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Research Article

INCIDENCE OF SUPERNUMERARY Y-CHROMOSOME AMONG MALE STUDENTS OF NNAMDI AZIKIWE UNIVERSITY NNEWI CAMPUS

Nzeako H.C.[1], *Ezejindu D.N.[1], Atuegwu C.L.[1] and Obinwa B.N.[1]
Department of Anatomy, College of Health Sciences, Nnamdi Azikiwe University, Nnewi Campus, Anambra State, Nigeria
**Author for Correspondence*

ABSTRACT
Supernumeral Y-chromosomes also called XYY syndrome, YY syndrome or Jacob's syndrome is an anueploidy (abnormal number) of sex chromosomes in which the human male receives an extra Y chromosome instead of the more usual 46. The aim of this study is to determine the incidence of supernumerary Y chromosome among male students of Nnamdi Azikiwe University, Nnewi Campus. A total of 405 males with an age average from 18-30 years were included in the study. The heights of the individuals were also measured using a standard height meter to the nearest centimetre. The weights of the individuals were also measured using a weighing balance to the nearest kilogram. Oral mucosal swab of each subject was also collected using a wooden spatula. A positive significant correlation between height and weight was observed. However there is a strong correlation between height and weight whereas there is no correlation between the parameters which are height, weight and age and the phenotype of the of the Y chromosome on male patient because it has no significant effect, which means that it does not depend on the XYY chromosome on the male patient to have height, weight irrespective of the increase in age.

Keywords: *Supernumerary Y-Chromosome, Nigeria*

INTRODUCTION
The word chromosome comes from a Greek work (chroma, colour) and (soma, body) due to their property of being strongly stained by dye; Haematoxylin and Eosin (H&E). A chromosome is an organized structure of DNA and protein found in cells. It is a single piece of coiled DNA containing many genes, regulatory elements and other nucleotide sequences. Chromosome also contains DNA-bound proteins which serve to package the DNA and control its functions. Chromosomes vary widely between different organisms.

The DNA molecules may be circular or linear and can be composed of 100,000 to 10,000,000,000 nucleotides in long chain (Paux *et al.*, 2008). Chromosome can be divided into two types – autosomes and sex chromosome. An autosome is a chromosome that is not an allosome (Griffiths *et al.,* 1999). For example, typically in humans there are 22 pairs of autosomes and one allosome pair.

A XX and XY make up the 23rd chromosome pair, which determines sex, typically female (XX) and male (XY). The Y- chromosome is one of the two sex-determining chromosomes in most mammals including humans. In mammals, it contains SRY gene, which triggers testicular development if present. DNA in the Y chromosome is passed from father to son and Y-DNA analysis may thus be used in gynaecology research. With 30% difference between humans and chimpanzees, the Y- chromosome is one of the fastest evolving parts of the human genome (Wade, 2010). In humans, the Y chromosome spans about 58 million base pairs (including block of DNA) and represents approximately 2% of the total DNA in the male cell. The human Y chromosome is unable to recombine with the X chromosome; except for a small piece of pseudoautosomal regions at the telomeres (which comprise about 5% of the chromosome's length) several phenotypes have been associated with the non-recombining portion of the Y chromosome (Luis *et al*., 2001). In comparison to other chromosomes, the Y chromosome is poor in gene, 50% of its sequence being composed of repeated elements. Moreover, the Y genes are in continuous decay probably due to lack of recombination of this chromosome. But Y chromosome at the same time plays a central role in human biology. The presence or absence of this chromosome determines gonadal sex. Thus

mammalian embryos with a Y chromosome develop testes, while those without it develop ovaries (Polani, 1981).

XYY syndrome (47, XYY) also called YY syndrome or Jacob's syndrome is an anueploidy of sex chromosome in which a male receives extra Y chromosome instead of the more usual 46. The first case of XYY syndrome was reported as incidental findings by Adam Sandberg and Colleagues in 1961. 47, XYY is not inherited, but usually occurs as a random event during the formation of sperm cells. An error in chromosome separation during anaphase 11 (of meiosis 11) called nondisjunction can result in sperm cells with an extra copy of the Y chromosome. If one of these atypical sperm cells contributes to genetic makeup of a child, the child will have an extra Y- chromosome in each of the body cells, (Robinson *et al.*, 1999). Only a dozen isolated 47, XYY cases were reported i the medical literature in the four years following the first report by Sandberg (Court, 1968). Then, in December 1965 and March 1966, *Nature and* The *lancet* published the first preliminary reports by British cytogeneticist Patricia Jacobs and colleagues at the MRC Human Genetics Unit at Western General Hospital in Edinburg of a chromosome survey of 315 male patients at the state hospital outside Carstair, Lanarkshire-Scotland's only special security hospital for the developmental disabled-that found nine patients, ages 17-36, averaging almost 6ft in height (average 5'11" range 5'7" to 6'2"), had a 47, XYY karyotype, and mischaracterised them as aggressive and violent criminals (Jacobs *et al*., 1965; Green, 1985; Beckwith, 2002). Over the next decade, almost all published XYY studies were height – selected, institutionalised XYY males (Milunsky, 2010). In January 1968 and March 1968, The *Lancet* and *science* published the first U.S reports of tall, institutionalised XYY males by Mary Telfer, a biochemist and colleagues at Elywyn Institute (Telfer *et al*., 1968). Telfer found five tall, developmental disabled XYY boys and men in hospitals and penal institutions in Pennsylvania and since four of the five had at least moderate facial acne, reached the erroneous conclusion that acne was a defining characteristic in XYY males (Telfer *et al*., 1968). After learning that convicted mass murder Richard Speck had been karyotyped, Telfer not only incorrectly assumed the acne-scarred Speck was XYY, but reached the false conclusion that speck was the archetypical XYY male or "super male" as Telfer referred to XYY males outside of peer-reviewed scientific journals (Telfer, 1968). The clinical features of 47, XYY are subtle and can be variable. Individuals with 47, XYY are usually physically normal as infants (Buyse, 1990; Jacobs *et al*., 1974). They are also usually fertile (Linden *et al*., 1996). They also tend to be tall and thin, they are not at increased risk of mental retardation although they may have speech delay, hyperactivity and educational difficulties (Linden *et al*., 1996; Buyse 1990). Generally individual with prenatal diagnosed 47, XYY syndrome have fewer developmental problems than individuals with postnatally diagnosed 47, XYY (Linden and Bender, 2002). Individuals with 47, XYY may have hypospadias, small testicles and undescended testicles (Buyse, 1990) and there may be an association with renal agenesis and renal cystic dysplasia (Rudnick-Schone *et al*., 1996). 47, XYY karotype has been reported among infants conceived by intracytoplasmic sperm injection (ICSI) (Aboulghar *et al*., 2001).

Many studies have revealed the association between 47, XYY and criminality with varying incidence ranging between 0-2%. Those studies might be biased. In the absence of definite data on criminality syndrome in the general population, it can be said that there is a need to study this association more thoroughly in a large population (Gosavi *et al*., 2009).

Thus this work is aimed at determining the incidence supernumerary Y-chromosome among male students of Nnamdi Azikiwe University, Nnewi campus.

MATERIALS AND METHODS

Research Design

This is a prospective, cross-sectional study investigating males in higher institution for the supernumerary Y-chromosomes.

Area of Study

The research study is focused on assessing the incidence of supernumerary Y- chromosome in male students of Nnamdi Azikiwe University, Nnewi campus, one of the tertiary health institutions in Anambra

state, Nigeria. Nnewi is the second largest city in Anambra state following Onitsha. It has a population estimate of 391,227 according to the Nigerian census (State National Population, 2012) and spans over 1,076.9 square miles (2,789km^2) in Anambra state.

Population of Study and Sample Size

The study population consists of male students of Nnamdi Azikiwe University, Nnewi campus between the ages of 18-30 years. Nnamdi Azikiwe University, Nnewi campus, have a total number of three faculties and seven departments. The numbers of students selected for this study are 405 and these constitute the sample size.

Instruments for Data Collection

The materials used for the study are height meter, weighing balance, wooden spatula, glass slide, absolute alcohol, stain and microscope.

Validity of the Instruments

- The height meter was capable of measuring to the nearest centimetre. It was manufactured by Calcon International Private Limited Pune-Maharashtra, Republic of India.
- The weighing balance measured the body weight to the nearest kilogram. It was manufactured by Naugra Export Company Ambala-Haryana, Republic of India.
- The wooden spatula was used for collection of the buccal smear which is a test where cells are taken from the tongue by scraping. It was manufactured by Medlift Health Care products-Noida, Uttar Pradesh, Republic of India.
- The glass slide was used for the smearing of the buccal smear collected with the spatula. It was manufactured by Atico Medical Pvt. Ltd Ambala-Haryana, Republic of India
- Absolute ethanol (100%) was used for fixing the slide.
- The dyes were used to stain specific cells of the specimen which help in viewing them under the microscope. EA50 and EA65 were manufactured by EMD Chemicals INC. Gibbstown United State. OG6 was manufactured by VWR International Ltd. Hunter Boulevard, utter worth, Leics, LE174XN, and England. Harris Haematoxylin was manufactured by ANATECH Ltd Battle Creek United State.
- The light microscope was able to magnify the specimen up to 1500 times. It was manufactured by Olympus Microscopy Hamburg, Germany.
- Ethical approval was obtained from the Ethical Committee, Faculty of Basic Medical Sciences Nnamdi Azikiwe University, Nnewi Campus.

Parameters in Data Collection

Prior to the data collection, the subjects gave their consent after an assurance of confidentiality was given. The parameters determined and recorded includes: Age, sex, height and weight.

Methods of Data Collection

In this study, height and weight were measured using the standard anthropometric instruments in centimetre and kilogram. All the measurements were taken by one observer to avoid inter-observer bias.

Data Analysis

The data collected was analysed using Statistical Package for Social Sciences (SPSS) version 16. Also range, mean, standard deviation and standard error of mean of age, stature and weight of the subjects were also determined.

RESULTS AND DISCUSSION

In this study, a sample of 405 male students of Nnamdi Azikiwe University, Nnewi Campus was measured for body height and weight and data analysis were carried out. No subject with XYY karyotype was detected.

Usually they are found in male prison population, maximum security hospital for the criminally insane and in the penal institution but accessing this segment of population proved difficult due to security situations in the country.

The results derived are summarized using tables, figures and charts below.

Table 1: Physical characteristics of the subjects

Parameters	Minimum	Maximum	Mean±SD	SEM
Age	18.00 years	30.00 years	22.74±2.22	0.11008
Height	156.70 cm	194.00 cm	176.43±6.21	0.30881
Weight	49.00 kg	120.00 kg	71.40±9.30	0.46192

Table 2: Correlation of the age, height and weight of the subjects

		Age	Height	Weight
Age	Correlation	1	-0.075	0.018
	Sig.		0.134	0.719
Height	Correlation	-0.075	1	0.461
	Sig.	0.134		0.000
Weight	Correlation	0.018	0.461	1
	Sig.	0.719	0.000	

*** Correlation is significant at the 0.05 level*

Discussion

A lot of studies have been carried out on XYY male individuals and have described the characteristics of a person possessing an extra Y chromosome as extremely tall stature, long limbs with striking long arm span, facial acne, severe mental retardation (including psychosis), aggressive, and anti-social behaviour involving a long history of arrests, subsequently beginning at an early age (Telfer, 1968). Previous studies of XYY males in forensic and in Danish youth prison has indicated that nearly all XYY males are above 180cm tall (Court, 1968; Nielson, 1971; Nielson and Henrikson, 1972).

In this study, the male individuals from the screened selected groups in tertiary institution within this height range do not have extra Y chromosome.

Height and Weight

In this study, the maximum male height was 194.00cm (6 feet 4 inch) and the minimum was 156.70cm (5 feet 1 inch). While the maximum and minimum weight was 120.00kg and 49.00kg. In Nigerians, the average male height and weight are 163.80cm (5 feet 4.5 inch) and 60.75kg (Okosun *et al*., 1998) whereas in Ghana, the average male height and weight are 159.30cm (5 feet 2.5 inch) and 62.491 kg (Subramian *et al*., 2001) this is because Nigerians are more affluent than Ghanaians and thus have better nutritional intake than Ghanaians (Subramian *et al*., 2001). In America, the average male height and weight are 178.90cm (5 feet 10.5 inch) and 81.93kg depending on thge age (McDowell *et al*., 2008) whereas in South Africans, the average male height and weight are 169.00cm (5 feet 6.5 inch) and 65.67kg (South African Demographic, 1998), this is because of less environmental stress, physical labour, better medical personnel and greater per capita income. In calabar, the males have height of 170.83±o.24cm and weight of 68.01±0.24 and this result is similar to urban adult population of Cameroon due to environmental influence, since Cameroon and Calabar share border (Kamadjeu *et al*., 2006).

In this study, the correlation between stature and weight was found to be statistically significant and positive (P<0.001), indicating a strong relationship between the two parameters. As well as there was no significant correlation between age and weight of the subjects. Judith *et al*., (2012) showed that the boys with XYY or XXY were, on average taller than the control boys (P<0.001) but had similar height S.D score hereby indicating that their height was statistically significant. Previous studies also reported that the observed height on the boys (n=1,084) are statistically significantly different from expected (P<0.001) in that there was a higher representation of boys in less than 3rd percentile and between 3rd and 20th percentile group (Borgaonakar, 1972). Dorus *et al*., (1976) noted that the prevalence of 47, XYY in all tall non-institutionalised males surveyed to date would be 0.00320 which is significantly different from the incidence of new born (P<0.001). he also noted that since height and personality characteristics may be related, it is important to note that within the sample of males studied, the two $&,XYY males considered together were not significantly taller than 46, XY males (P=0.15, Mann-Whitney U-test).

Previous studies by Nielson (1970) showed that his diagnosis of patients with XYY syndrome was made by sex chromatin examination on Feulgen stained buccal smear and chromosome analysis on leucocytes. In the current study, the diagnosis was made by sex chromatin on papanicolaou stained buccal smear. In a study by Grover *et al*., (2012) they compared the micronuclei frequencies in oral exfoliated epithelial cells with three different stains; Feulgen stain, Papanicolaou stain and Haematoxylin and Eosin stain in 45 cases of potentially malignant disorder and 15 controls with healthy mucosa. The result of the Mean micronuclei frequency in cases was found to be 3.8 with feulgen stain, 16.8 with Papanicolaou stain and 25.9 with H and E. Statistically significant value ($P<0.01$) were observed when the three stains were compared together using Kruskal Walli's ANOVA test.

Hence, H and E gave the best count, followed by Papanicolaou stain then Feulgen being a DNA specific stain gave the least count, although statistically significant results from the comparison of micronuclei frequency between cases and control were obtained with all three stains. In the same study by Neilson, the mean age of the 12 patients was 24.8 ± 6.5 years with a range from 16-27 years while in the current study, the mean age of 405 patients was 22.74 ± 22.22 with a range from 18-30 years.

In a study by Patricia *et al*., (1965), it was noted that nine patients, aged 17-36, who had 47, XYY karyotype and was mischaracterised as aggressive and violent criminals were found. The patients have maximum and minimum height of 188.00cm (5 feet 7 inch) and 170cm (6 feet 2 inch). In this study, patients aged 18-30 years were used.

The maximum male height was 194.00cm (6 feet 4 inch) and minimum was 156.70 cm (5 feet 1 inch) while the maximum and minimum weight was 120.00kg and 49.00kg. No patients with XYY karyotype was detected despite the increased height.

Conclusion

However there is a strong correlation between height and weight whereas there is no correlation between the parameters which are height, weight, age and the phenotype of the Y-chromosome on male patients because it has no significant effect; which means it does not depend on the XYY chromosome on the male patient to have height, weight irrespective of increase in age. On the other hand; based on the research it was discovered that the check on phenotype on male individual is based on personal check, in other to be able to attend to ones need on the bases of Y, XYY and XXY chromosome.

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