

SHORT COMMUNICATION

SEX RATIO OF TWINS IN A SOUTHEASTERN BRAZILIAN POPULATION

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ABSTRACT

The sex ratio of 1,150 twin births (363 MM, 407 MF and 380 FF pairs) was compared to that of 272,644 single births from the city of Campinas, State of São Paulo, Brazil. These births referred not only to live but also to stillborn children. The sex ratio of the twins (97.1 males per 100 females) was significantly lower than that of the singletons (106.3 males per 100 females).

INTRODUCTION

The sex ratio at birth, also named *secondary sex ratio*, shows great variability in human populations, but always deviates in favor of males, with values ranging from 101 to about 113 males per 100 females (Beiguelman, 1982).

The excess of newborn males is not due to a surplus of female deaths before birth. It is well known that among aborted embryos and stillborn children the number of males significantly exceeds that of females (Ciocco, 1940; Tietze, 1948). The same is true for embryos obtained from induced abortion (Lee and Takano, 1970). As the secondary sex ratio still favors the males, in spite of the intra-uterine selection against them, this would mean that the sex ratio at the time of fertilization (*primary sex ratio*) would be still higher than at birth.

The sex ratio favoring males cannot be attributed to a higher proportion of spermatozoa bearing a Y chromosome, since 55% of human male gametes lack this sex chromosome (Beatty, 1974). Therefore, one has to accept that spermatozoa with a Y chromosome have a greater fertilizing capacity than spermatozoa bearing an X chromosome. If the spermatozoa had the same fertilizing capacity, one would observe an excess of female newborns and not the opposite.

The sex ratio of human offspring depends upon the day of the menstrual cycle when insemination occurs, a male child being more likely to be conceived if a fruitful coitus occurs earlier in the cycle than later (Guerrero, 1970, 1974; James, 1971, 1976). As a consequence, the sex ratio is associated with the coital rate. Thus, a higher coital rate increases the probability of both insemination early in the menstrual cycle and the conception of a male child (James, 1971).

This would explain the high sex ratios observed among children born to mothers who conceive in the first months after marriage, when couples have high coital rates, as well as among children born in wartime or just after wars (Bernstein, 1958; Renkonen, 1964, 1970; James, 1971). According to James (1971), the high sex ratios in wartime or just after wars would also be directly associated with unusually high coital rates, when soldiers have short home leaves or are on demobilization leave. Thus, the decline of the sex ratio with duration of marriage or with parental age would be a consequence of a decrease in the coital rate.

According to the majority of the authors, the sex ratio in twin births is lower than in singletons (see Stocks, 1952; Barr and Stevenson, 1961; Susanne and Corbisier, 1969; Mellender-Araújo, 1973; Czeizel, 1974; James, 1975; Bertranpetit and Marin, 1988, among others). Very few studies could not confirm this tendency (Pedreira *et al.*, 1959; Rola-Janicki, 1974). Since data concerning the sex ratio at birth of large samples of Brazilian twins are scarce, we decided to analyze the sex ratio of newborn twins and singletons in a southeastern Brazilian population.

SUBJECTS AND METHODS

The sex ratio of 1,150 twin births (363 MM, 407 MF and 380 FF pairs) was compared to that of 272,644 single births (140,500 males and 132,144 females). These births referred not only to live but also to stillborn children. All singletons and most of the twin births (938 pairs) were born at a maternity hospital in Campinas (*Maternidade de Campinas*), State of São Paulo, Brazil which serves about 70% of the mothers of all social classes in this city. The remaining 212 twins were born in another important hospital of Campinas (*Casa de Saúde*). This city now has more than one million inhabitants and these may be considered as representative of the southeastern Brazilian population.

The number of males per 100 females among the twins was obtained by $100(2a+b)/(2c+b)$ where a , b , c are the numbers of MM, MF and FF twin pairs. Among the singletons this number was obtained by $100 M/F$.

RESULTS AND DISCUSSION

Our data are in agreement with those of most authors, since the sex ratio of the 1,150 twins births (97.1 males per 100 females) was significantly lower ($\chi^2 = 4.712$; 1 d.f.; $P < 0.05$) than that of singletons (106.3 males per 100 females).

It is not easy to explain the low sex ratio of twin births. The hypothesis that this lower sex ratio would be caused by a higher rate of stillbirths among twins cannot be accepted. Stillborns do have a high sex ratio, but our data considered all births, live plus stillbirths.

Maternal age, parity and incidence of dizygotic twins are all positively correlated (Allen and Parisi, 1990). A positive correlation also exists between sex ratio and coital rate, while these variables decrease with maternal age (James, 1971). This might lead one to suppose that the sex ratio of dizygotic twins would be shifted towards females, since dizygotic pairs predominate among twins in all populations, except the Japanese (Imaizumi and Inouye, 1979). Nevertheless, this hypothesis must also be rejected, as the regression of sex ratio on maternal age in twins does not decline monotonically like that of singletons. On the contrary, it rises until the interval between 35 and 39 years (James, 1975).

An alternative hypothesis offered by James (1975) considers that the sex ratio in monozygotic twins is lower than that in dizygotic pairs or in singletons, being constant for all maternal ages. If this hypothesis is correct it would account for the low overall sex ratio in twins observed by most authors, as well as for the exceptional data in which the sex ratio in twins is not low. Thus, among Blacks, who exhibit the highest incidence of dizygotic pairs (Azubuike, 1982; Akanlawon and Ejiwunmi, 1986) one would not expect to find a low sex ratio in twins. The early findings of Pedreira *et al.* (1959) who observed a high sex ratio in twins (110,4) from Salvador, State of Bahia, Brazil, might perhaps be attributed to the predominance of individuals with Black ancestry in its population.

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RESUMO

A razão de sexo de 1.150 partos gemelares (363 MM, 407 MF e 380 FF) foi comparada com a de 272.644 partos únicos, todos ocorridos na cidade de Campinas, Estado de São Paulo, Brasil. Estes partos disseram respeito não apenas a recém-nascidos vivos mas também a natimortos. A razão de sexo dos gêmeos (97,1 meninos por 100 meninas) foi significativamente inferior à observada entre os recém-nascidos de parto único (106,3 meninos por 100 meninas).

REFERENCES

- Akanlawon, A.O. and Ejiwunmi, A.B. (1986). Biological factors in multiple birth in Lagos. *East Afr. Med. J.* 63: 115-120.
- Allen, G. and Parisi, P. (1990). Trends in monozygotic and dizygotic twinning rates by maternal age and parity. Further analysis of Italian data, 1949-1985, and rediscussion of US data, 1964-1985. *Acta Genet. Med. Gemellol.* 39: 317-328.
- Azubuikwe, J.C. (1982). Multiple births in Igbo women. *Brit. J. Obstet. Gynaecol.* 89: 77-79.
- Barr, A. and Stevenson, A.C. (1961). Stillbirths and infant mortality in twins. *Ann. Hum. Genet.* 25: 131-140.
- Beatty, R.A. (1974). Genetic aspects of spermatozoa. In: *Physiology and Genetics of Reproduction* (Coutinho, E.M. and Fuchs, F.C., eds.). Part A, Plenum Press, New York, Chap. 12: 183-196.
- Beiguelman, B. (1982). *Citogenética Humana*. Editora Guanabara Koogan S.A., Rio de Janeiro.
- Bernstein, M.E. (1958). Studies in the human sex ratio: a genetic explanation of the wartime increase in the secondary sex ratio. *Am. J. Hum. Genet.* 10: 68-70.
- Bertranpetit, J. and Marin, A. (1988). Demographic parameters and twinning: a study in Catalonia, Spain. *Acta Genet. Med. Gemellol.* 37: 127-135.
- Ciocco, A. (1940). Sex differences in morbidity and mortality. *Quant. Rev. Biol.* 15: 59-73; 192-210.
- Czeizel, A. (1974). Unexplainable demographic phenomena of multiple births in Hungary. *Acta Genet. Med. Gemellol.* 22 (Suppl.): 214-218.
- Guerrero, R. (1970). Sex-ratio: a statistical association with the type and time of insemination in the menstrual cycle. *Int. J. Fertil.* 15: 221-225.
- Guerrero, R. (1974). Association of the type and time of insemination within the menstrual cycle with the human sex-ratio at birth. *N. Engl. J. Med.* 291: 1056-1059.
- Imaizumi, Y. and Inouye, E. (1979). Analysis of multiple birth rates in Japan. *Acta Genet. Med. Gemellol.* 28: 107-124.
- James, W.H. (1971). Cycle day of insemination, coital rate and sex ratio. *Lancet* 1: 112-114.
- James, W.H. (1975). Sex ratio in twin births. *Ann. Hum. Biol.* 2: 365-378.
- James, W.H. (1976). Timing of fertilization and sex ratio of offspring. A review. *Ann. Hum. Biol.* 3: 549-556.
- Lee, S. and Takano, K. (1970). Sex ratio in human embryos obtained from induced abortion: histological examination of the gonad in 1,452 cases. *Amer. J. Obstet. Gynecol.* 108: 1294-1296.

- Mellender-Araújo, A. (1973). Estrutura populacional e malformações congênitas na população de Porto Alegre. Doctoral Thesis, Univ. Fed. Rio Grande do Sul.
- Pedreira, C.M., Peixoto, L.I.S. and Ito-Rocha, L.M.G. (1959). Estudo da gemelaridade na população de Salvador, Bahia. *Anais I Reunião Brasil. Genét. Hum.* (Curitiba): 137-140.
- Renkonen, K.O. (1964). Problems connected with the birth of male children. *Acta Genet. 14*: 177-185.
- Renkonen, K.O. (1970). Heterogeneity among first post-nuptial deliveries. *Ann. Hum. Genet. 33*: 319-321.
- Rola-Janicki, A. (1974). Multiple births in Poland in 1949-1971. *Acta Genet. Med. Gemellol. 22* (Suppl.): 202-209.
- Stocks, P. (1952). Recent statistics of multiple births in England and Wales. *Acta Genet. Med. Gemellol. 1*: 8-13.
- Susanne, C. and Corbisier, J.V. (1969). Les naissances gémellaires en Belgique (1960-1961). *Acta Genet. Med. Gemellol. 18*: 294-320.
- Tietze, C. (1948). A note on the sex ratio of abortions. *Human Biol. 20*: 156-160.

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