TRENDS OF HUMAN SEX RATIO AT BIRTH AND TWINNING RATE IN IBADAN, SOUTH-WESTERN NIGERIA

BAKARE, A. A.,[1]* ELEGBEDE, E.O.[1] and **OSOWOLE, O.I.[2]**
[1]Cell Biology and Genetics Unit, Department of Zoology, University of Ibadan, Ibadan. Nigeria.
[2]Department of Statistics, University of Ibadan, Ibadan, Nigeria

*Corresponding author: *adekunle.bakare@mail.ui.edu.ng adebakar19@yahoo.com*

Abstract

The human sex ratio at birth (SRB) and frequency of twinning are demographic parameters that vary among populations. A retrospective study was carried out to investigate the trend of SRB, as well as twinning rate in Ibadan, Nigeria. Data on sexes of singletons, twins, triplets and quadruplets from 1997 to 2008 collected from the University College Hospital (UCH), Ibadan were analyzed by year, quarter, month and maternal age-groups using descriptive tabulation time series analysis, *Chi*-square and student *t*-test. An upward trend was observed in the SRB with an average ration of 110.1:100 for the period of study. The highest and lowest sex ratio of 126.6:100 and 50:100 were recorded in the 15-19 and <15 years of maternal age-groups respectively. The mean frequency of twin births was 35.9‰ with the highest of 52.7% in 1997 and lowest of 27.8% in 2006. The maternal age-group 20-24-year had the highest occurrence (46.5%) of twin births, while the lowest (21.8‰) was recorded in the 15-19-year age-group. Trend analysis shows a downward trend in the frequency of twin births, but still ranks among the highest values in the world. It is believed that maternal age, genetic and some socio-environmental factors might have influenced the SRB and twinning rate. These findings are consistent with earlier studies in Nigeria.

Keywords: sex ratio, twinning, Ibadan, south-western Nigeria, human reproduction.

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Introduction

The ability to reproduce and perpetuate the species is a unique feature of living organisms. The survival of each species requires that its members produce new individuals to replace those that die, thus ensuring a fairly constant, but dynamic population**.** The male proportion at birth, also known as sex ratio at birth (SRB), is a standard measurement to assess the distribution of birth frequencies according to gender. Due to equal segregation of the **X** and **Y** chromosomes in male during meiotic division, the human sex ratio is expected to be approximately 1:1 at birth. But it varies from one population to another; with values obtained in various populations skewed towards a particular sex (Halder and Fauzdar, 2006; Azeez *et al*, 2007). The variation has been attributed to factors including genetic, parental age, parental occupation, birth order, race, coital rate, environmental toxins, hormonal treatments, stress, several diseases, war, maternal weight, malnutrition, maternal metabolism and probably seasonal variation (Anderson and Bergstrom, 1998; Cagnacci *et al*, 2004; James, 2004; Hesketh and Zhu, 2006; Ruckstuhl *et al*, 2010; Terrell *et al*, 2011).

In the human species, there is significant variation in the incidence of twinning among the various populations. This has been attributed to socio-environmental factors, diet, maternal history of twinning, maternal age (Emil *et al*, 2005; Akinboro *et al* 2008, Steinman, 2009), fertility therapy to induce ovulation (Aisien *et al*, 2000), race or ethnicity of human population (Nylander, 1981), increase in the use of contraceptives, increase in spontaneous abortion rates, seasonal variation (Nylander, 1981; Pison and D'Addato, 2006), environmental pollution (Obi-Osius *et al*, 2004) and multiparity. Information on SRB and twinning rate in Ibadan, Nigeria is limited. Available data recorded up to 1995 showed an annual mean sex ratio of 108.8:100 in Ibadan (Mosuro, 1997). Data is also lacking on the predictive pattern of twinning and sex

ratio in Nigeria. In this study, we determined the current status of secondary sex ratio and twinning rate in Ibadan, Oyo State, Nigeria. We also provided information on the trend for the 10 years following the period of data analyzed in this study.

Materials and methods

Study location and data collection

This study was carried out in Ibadan ($3^0$5E and Latitude $7^0$20E), south-western Nigeria (Figure 1). Ibadan is the largest city in West Africa and second largest in Africa, with land size covering an area of 240 km^2 and human population of 2,550,593 (Federal Republic of Nigeria, 2007). The Yorubas are the major ethnic group in Ibadan while others including the Hausas, Nupes and Fulanis (from the north); and Ibos, Itshekiris, Efiks and Ijaws (from the south-east and south-south) are in the minority. The University College Hospital (UCH), Ibadan, is a major tertiary health institution located in Ibadan North Local Government Area of Oyo State, Nigeria. It provides specialist out-patient and in-patient medical and surgical care and also serves as a major referral hospital. Data were collected from the Central Records Department of the hospital. It consisted of births recorded from 1st January 1997 to 31st December, 2008. The data include monthly birth record for each year of the study period and was grouped into 9 categories for maternal age (<15, 15-19, 20-24, 25-29, 30-34, 35-39, 40-44, >44 and unknown age). The order of birth (singleton, twin, triplet and quadruplet) and sex of birth were categorized by the maternal age.

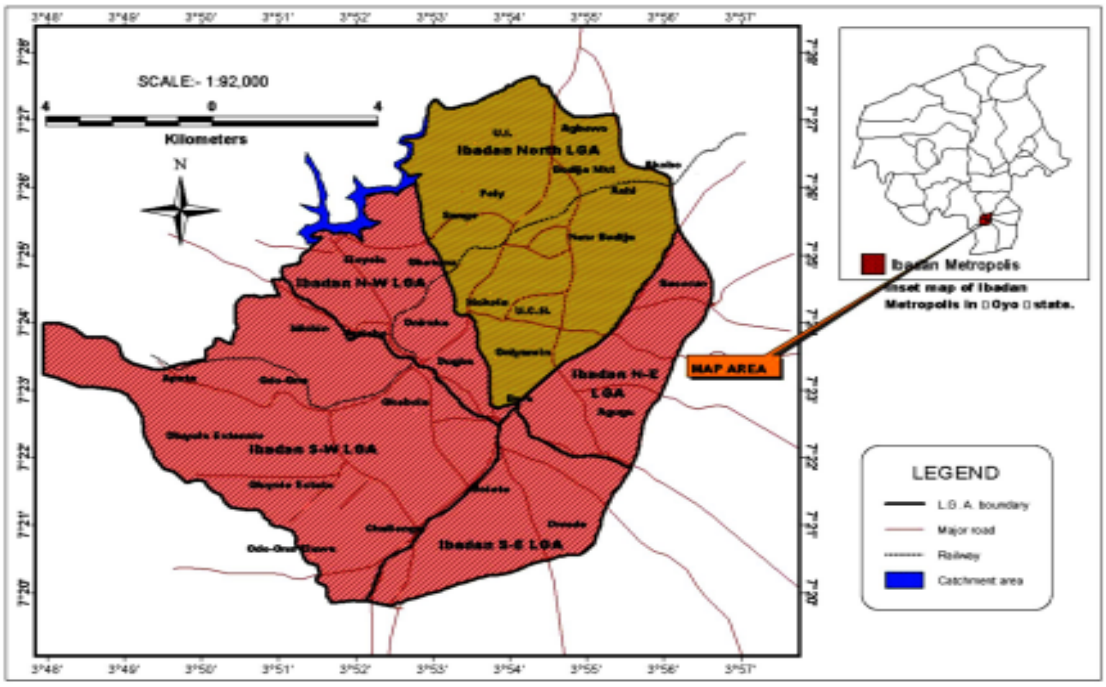

Figure 1: Map of Ibadan metropolis showing the University College Hospital (UCH; arrowed), Ibadan, Oyo State, Nigeria.

Data analysis

Data were analysed with SPSS® 10.0 and Microsoft Office Excel® 2007. The analysis of SRB and frequency of twinning was by monthly, quarterly and annual values, as well as maternal age. Eight maternal age-groups (<15, 15-19, 20-24, 25-29, 30-34, 35-39, 40-44, >44 years), were considered for the possible influence of mother's age on both parameters. Births from mothers with unknown age were recorded but excluded from this analysis. In order to eliminate false assumptions due to extreme values and small sample size, the maternal age-group <15 and >44 were excluded before making inference on the effect of maternal age on human secondary sex ratio and the frequency of twinning. Deliveries with unspecified sex due to congenital abnormalities or other reasons were also excluded from the computation in order to minimize bias towards a particular sex.

All the data sets on sex ratio were pooled together to obtain the SRB determined using the formula ($x/y \times 100$):100 (where 'x' is the number of male births and 'y' is the number of female births). The number of single births, twin births and total births were denoted by 'x', 'y' and 'z' respectively. The number of single births for every twin delivery (x/y) was determined. The number of twin births in every 1,000 deliveries was computed as:

$$\frac{\text{Twin deliveries (y)}}{\text{Total deliveries (z)}} \times 1000$$

The trend of SRB and twinning frequency for the period of study was determined by fitting the trend line using the method of least squares. Seasonal indices were computed and used to forecast the trend for the 10 years following the period of data collection using the additive model. Descriptive analyses included the determination of rates, percentages and ratios, while comparative analyses included the student *t*-test and *chi*-squared tests for discrete variables. *Chi*-square analysis was used to determine the deviation of the sex ratio, as well as the frequency of twinning for the years from the average value, at 5% level of probability.

Result

The total number of deliveries during the study period was 16,287. This included 15,679 singletons, 584 twins, 22 triplets and 2 quadruplets. The overall average SRB for single and twin deliveries was 110:100 and 111.3:100 respectively, while equal number of male and female was observed among triplets and quadruplets. Table 1 shows the annual SRB of total birth recorded from 1997 to 2008. The average sex ratio for the 12 years was 110.1:100. The highest SRB of 116.9:100 was recorded in 2001 and the least of 92.1:100 was recorded in 1998, which was the only year with more female than male births. There was a significant deviation ($p<0.05$) of the sex ratio for the years from the average for the 12 years ($\div^2 = 5.36$, $df = 11$). Student *t*-test analysis showed no significant difference ($p>0.05$) between the SRB of total births and live births ($t = 1.33$, $df = 11$); while marked differences occurred in the sex ratios between still births and live births, as well as between stillbirths and total births (Table 1).

The monthly sex ratio ranged from 104.2 in September to 120.5 in February (Table 2). There was no significant deviation ($p>0.05$) of the sex ratio for the months from the mean of all the months ($\div^2 = 3.54$, $df = 11$). Quarterly analysis of the data is also presented in Table 2. The highest sex ratio was recorded in the 4th quarter, while the least was in the 3rd quarter. Based on the sample mean, the expected number of males and females for each quarter were determined. The deviations between observed and expected ratios were significant ($p<0.05$; $\div^2 = 0.39$, $df = 3$). Analysis based on maternal age-groups showed that the highest sex ratio of 126.6:100 for the

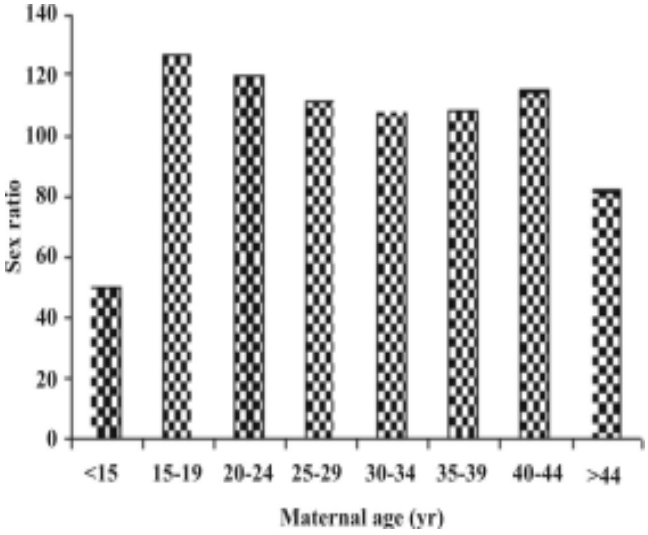

Figure 2: Maternal age analysis of sex ratio of total births recorded in the University College Hospital (UCH), Ibadan, for 12 years (1997-2008).

Table 1: Annual sex ratio of live births, still births and total births recorded in the University College Hospital (UCH), Ibadan for 12 years (1997-2008).

Year	Live births			Still births			Total births		
	M	F	Sex ratio	M	F	Sex ratio	M	F	Sex ratio
1997	486	445	109.2:100	46	42	109.5:100	532	487	109.2:100
1998	394	440	89.5:100	37	28	132.1:100	431	468	92.1:100
1999	439	431	101.9:100	47	36	130.6:100	486	467	104.1:100
2000	507	488	103.9:100	70	39	179.5:100	577	527	109.5:100
2001	569	491	115.9:100	66	52	126.9:100	635	543	116.9:100
2002	507	484	104.8:100	68	71	95.8:100	575	555	103.6:100
2003	563	505	111.5:100	75	71	105.6:100	638	576	110.8:100
2004	683	652	104.8:100	65	77	84.4:100	748	729	102.6:100
2005	640	596	107.4:100	81	64	126.6:100	721	660	109.2:100
2006	924	788	117.3:100	94	84	111.9:100	1018	872	116.7:100
2007	1005	882	113.9:100	74	61	121.3:100	1079	943	114.4:100
2008	1344	1155	116.4:100	114	102	111.8:100	1458	1257	116:100
Total	**8061**	**7357**	**109.6:100**	**837**	**727**	**115.1:100**	**8898**	**8084**	**110.1:100**

Table 2: Monthly and quarterly sex ratio of total births recorded in the University College Hospital (UCH), Ibadan for 12 years (1997-2008).

Monthly analysis				
Month	Male	Female	Total	Sex ratio
January	510	487	997	104.7:100
February	571	474	1045	120.5:100
March	661	629	1290	105.1:100
April	806	737	1543	109.4:100
May	929	856	1785	108.5:100
June	814	705	1519	115.5:100
July	771	738	1509	104.5:100
August	773	716	1489	108:100
September	824	791	1615	104.2:100
October	847	774	1621	109.4:100
November	778	648	1426	120.1:100
December	616	535	1151	115.1:100
Quarterly analysis				
Quarter	Male	Female	Total	Sex ratio
Jan-Mar	1741	1591	3332	109.4:100
Apr Jun	2546	2299	4845	110.7:100
Jul -Sep	2368	2245	4613	105.5:100
Oct -Dec	2239	1952	4191	114.7:100

age-group of 15-19 years, while the lowest of 50:100 was recorded for the age-group of <15 years (Figure 2).

There was a significant deviation ($p<0.05$) of the sex ratio for the maternal age-groups from the mean of all the age-groups ($\div^2 = 42.34$, $df = 7$). Exclusion of the <15 and >44 maternal age-groups still resulted in significant deviations ($p<0.05$) ($\div^2 = 2.30$, $df = 5$). Trend line fitted for the data reveals an upward trend of the sex ratio of total births during the period of study (Figure 3). Figure 4 shows Time plot of sex ratio for the 144 months of the study period. Fifteen peaks were observed in the plot which occurred in the months of February, March, April, June, August, September, October, November and December with the frequencies 2, 1, 1, 3, 1, 1, 2, 1 and 3 respectively. No regular pattern of seasonal variation could however be deduced from this observation. The result of the forecasted values of sex ratios for the 10 years following the study period is presented in Table 3.

Table 4 shows the annual incidence of twin births recorded in the UCH, Ibadan from 1997 to 2008. The highest incidence of twin births (52.7‰) was recorded in 1997, while the lowest (27.8‰) was obtained in 2006. The average number of twin births pooled for the period was 35.9‰ and the average number of the single birth for each twin delivery was 26.8. There was a significant deviation ($p<0.05$) of the frequency of twinning from the average for the 12 years ($\div^2 = 13.83$, $df = 11$). Monthly analysis (Figure 5) shows that the month of October has the highest incidence of twinning (41.2‰), while the least value was in November (25.3‰). There was a significant deviation ($p<0.05$) of the frequency of twinning for the months from the mean ($\div^2 = 6.51$, $df = 11$). Quarterly analysis (Figure 6) shows that the highest incidence of twinning was recorded in the 3rd quarter (36.3‰), while the least was in the 4th quarter (34.4‰). Based on the sample mean, the expected twinning rate for each quarter was determined. The deviations between observed and expected ratio were not significant ($p>0.05$; $\div^2 = 0.05$, $df = 3$).

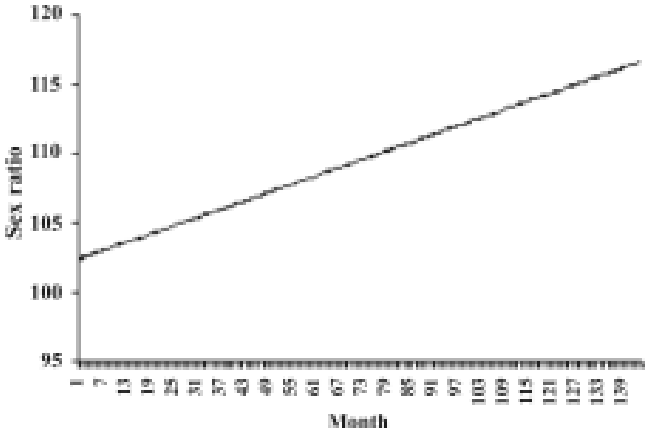

Figure 3: Trend of the sex ratio of total births recorded in the University College Hospital (UCH), Ibadan, for 12 years (1997-2008).

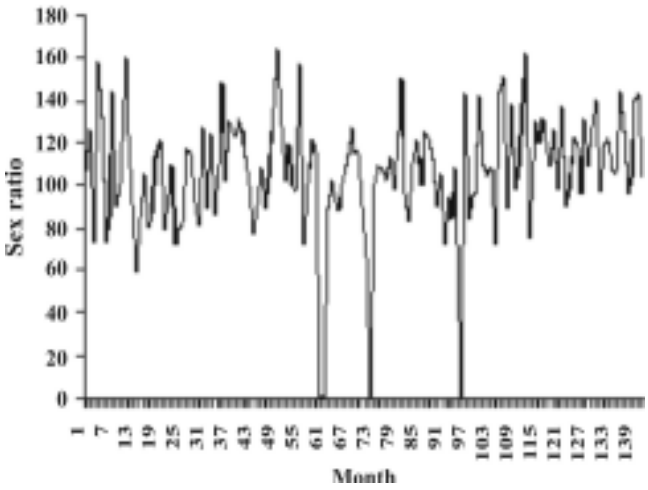

Figure 4: Time plot of the sex ratio of total births recorded in the University College Hospital (UCH), Ibadan, for 12 years (1997-2008).

Table 3: Forecasted values for human secondary sex ratio in Ibadan for 10 years based on 12-year (1997-2008) birth record obtained at the University College Hospital (UCH), Ibadan, Nigeria.

	Year									
Month	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
January	94.5	95.7	96.9	98.1	99.3	100.5	101.7	102.9	104.1	105.3
February	109.2	110.4	111.6	112.8	114	115.2	116.4	117.6	118.8	120
March	115.5	116.7	117.9	119.1	120.3	121.5	122.7	123.9	125.1	126.3
April	123.2	124.4	125.6	126.8	128	129.2	130.4	131.6	132.8	134
May	120.2	121.4	122.6	123.8	125	126.2	127.4	128.6	129.8	131
June	121.7	122.9	124.1	125.3	126.5	127.7	128.9	130.1	131.3	132.5
July	115.5	116.7	117.9	119.1	120.3	121.5	122.7	123.9	125.1	126.3
August	121.7	122.9	124.1	125.3	126.5	127.7	128.9	130.1	131.3	132.5
September	114.2	115.4	116.6	117.8	119	120.2	121.4	122.6	123.8	125
October	119.1	120.3	121.5	122.7	123.9	125.1	126.3	127.5	128.7	129.9
November	129.5	130.7	131.9	133.1	134.3	135.5	136.7	137.9	139.1	140.3
December	123.5	124.7	125.9	127.1	128.3	129.5	130.7	131.9	133.1	134.3
Mean	**117.3**	**118.5**	**119.7**	**120.9**	**122.1**	**123.3**	**124.5**	**125.7**	**126.9**	**128.1**

Table 4: Annual incidence of twinning recorded in the University College Hospital (UCH), Ibadan, for 12 years (1997-2008).

Year	Single deliveries (x)	Twin deliveries (y)	Total deliveries (z)	Number of singletons for every twin delivery (x/y)	Frequency of twinning ($y/z \times 1000$)
1997	917	51	968	18	52.7
1998	846	25	871	33.8	28.7
1999	881	35	916	25.2	38.2
2000	1023	40	1063	25.6	37.6
2001	1085	42	1127	25.8	37.1
2002	1037	42	1079	24.7	38.9
2003	1114	46	1160	24.2	39.7
2004	1380	48	1428	28.8	33.6
2005	1266	57	1323	22.2	43.1
2006	1785	51	1836	35	27.8
2007	1894	65	1959	29.1	33.2
2008	2451	82	2533	29.9	32.4
Total	**15679**	**584**	**16263**	**26.8**	**35.9**

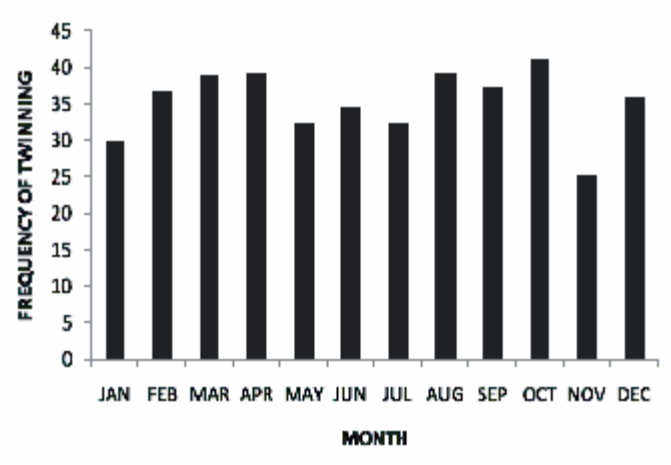

Figure 5: Monthly frequency of twinning recorded in the University College Hospital (UCH), Ibadan, for 12 years (1997-2008).

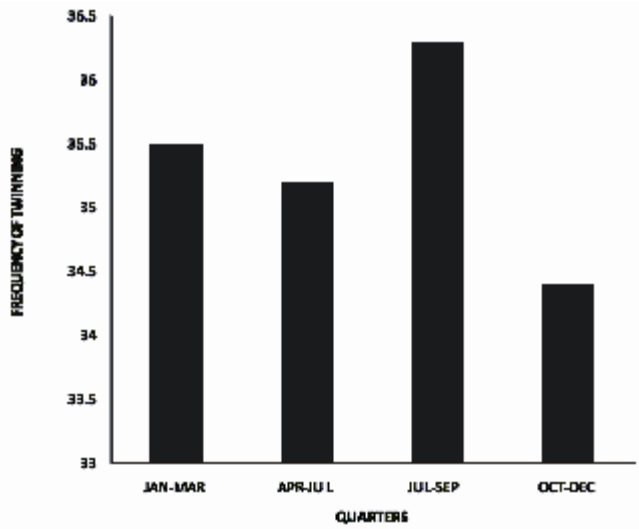

Figure 6: Quarterly frequency of twinning recorded in the University College Hospital (UCH), Ibadan, for 12 years (1997-2008).

Data analysis by maternal age shows that the highest incidence of twin births (46.5%) occurred in the 20-24 years age-group, while the lowest (21.8‰) was in the 15-19 years age-group (Figure 7). No twin birth was recorded among the <15 years and >44 years age-groups. With the exclusion of the <15-year and >44-year age-groups, *Chi*-squared analysis showed significant deviations ($p<0.05$) of the twinning rates for the maternal age-groups from the mean value ($\div^2 = 9.17$, $df = 5$). Trend line fitted for the data reveals a downward trend during the period of study (Figure 8). Time plot of the incidence of twinning for the 144 months of the study period is presented in Figure 9. Seventeen peaks were observed during the period of study occurring in the months of February, March, April, May, August, September, October, November and December with frequencies 1, 1, 4, 1, 1, 1, 4, 2 and 2 respectively. The peaks occurred randomly in the months of the year, but were mostly seen in April and October**.** No regular pattern of seasonal variation could however be deduced from this observation. The result of the forecasted values of the incidence of twinning for the 10 years following the period of data collection is presented in Table 5.

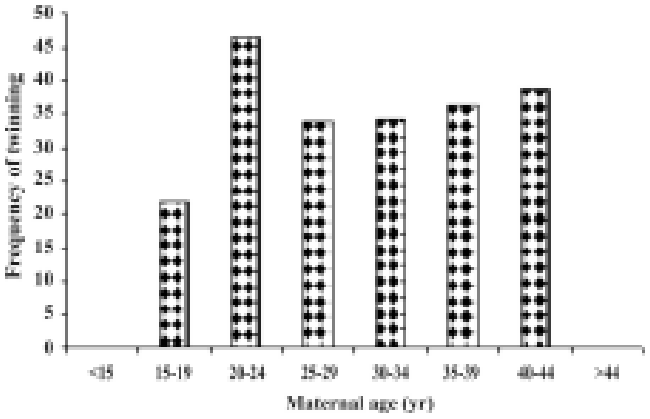

Figure 7: Maternal age analysis of frequency of twinning recorded in the University College Hospital (UCH), Ibadan, for 12 years (1997-2008).

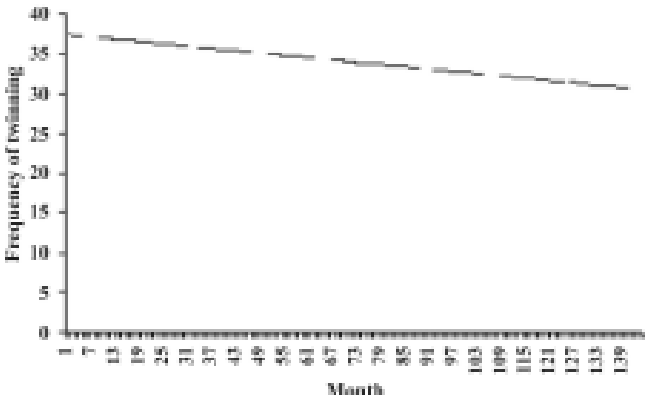

Figure 8: Trend of the incidence of twinning recorded in the University College Hospital (UCH), Ibadan, for 12 years (1997-2008).

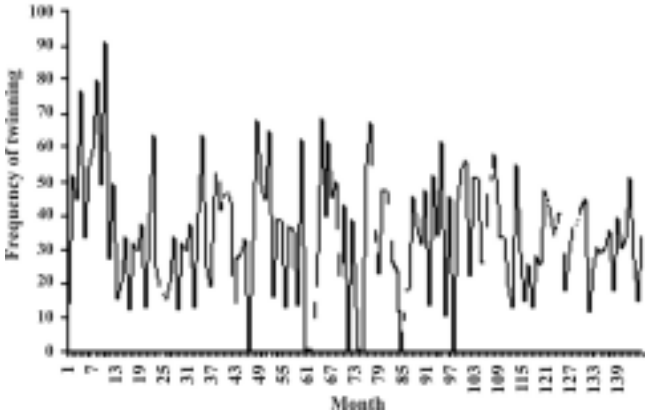

Figure 9: Time plot of the incidence of twinning recorded in University College Hospital (UCH), Ibadan, for 12 years (1997-2008).

Table 5: Forecasted values for the incidence of twinning in Ibadan for 10 years based on 12-year (1997-2008) birth record obtained at the University College Hospital (UCH), Ibadan, Nigeria.

	Year									
Month	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
January	18.0	17.5	16.9	16.3	15.7	15.2	14.6	14.00	13.42	12.85
February	25.6	25.1	24.5	23.9	23.3	22.8	22.2	21.60	21.02	20.45
March	37.0	36.4	35.8	35.2	34.6	34.1	33.5	32.92	32.34	31.76
April	36.4	35.8	35.2	34.6	34.1	33.5	32.9	32.32	31.75	31.17
May	29.8	29.2	28.6	28.0	27.5	26.9	26.3	25.73	25.16	24.58
June	32.0	31.4	30.8	30.3	29.7	29.1	28.5	27.96	27.38	26.80
July	30.4	29.8	29.2	28.6	28.0	27.5	26.9	26.32	25.74	25.16
August	33.0	32.4	31.9	31.3	30.7	30.1	29.6	28.98	28.41	27.83
September	30.5	29.9	29.4	28.8	28.2	27.6	27.1	26.48	25.91	25.33
October	38.6	38.0	37.4	36.8	36.3	35.7	35.1	34.52	33.95	33.37
November	22.3	21.7	21.1	20.6	20.0	19.4	18.8	18.26	17.68	17.10
December	28.5	28.0	27.4	26.8	26.2	25.7	25.1	24.51	23.93	23.35
Mean	30.2	29.6	29.0	28.4	27.9	27.3	26.7	26.1	25.56	24.98

Discussion

The human secondary sex ratio and frequency of twinning are important demographic factors that can be used to monitor changes in environmental conditions and social behaviour in a given population over time. Data analyzed herein are assumed to be a reflection of the current status of SRB and the rate at which twin births occurred in Ibadan metropolis. In Nigeria, not all records of births are available in hospitals or birth registries, as births occurring at home or unwanted and abandoned infants were not recorded. Only 37% of births in Nigeria take place within health facilities (National Planning Commission/UNICEF, 2001). The average SRB of 110.1:100 for the period of study is almost similar to the annual SRB of 108:100 for a 20 year period (1976-1995) for Ibadan (Mosuro, 1997) and 108:100 for Makurdi in Nigeria (Swende, 2011) and is comparable with findings in Caucasians. But it shows a significant deviation ($p<0.05$; *chi*-square) from the average of 105.5:100 for all races of the world and falls outside the range of 101.1:100 and 107:100 reported for several other black populations (Gray and Bortolozzi, 1977; Hesketh and Zhu, 2006). The sex ratio for Ibadan with a natural human population of 2,550,593 (1,265,754 males and 1,284,839 females) is 98.5:100 (Federal Republic of Nigeria, 2007). This ratio is below the value obtained in our analysis. The difference could be due to gender differences in the rate of migration, death or birth in the study location (or perhaps more females than males were captured in Ibadan during the national population census exercise). Our observations are however, in line with the sex ratio of natural population of Oyo State (of which Ibadan is the state capital) and Nigeria as the 2006 population census shows slight preponderance of males over females (Federal Republic of Nigeria, 2007).

From the 10-year forecasted values (2009-2018, Table 3), there is an upward trend of SRB in Ibadan and this shows bias for more males than females at birth. Several reports of SRB in different populations of the world seem to readily agree that the number of males at birth has exceeded the number of females (Russel, 1936; Stern, 1960; Gray and Bortolozzi, 1977). The predominantly black populations of several West Indian Islands were reported to have as few as 101.1:100 for Cuban negroes (Stern, 1960), 103.1:100 for Guyanese of African origin (Ashcroft, 1970) and 103:100 for Jamaican negroes (Novitski, 1977), while the SRB for the black population of the United States was put at 102.6:100. These reports point to the fact that sex ratio is less biased in favour of males among black populations.

Based on comparative monthly analysis, the highest and lowest SRB occurred in the months of February (120.5:100) and September (104.2:100) respectively, while according to Mosuro (1997) the highest sex ratio of 111.4:100 for the month of October and lowest of 105.2:100 in the month of May were obtained in a 20-year record obtained from same study location. This shows that there was no consistent regular pattern of variation in sex ratio from records of 32 years at UCH Ibadan; likewise, the comparative quarterly analysis. The similarity in the highest value of sex ratio for the 4th quarter with that of Mosuro (1997) may suggest an element of seasonal influence on SRB in Ibadan. It is a well known fact that there is a 38-40 weeks gestation period between the time of conception and the time of parturition. In assuming this fact for the quarterly sex ratio observed in UCH births, it then follows that a high primary sex ratio at conception during the 1st quarter would reflect in a high secondary sex ratio in the 4th quarter. Similarly, a low SRB noted in the 3rd quarter implies a low primary sex ratio in the preceding 4th quarter, which falls in the dry season when environmental temperature is high. Also, human populations are more involved in business activities in preparation for the approaching new year which probably culminate in a resultant social stress and fatigue. These factors tend to result in reduced frequency of coitus and are in concordance with the theory of James (1971) that the sex ratio is directly related to the coital frequency.

Analysis of sex ratio by maternal age showed that it decreased with maternal age. This is in line with earlier reports that the number of males per 100 females decreases with increasing maternal age (Kang and Cho, 1962; Mathews and Hamilton, 2005). However, the low SRB seen in the <15-year and >44-year maternal age-groups may have been as a result of the relatively small sample size of the groups. The upward movement of trend line can be attributed to the fact that there is increasing early marriage and few child births among couples nowadays. This has the tendency of restricting a high percentage of children-bearing within young maternal age (19-34 years), where there seems to be a high probability of producing sons.

Reports on factors suspected to influence sex ratio are still contradictory. The likelihood of having a male rather than a female varies from family to family. If there is an association between having a male and variations in **Y**-chromosome, then all males belonging to a family with a preponderance of males will have an excess of male children. However in females, such relationship could not hold. A statistically significant tendency to belong to sibships with a higher percentage of males when their father's sibship also had a preponderance of males was noted by Trichopoulos (1967). Students whose father's sibship had a preponderance of females belonged to a sibship with a lower percentage of males. It is therefore most likely that there is a genetic basis for sex ratio variation, which

may not be affected by race, season, maternal age and other factors that have been suspected to influence human secondary sex ratio. There has been no concrete conclusion on the precise effect of environmental pollution on SRB. While some studies linked high SRB in certain human population to environmental pollution from industries (Hytten, 1982; Lloyd *et al*, 1985), others attributed decline to environmental pollution (Astollfi and Zonta, 1999; Vartiainen *et al*, 1999; Morcarelli *et al*, 2000; Gibson *et al*, 2008). Our study location is an urban and industrialized city that has experienced an upward trend in environmental pollution resulting from improper municipal and industrial waste management. If the previous assertion was true, then the upward trend in SRB observed in this study may be partly attributed to environmental pollution. However, data obtained in this study does not provide substantial evidence to validate this hypothesis.

The incidence of twinning for the 12 years (35.7%) ranks among the highest in the world but is lower than previous values of 37.2-48.8% reported for Ibadan (Bulmer, 1970; Nylander, 1981; Mosuro, 1996), and 40.2-53% reported for the Yoruba's in south-western Nigeria (Knox and Morley, 1960; Akinboro *et al* 2008). But it is close to values (37.2%) obtained from same study location in Ibadan (Mosuro, 1996) and shows a downward trend in twinning rate in south-western Nigeria and especially in an urban centre. Comparatively with some other parts of Nigeria; the value is higher than 14.4‰ in Maiduguri, north-east Nigeria (Nwobodo *et al*, 2005), 29.5% in Niger (Igberase *et al*, 2008), 26.5% in Calabar (Bassey *et al*, 2004), 28% in Jos and Eastern Nigeria (Aisien *et al*, 2000; Onah and Ugwu, 2008) and 35.1% in Ilorin and among the Igbo population in eastern Nigeria (Azubuike 1982; Fakeye, 1986). Also, it is higher than 11% twin births recorded in Kenya (Van Ginneken and Muller, 1984), 20% twin births observed in Sub-Saharan Africa (Pison, 1992), 16.1% in Nepal (Katz *et al.*, 2001), 33.4% and 26.6% for Accra and Kumasi in Ghana respectively (Mosuro *et al*, 2001) and 20% twinning rate reported for Africa (Pison, 2000).

The downward trend observed herein is in accordance with previous reports from south-western Nigeria (Marinho, 1986; Mosuro, 1996; Akinboro *et al* 2008), and also reflects in the 10-year forecasted values for twinning incidence in Ibadan. The baseline potential to twin birth is inherited, but the control of the rate of twinning is multifactorial (Steinman, 2009). One of the factors that might have been responsible for the downward trend is social class. Twinning rate in the lowest social class has been noted to be over twice that in the middle and highest social classes in Nigeria (Nylander, 1981). Ibadan is a city with middle and high social classes. In addition, increasing urbanization, better living condition, the ever dynamic societal value such as family planning, reduction in polygamy, policy on reduction in the number of children produced per family and more women pursuing career goals have had resultant effect on the downward trend in twinning rate. Inter-ethnic marriages between the various ethnic groups in Ibadan have resulted in admixture of genes; this makes it difficult to deduce the role of genetic predisposition as a factor influencing the incidence of twin birth. It has been suggested that the high twinning rate in south-west Nigeria is influenced by diet (Steinman, 2006; 2009). It is generally believed that the Yoruba's predisposition to high twinning rate is as a result of preference for consumption of yam (*Discorea* species). Yam is believed to contain the natural hormone phytoestrogen, which is believed to induce multiple ovulations (no data have been reported to substantiate this claim). Indigenes of the studied-location are known to have preference for food prepared in different forms of yam. The downward trend in the incidence of twin births might have partly been due to current dietary changes because of readily available fast foods which are convenient sources of diet for many people in urban centers in Nigeria. A similar trend was observed by Steinman (2006) among a population of people that moved from the countryside to the city, with a corresponding change in diet in the United States of America.

Based on maternal age, the highest twin birth rate was observed in the age-group 20-24 years. This is within the age-group of 20-29-year with high number of twin deliveries in some states in Nigeria (Akinboro *et al*, 2008; Onyiriuka, 2011). According to Mosuro (1996), the relative youthfulness of the age-group with the highest twinning rate may be related to modern trend in Nigerian women toward early marriage and having fewer children, especially in urban areas. Due to such social changes, there are fewer old mothers now having children. These culminate in a downward trend in the twinning rate. Aside from the highest twinning rate observed in the 20-24 years age-group, it can also be observed that twinning rate increased with maternal age-group. This is in accord with the data obtained from Europe and White United States populations (Bulmer, 1970), and is still within the general belief that the rate of twinning appears to increase with maternal age-group, reaching a peak at 37 years (Bulmer, 1970). Also, the lowest twinning rate observed among the 15-19 years age-group may be attributed to the fact that most mothers in this group are nulliparous.

Another factor which might have contributed to the observed downward trend in twinning rate is industrialization and urbanization (Pollard, 1995). Urbanization is well known to result in high population growth rate, migration from rural areas into urban centers and the gradual breakdown of family structure. Also, if urbanization continues in areas that were initially agricultural, it may lead to an environment in which psycho-social stress is

a significant factor. Therefore, there is a possibility that psycho-social stress may be partly responsible for the decline of twinning rate in Ibadan, Nigeria. Although this cannot be significantly validated by the data from this study, previous reports from south-western Nigeria (Marinho, 1986; Mosuro, 1996) showed a possible continuing decline in the incidence of twinning in urban settlements in south-western Nigeria and are in concert with our findings. Psycho-social stress might have also increased in the study location due to continuous increase in political strife, struggle for survival and population density; the human population of Ibadan increased from 1,222,570 by 1991 census to 2,550,593, by 2006 census (Federal Republic of Nigeria, 2007). In addition, the use of oral contraceptive has been suggested to contribute to the decline in twinning rate through its direct influence on the reduction in the probability of double ovulation and conception (Parisi and Caperna, 1982). There has been increased awareness in the use of contraceptives in Nigeria and this might have contributed to decline in twinning rate noticed in the country. While data indicates downward trends in twinning rate in Nigeria, reports are showing ever-increasing twinning rate in many parts of the world. Fisk (2007) reported that twinning rates have increased by 50% in the developed world in the last 20 years due to increasing use of assisted reproductive technology (ART) and increasing maternal age (Onyiriuka, 2011).

This study has presented data on human secondary sex ratio and frequency of twin births in Ibadan. Data analysis revealed an upward trend in SRB and a downward trend in the incidence of twin births. Although there has been a downward trend in the incidence of twin births, the result shows a high frequency of twinning that still ranks among the highest in the world. These are consistent with earlier studies in Nigeria. Further studies are therefore needed to evaluate the role of factors suggested to have influenced these demographic parameters in the Nigerian population.

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