



Prior and Post Adaptation of Marriage Testing Policy: The Impact of Couple's Hemoglobin Genotype Testing in the Reduction of Sickle Cell Anaemia (SCA) in Katsina State

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Abstract

Sickle cell anemia (SCA) is a major genetic disease with the greatest burden in sub-Saharan Africa. To try to help reduce this burden, the Katsina State government have passed a law of compulsory sickle cell hemoglobin screening test before marriage in 2018. This study is an assessment of impact of the law for compulsory genotype test in Katsina state. The study further assesses the level of compliance to the strict Law on genotype testing. The study adopts a non-survey (ex-post facto) research design. Secondary data was adopted in analyzing the relationship between years after passing the law and year before passing the law and the reduction in the infant getting a sickle cell disease. A sample of six general hospitals were taken out of the total general hospitals in Katsina State. A five-year (2018–2022) retrospective study of hospital records was undertaken to investigate the incidence of haemoglobin genotype status of infants in Katsina state before and after the government policy. Data collected was analyzed using frequency and percentage and also chi-square (X^2) was used for testing the hypothesis using SPSS version 25. The records showed that a total of 12467 cases were attended to during the period. Total 12467 infants were tested in the study area for the period of 2018-2022. The incidence of occurrence of the diseases was recorded to be high 604 cases (23.8%) in the year 2018 (Year without a compulsory government law), followed by 564 (21.4%) in the year 2019, 296(19.5%) in 2020, 356(14.3%) in 2021 and 339 (10.3%) in the year 2022 (Figure 1). The least occurrence was recorded in the year 2022 with 339 (10.3%) infants. The result further indicates that the infant genotype AA increases down the years, with least prevalence in 2018 with 42.6% and highest prevalence of 54.5% in 2022. A similar trend occurs for those with genotype AS, with sharp decrease of 33.6% in 2018 to 22.4%. It therefore recommended that the Katsina state government should do more intense awareness on the law to all people of the state so as completely eliminate the disease in the area.

Keywords: Prior and Post, Adaptation, Marriage, Testing, Policy, Sickle Cell Anemia (SCA), Genotype and Marriage.

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INTRODUCTION

Although all social structures have an impact on people's wellbeing, not all of them do so equally. Marriage is a somewhat significant institution in contemporary Nigeria. It has been demonstrated that the existence and quality of a marriage connection have a significant impact on an individual's well-being in contemporary Nigerian society. Many studies comparing the wellbeing of married and single people have demonstrated the importance of marital relationships.

A specific gene or group of genes that an individual carries is referred to as their genotype. A person's whole heritable genetic identity, or genotype, is what makes them unique as an organism or person. Moreover, it refers to the gene alleles or variants that an organism carries (Vonk, 2018). This phrase may also refer to a particular gene or gene combination that an individual carries. The term "phenotype" also refers to your physical qualities, which include your overall state of health, family history of illnesses, and personality traits in addition to the more obvious ones like your hair and eye color. Not all traits are genotype-dependent. For instance, when one cherishes dogs.

Individuals who are genetically incompatible run a high risk of having a kid with sickle cell disease, a dangerous condition that drastically shortens lifespan and causes physical hardship (Tubman et al., 2016). Due to the significant likelihood that your child may be born with sickle cell anemia, you must pass a genotyping test before getting serious with a partner. The genotype of the child will be directly influenced by the genotype combination of the parents. Children born to parents with different genotypes used to have a high death rate, and nobody understood how to prevent it.

A blood condition called sickle cell anemia (SCA) is autosomal recessive. Most carriers of the mutant hemoglobin S gene do not exhibit any symptoms. There is a 25% risk that a pregnancy will result in a child with sickle cell anemia when both parents are carriers (Hemoglobin SS). Red blood cells in those with the condition take on a sickled appearance, resulting in cells that block small blood arteries, decreasing blood flow through them, and harming the tissue those vessels supply. Around 6 million newborns are affected each year by the fatal genetic blood illness known as sickle cell disease (SCD) (Piel et al., 2013; McGann et al., 2013).

SCD is the most frequent genetic illness in Africa, affecting about 250,000 children every year, mostly in sub-Saharan Africa (Modell & Darlison, 2008). Moreover, Nigeria and the Democratic Republic of the Congo, both in sub-Saharan Africa, account for 30% of all SCD and SCT newborns worldwide each year (Piel et al., 2013). Nigeria does not have a national newborn screening program for SCT and SCD despite the extremely high incidence of SCD (Rahimy et al. 2009; Odunvbun et al., 2008).

According to statistics from the state Ministry of Health for 2014, Katsina had the largest number of sickle cell patients in the nation at 17,000, according to Daily Trust. The Secretary to the Government of the State, Alhaji Mustapha Inuwa, stated at the launch of the free genotyping and malaria screening program that sickle cell was characterized by significant morbidity and mortality, with 50% of individuals dying within the first ten years of their existence (Daily Trust, 2014). In order to lessen the threat in 2018, the Katsina State administration has mandated a mandatory haemoglobin genotype test for all prospective couples through its ministry of health. Therefore, the present study was undertaken to determine the impact of the law passed by the

government in curbing the incidence of sickle cell disease in Katsina State, northwestern Nigeria from the period of 2018-2022.

MATERIALS AND METHODS

Sample collection

In order to look into the prevalence of the diseases in Katsina, the hospital record officers were contacted for the pertinent hospital records of instances of newborns genotype status seen at six Katsina state General Hospitals from 2018 to 2022. 15112 examples in total were examined and discussed using descriptive statistical methods, such as tables and percentages, which were well selected for this type of study.

Description of study area

Northern Nigeria's Katsina State, with an aerial extent of 23,850 km², is situated roughly between latitudes 11° 30' N and 13° 15' N and longitudes 6° 52' E and 9° 20' E. (Alo et al., 1998). The State is bordered to the north by the Niger Republic, to the east by Jigawa and Kano States, to the south by Kaduna State, and to the west by Zamfara State. The modern Katsina State was created on September 23, 1987, when the previous Kaduna State was divided into the two historic kingdoms of Katsina and Daura (Alo et al., 1998). Nowadays, Katsina State is one of the 36 states that comprise the Federal Republic of Nigeria, and the State is divided into thirty four LGAs. The State has a population of 5,801,584 people as of the 2006 national population census, and the 2016 population forecast puts that number at 7,831,319 people (NBS, 2017). Members of the Hausa and Fulani ethnic groups, who are predominately Muslims based on religion, make up the majority of the state's population. Along the rivers and dams in the State, people's primary professions are irrigation farming during the dry seasons and rain-fed agricultural during the wet seasons. The Fulani and indigenous Hausa people of the State also raise cattle in the grassland areas. Another important occupation is trading, which involves traveling to the weekly markets in the towns and villages of the State to buy and sell goods.

The population

Katsina State has a population of 5,801,584 people as of the 2006 national population census, and the 2016 population forecast puts that number at 7,831,319 people (NBS, 2017).

Sample size

Out of the total general hospitals in Katsina state, six general hospitals were randomly selected in katsina state consisting katsina, daura, Rimi, Musawa, Malumfashi and Kankia general hospitals respectively.

Data analysis

SPSS version 26 was used to enter and evaluate the data. Using descriptive techniques, the prevalence of genotype status of infants was determined. Chi-square was used to determine the

associations. When the P-value was less than 0.05, the association was considered statistically significant, and when the P-value was greater than 0.05, considered otherwise.

RESULTS

Throughout the years 2018 to 2022, a total of 12467 newborns were tested in the study region. The prevalence of the diseases was reported to be high in the year 2018 (a year without a mandatory government law), with 604 instances (23.8%), followed by 564 (21.4%) in 2019, 296(19.5%) in 2020, 356(14.3%) in 2021, and 339 (10.3%) in 2022 (Figure 1). The year 2022 had the lowest incidence, with 339 (10.3%) babies. The results also show that the prevalence of the baby genotype AA rises with time, with the lowest frequency in 2018 (42.6%) and the highest prevalence in 2022 (54.5%). Similar trends are seen in those with the genotype AS, who had a dramatic drop from 33.6% in 2018 to 22.4%.

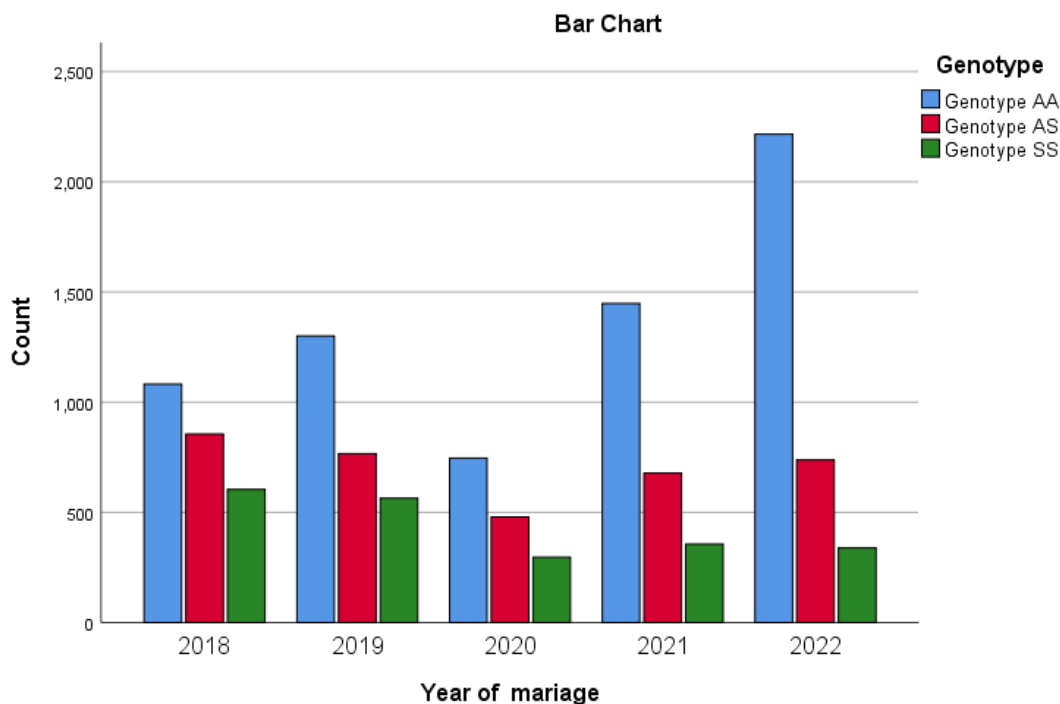


Figure 1: Prevalence of the infant Genotype status in relation to the period of the study

Prevalence of hemoglobin genotype testing on infants in the study locations in Katsina state before the passage of the compulsory testing law

Figure 2 shows the Prevalence of hemoglobin genotype testing on infants in the study locations in Katsina state before the passage of the compulsory testing law. The result show that prior to the enactment of the law for compulsory testing of genotype in the year 2018. A total of 2541 infants were screened for the hemoglobin genotype in the year 2018. Out of which 42.6% have the genotype AA (Healthy individuals), 33.5% have also genotype AS (Carriers) while 23.8% were having genotype SS (Sickle cell anemia diseases). The result further indicates that for the records of infants tested in the health facilities; general hospital Katsina have the highest percentage records of infants tested for genotype with 26.20% while general hospital Kankis has

the least records of infants tested for genotype status with 11.35%. However, there was significant difference in prevalence across the study locations ($\chi^2 (10) = 193.7175$; $P < 0.05$).

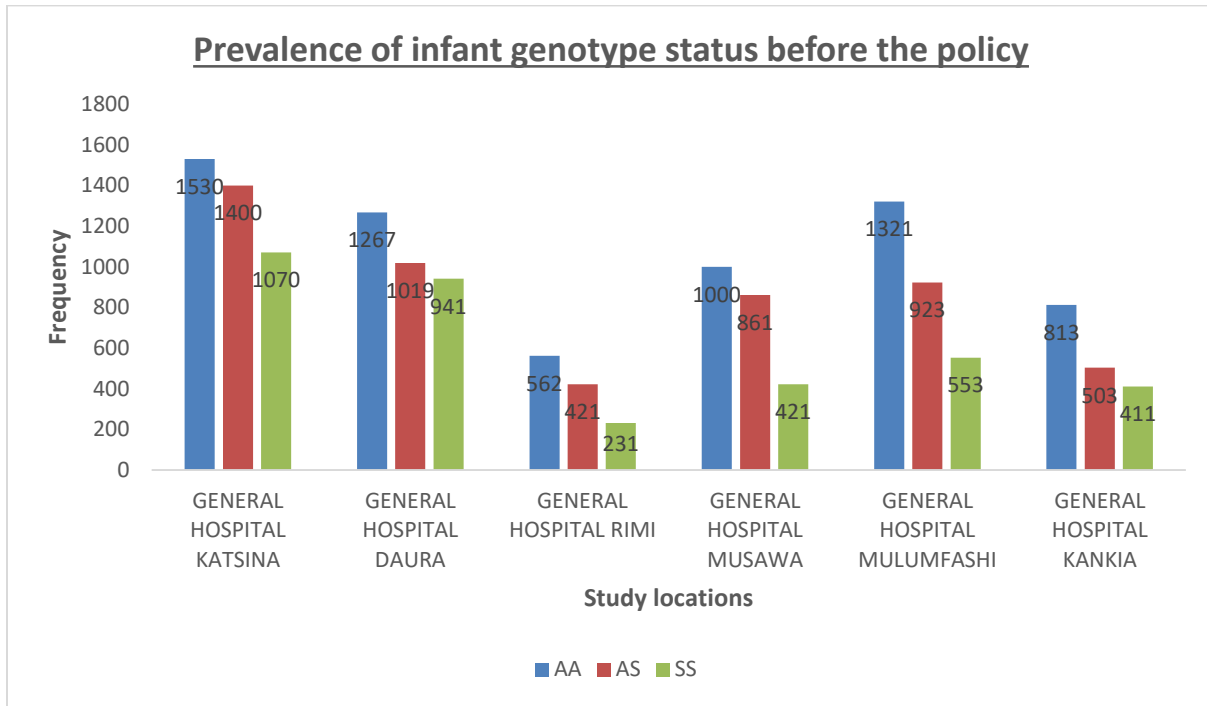


Figure 2: Infant genotype status in the study locations before the law

Significance of the government hemoglobin genotype testing policy on infant's genotype status in Katsina State

A total of 9926 infants screened for the status of their genotype after the government policy of compulsory genotype testing. The records showed that 57.5% have genotype AA, 26.8% with AS and 15.7% have genotype SS. From the result in table 2 indicate a rapid decline in the number of infants with SS in the year 2019 with 21.4% to as low as 10.3% in the year 2022. The result further revealed a rapid increase of infants with genotype AA having 49.4% in 2019 to as much as 67.3% in 2022. A similar trends of rapid decline in the number of those infants with AS; with 29.1% in 2018 rapidly decline to as low as 22.4% in the year 2022. The results indicate a rapid reduction in the number of those with potential sickle cell anaemia down the years. These pattern in the infant hemoglobin genotype was thus significantly different across the years before and after the law ($\chi^2 (6) = 279.058$; $P < 0.05$).

Table 1: Significance of the government heamoglobin genotype testing policy on infant's genotype status in Katsina State

	G			E			N			O			T			Y			P			E		
Years	A						A			A			S			S			S			TOTAL	Chi-square	P - v a l u e
2019	1	3	0	0	(4	9	.	4)	766	(29.1%)	564	(21.4%)	2	6	3	0						
2020	7	4	6	(	4	9	.	0	)	479	(31.5%)	296	(19.5%)	1	5	2	1	$\chi^2(6) = 279.058$	P = 0.000				
2021	1	4	4	8	(	5	8	.	3	)	678	(27.3%)	356	(14.3%)	2	4	8	2					
2022	2	2	1	6	(	6	7	.	3	)	738	(22.4%)	339	(10.3%)	3	2	9	3					
TOTAL	5	7	1	0	(	5	7	.	5	)	2661	(26.8%)	1555	(15.7%)	9	9	2	6					

Source: SPSS version 25

DISCUSSION

From the result in our study, it is seen that before the compulsory government law there was high prevalence of the sickle cell disease owing to the facts that people were not going for genotype test before marriage, while it indicated in our study that after the Katsina State government passed the law on compulsory genotype testing before marriage, the result shows a drastic reduction in number of infants with a sickle cell disease. This clearly indicates that there is a compliance on the part of the people. Infants with SCD must be identified through diagnostic screening in order for newborns and families to receive potentially life-saving medical and educational interventions as soon as possible. Many children might not be discovered in time to receive important preventative care without thorough neonatal screening. In light of this, a considerable drop in pediatric SCD mortality was caused by the introduction of universal newborn SCD screening in many affluent nations (Vichinsky et al., 1988; Gaston et al., 1986). Newborn screening has been suggested by the World Health Organization as a crucial tactic for lowering pediatric mortality in Africa (WHO, 2010).

In several low-resource contexts across Africa, such as the Democratic Republic of the Congo (DRC), Burkina Faso, Ghana, Nigeria, Angola, and Liberia, numerous pilot or demonstration programs for universal newborn screening have been introduced. The program has yet to be scaled up at the national level in any of these nations, and none of them has been able to sustain a long-term national sickle cell newborn screening (Boer et al., 2006; Tshilolo et al., 2009; Kafando et al., 2005; Ohene-Frempong et al., 2008).

CONCLUSION

The whole set of genes in a cell, an organism, or an individual makes up the genotype. It is based on the genetic information that a person's parents gave them. The genotype of a person represents all of their genetic information, which is based on the genes their parents passed on to them. Except for twins or multiple births from the same fertilized egg, children born to a parent

will have separate genotypes. The primary influencing factor in the development of phenotype is genotype, which specifies the sort of trait that a phenotype can have.

Based on the result of this work. It concluded that the Katsina State Government law enacted to enforce a compulsory genotype testing in the state have significantly reduce the incidence of sickle cell disease in the study area. Thus it is therefore recommended that the government should intensity campaign and to create awareness on this law.

Data Availability

Data are available from the corresponding author upon request.

Ethical Approval

The permission of the individual school authorities was obtained using a letter of introduction from the registrar of the federal polytechnic Daura. Permission to carry out the investigation was issued to Katsina state ministry of health through department of Katsina state health service management board to collect data in the study area.

Conflicts of Interest

The author declares that they have no competing interest.

Authors' Contributions

Nura and Abdurrashid contributed in the proposal development, study design, data collection, and analysis and also the contributed in the supervision from the proposal development, fieldwork, laboratory analysis, and development of the paper.

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