, 1981) and Turkmenistan (Revasov et al., 1983). The inbreeding coefficient values derived from the data collected through household survey ranged between 0.0022 to 0.0330 and was attributable to corresponding level and type of related marriages preferred by the isolated countries.

SOUTHERN ASIA

Studies on consanguinity and its related genetic effects have been well documented in the South Asian countries like Iran, Pakistan, Sri Lanka and India (Bittles, 1998).

IRAN

Iran, one of the Muslim dominated countries showed a high prevalence of consanguinity (Naderi, 1979; Farhud et al., 1991). First
cousin and second cousin marriages were highly preferred in most of the communities studied. Farhud et al. (1991) have reported a high rate of consanguinity (73.5%) with a coefficient of inbreeding, 0.0392 among certain Tribal communities and a low rate of consanguinity (2.81%) with mean coefficient of inbreeding 0.0018 among Armenian population. Further in Jewish community of Iran inbreeding was promoted by uncle-niece marriages besides first and second cousins.

PAKISTAN

Related marriages are very common in this Muslim dominated country. The results based on several hospital and household surveys revealed high incidence of inbreeding ranging from 31.1-61.2% (Shami and Zahida, 1982; Shami and Siddiqui, 1984; Bittles, 1995). Data on several studies indicated high preference of parallel first cousin marriages and positive correlation between the degree of inbreeding and mortality (Shami et al., 1989; Wahab and Ahmad, 1996). Maternal and paternal age at marriage and maternal education were negatively correlated with consanguinity. High rate of consanguinity and low social status were shown to increase perinatal deaths and recessive malformations (Chitty and Winter, 1989).

A household and hospital based survey by Bittles et al. (1993a) showed high prevalence of consanguineous marriages in the Punjab cities of Pakistan. Shami et al. (1994) have reported that about half of the marriages in the urban areas were between close relatives with high
preference for first cousins. The reports of Hussain and Bittles (1998) evidenced that the incidence of consanguinity was negatively correlated with age at marriage and spousal age differences. There was also higher parental fertility and pre-reproductive mortality in the consanguineous group. The positive association between the degree of consanguinity and total mortality was reported to be influenced by the expression of deleterious recessive genes (Bittles, 1994; Hussain and Bittles, 1998). Grant and Bittles (1997) have reported that even after controlling the non-genetic variables, inbreeding at the level of first cousin influenced a significant adverse effect on the survival of inbred offsprings.

SRI LANKA

Only a few investigations have been made on the aspects of closely related marriages in the population of Sri Lanka. Reid (1976) had studied the effect of consanguineous marriage on couple fertility and offspring mortality and reported 21.5% of consanguinity with coefficient of inbreeding 0.0092. The results exhibited a reduction in the number of pregnancies, live births and living offspring due to inbreeding, while the influence on rate of abortion, still birth and child mortality was not significant. Lucas and Jayawardena (1991) have reported the incidence of homozygous sickle cell disease among the consanguineous families.

INDIA

The Indian population comprises about 75% of Hindus, 8% of Scheduled Tribes, 13% of Muslim communities and the rest are Sikh, Christian, Buddhist, Jain, Parsee and Jewish groups. India is considered
to be a country with highest rates of inbreeding. Early reports on consanguinity were contributed by Sanghvi (1954, 1966), Sanghvi et al. (1956), Dronamraju (1964), Dronumraju and Meerakhan (1961) and Centerwall and Centerwall (1966). Consanguinity in India is associated with religious and sect affiliations, linguistic and cultural diversities, socio-economic status, urban/rural residence, literacy level and traditions (Afzal and Sinha, 1984; Bittles et al., 1991; Badaruddoza and Afzal, 1992, 1997).

The Nation-wide National Family Health Survey (1994, 1995) results brought to light important findings on the marriages between relatives and demographic consequences quite extensively. The high intensity of consanguineous marriages were found to be in the Southern regions such as Andhra Pradesh, Karnataka, Tamil Nadu and Pondicherry in contrast to Northern states. The findings revealed that only 10% of ever married women in India married a first cousin and 4% married a second cousin, uncle or other blood relatives. Among the different social groups in the country Muslim (27%) and Buddhists (20%) involved in consanguineous marriages as compared to a low proportions among the Sikhs (3.2%), Jains (5.5%) and Scheduled Tribes (10%). The regional differences distinguished Maharashtra and the Southern states excluding Kerala by high prevalence of close relative marriages from the remaining parts of India. In every state consanguineous marriages were mainly between first cousins, either on the father's side or on the mother's side. Uncle-niece marriages were rare in all the states except in Tamil Nadu and Andhra pradesh (Krishna Reddy, 1998).
The effects of consanguinity was noticed in terms of pregnancy wastage, mortality at different stages and morbidity. However, there were a few instances of negligible level of adverse effects was reported to be attributed with elimination of deleterious genes from the population of continuous inbreeding over generations (Rao et al., 1972; Sanghvi, 1974; Rao and Inbaraj, 1977a, b).

NORTHERN STATES OF INDIA

The North Indian Hindus and the Sikhs practise close caste endogamy, but there is strict prohibition of marriage to a biological relative (Kapadia, 1958). In several states, consanguineous (Sapinda) regulation has been enforced with great rigidity by the Brahmins. In general, low level of consanguinity of which preference for first cousin types was reported among the Hindus (Sanghvi, 1966; Roychoudhary, 1976; Bittles et al., 1991). High rates of inbreeding were reported in the Muslims by several studies in many states of North India (Afzal, 1988; Agarwal et al., 1991; Hussain and Bittles, 1998). Double first cousin marriages were reported from Muslims of Madhya Pradesh (Bittles and Hussain, 2000) and Uttar pradesh (Badaruddoza and Afzal, 1998). Uncle-niece marriage was reported to be less frequent among the Muslim community. Even though uncle-niece marriages reported to be the most prevalent types in several communal groups in Madhya pradesh and Orissa (Das and Malhotra, 1995), such marriages were prohibited in certain Hindu communities like Raj Gonda of Maharashtra (Das and Malhotra, 1995).
Consanguineous marriages were less common among Scheduled Tribes with the exception in Jammu and Madhya Pradesh (Reddy and Modell, 1997). As compared to urban areas, the practice of marrying relatives was high in rural areas in most of the states and it was attributed with socio-economic and literacy factors (Roychoudhary, 1976).

**SOUTHERN STATES OF INDIA**

Marriages between blood relatives are highly preferred and encouraged in South India as part of the prevailing social customs particularly in the states of Andhra Pradesh, Karnataka and Tamil Nadu. Inbreeding in South India is negatively correlated with socio-economic status (Centerwall et al., 1969; Rao and Inbaraj, 1977a). The frequency and patterns of consanguineous unions vary between and within each state (Sanghvi, 1966; Kumar et al., 1967; Hann, 1985), between the major religious groups (Bai et al., 1981; Devi et al., 1982) and in the majority Hindu population by caste (Rao and Reddy, 1983).

First cousin type was the most preferred one followed by uncle-niece in almost all the Hindu inbreeding groups. However uncle-niece marriage was reported to be the most prevalent type in certain communities in Tamil Nadu (Rao and Inbaraj, 1977a, b), Andhra Pradesh (Reddy and Naidu, 1978; Rao and Reddy, 1983; Reddy et al., 1997; Babu et al., 1999), Karnataka (Devi et al., 1982). Kulkarni and Kurian (1990) have reported high preference of uncle-niece marriages in Hindus and first cousin in Muslims of Karnataka. Uncle-niece marriages were prohibited in certain
Hindu communities like Kodavas and Amma Kodavas of Karnataka (Saheb et al., 1978) and Kotia of Andhra Pradesh (Yasmin et al., 1997). Of the four subtypes matrilateral cross was the most favoured followed by patrilateral cross type. Parallel type was prohibited among the Hindus except certain Hindu groups in Tamil Nadu (Ramesh et al., 1989). Muslims are found to practise both parallel and cross cousin marriages. Patrilateral cross type was more prevalent among Kotia tribe of Andhra Pradesh (Yasmin et al., 1997).

The Muslim community exhibited high frequency of consanguinity. They are found to practise both parallel and cross cousin marriages. In Christian communities, the Orthodox churches prohibit consanguineous marriages, the Roman Catholic Church currently requires Diocesan permission for marriages between first cousin and the Protestant denominations sanction marriages up to and including first cousin (Bittles, 1998). In general, the Christian communities had no significant rate of consanguinity especially in the states of Kerala and Andhra Pradesh. Among the Christian communities in Kerala, related marriages are virtually non existent because of religious ban prohibiting marriages closer than fourth cousins (NFHS, 1994; Krishna Reddy, 1998). It is interesting to note that there was no change in inbreeding through time in Karnataka, but definite decline was observed in Andhra Pradesh and Tamil Nadu. The decline in consanguinity was attributed with the changes in demographic and social situations (NFHS, 1995; Krishna Reddy, 1998; Krishnamoorthy and Audinarayana, 2001). Hornby et al. (2001) have
observed that high rates of consanguinity in Andhra Pradesh influence genetic recessive aetiology in terms of anophthalmos in the inbred offsprings.

The pioneering consanguinity studies in the state of Kerala were the ones by Kumar et al. (1967); Ali (1968); Abraham and Mathew (1969). Subsequently a more detailed and systematic study was initiated by Prof. P.M. Mathew in the Kerala University in 1980's (Mathew, 1987) and this was followed by studies in over 30 inbreeding castes/communities which included several hill tribes distributed in several districts of the state such as Thiruvananthapuram (Pillai, 1994, 1997, 2001; Pillai, Mathew, 1995, 1996, 1997; Joseph and Mathew, 1991a,b), Kollam (Shyni and Pillai, 2000), Alappuzha (Sudhakaran, 1997; Sudhakaran and Vijayavalli, 1998), Kottayam, Idukki and a few northern districts (Joseph and Mathew, 1991a, 2002; Sindu et al., 2001). The consanguinity rates noticed in the different groups studied in the state varied widely from 1.5-over 95%; of which the very high rates were in the hill tribes, the Mudugars (87.60%) of Attappady (Joseph and Mathew, 1991a) and three tribal groups in the Idukki district (Sindu et al., 2001) the rates crossed 95%, the highest ever reported being 97% in the tribe 'Kurumba pulaya'. The lowest rate (1.5%) noticed was in the Christian section of the Mala Araya tribal group of Kottayam district and this very lower rate has been pointed out to be due to Church ban on closely related alliances (Joseph and Mathew, 2002).

In great many of the castes and communities in the state, the level of consanguinity was found to be very much associated positively
with the degree of spousal relationship. Of the various patterns ranging from uncle-niece to second cousin alliances, the most common in almost all the groups was cross cousin marriages with the matrilateral cross type showing an edge over the patrilateral cross type. Level of literacy and age of spouses at marriage were reported with various socio-economic covariables. Noticeably significant risk effects were noticed among the offsprings of consanguineous families expressed in terms of increased mortality and morbidity. The genetic loads estimated in the various communities in terms of lethal equivalents based on A and B statistics ranged from 0.5-10.

In Tamil Nadu, only a few attempts have been made on consanguinity and its effects Centerwall and Centerwall, 1966; Rao et al., 1972; Rao and Inbaraj, 1977; Vasantha Kumari and Pillai, 2000 a,b, 2002). In a group of families of North Arcot district, 45.50% consanguinity was observed with preference for first cousin types followed by uncle-niece marriages and it had no significant effect on mortality and morbidity (Centerwall and Centerwall, 1966; John and Jayabal, 1971). In a North Arcot population, consanguinity was more in the rural than in urban areas. Consanguinity with first cousin and uncle-niece marriages were common among the spouses (Rao, et. al., 1972; Rao and Inbaraj, 1977). Further, Rao and Inbaraj (1977) have reported that the first cousin and uncle-niece marriages had significantly influenced post-neonatal mortality rates as compared to the beyond first cousins. The recently conducted National Family Health (NFHS, 1994) Survey reported that nearly one-fourth of
ever married women married a first cousin. About 22% married a second cousin, uncle or other blood relatives.

The frequency of marrying a close relative do not vary much by age, indicating that the intensity to marry a relative has not changed much over by time. Rural women were more likely to have marriages with a close relative than urban women (Rao and Inbaraj, 1977; NFHS, 1994). Less educated women were more likely to have married a close relative than literate women. Consanguineous marriages were more common among Hindus, Muslims and Scheduled Castes than among Christians (NFHS, 1994). In almost all the studies, frequency of related marriages is significantly higher among the rural and illiterate sections of population. The reason for the relatively high incidence of consanguinity among the rural and illiterate communities have often been attributed to socio-economic and literacy factors (Rao and Inbaraj, 1977a; Billtes, 1990).

Consanguinity studies revealed various degree of detrimental effects of related marriages expressed in terms of pregnancy wastage, mortality at various stages and morbidity. However, there were a few reports of negligible or even absence of adverse effects of consanguinity, and in such cases it has been pointed out that continued inbreeding over generations must have eliminated the deleterious genes from populations resulting in the narrowing of their differences and also even to complete elimination of detrimental effects (Sanghvi, 1974; Rao and Inbaraj, 1977a,b, 1979a,b, 1980; Reddy, 1992).