Statistical Modelling of Sickle Cell Disease

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Abstract: **India has the largest concentration of tribal populations globally. They are believed to be the early settlers in the country and are considered to be the original inhabitants. According to the Census of India 2011, the tribal population of India is 8.6 per cent of the total population which is about 67.8 million people. The first description of sickle haemoglobin in India was by Lehman and Cutbush in 1952 in the tribal populations in the Nilgiri hills in south India. In the same year, Dunlop and Mazumder also reported the presence of sickle haemoglobin in the tea garden workers of Upper Assam who were migrant labourers from tribal groups in Bihar and Odisha. Since then, many population groups have been screened and the sickle cell gene has been shown to be prevalent among three socio-economically disadvantaged ethnic groups, the scheduled tribes, scheduled castes and other backward classes in India. In our study statistical linear and nonlinear modelling has been carried out by using SPSS (ver.19).**

***Key Words*— H1N1, SIR Model, Excel 2007.**

I. INTRODUCTION

Sickle cell disease (SCD) is one of the most common monogenic disorders globally with an autosomal recessive inheritance. James Herrick, a physician first described the characteristic sickle shaped red cells in a medical student from Grenada in 1910. Linus Pauling and his colleagues showed that sickle haemoglobin (HbS) had an altered electrophoretic mobility and they were the first to define it as a molecular disease in 1949. A few years later in 1957, Vernon Ingram discovered that sickle haemoglobin resulted from a single amino acid substitution in the haemoglobin molecule. The disease results from a single base A>T mutation in the triplet encoding the sixth residue of the β-globin chain, leading to a substitution of valine for glutamic acid and the abnormal haemoglobin S (HbS).

The sickle cell gene is widespread in India, affecting predominantly the tribal peoples of central India (states of Gujarat, Maharastra, Madhya Pradesh, Chhattisgarh, and Orissa) with another focus of the gene in southern India in the north of Tamil Nadu and Kerala. The tribal peoples in these areas are often relatively backward, living in rural areas with limited facilities, and generally marginalized from much of Indian society. Detection of the sickle cell trait and sickle cell disease among these peoples therefore poses particular challenges. There have been many programs designed to advance the tribal peoples in the Indian society, and sickle cell disease has emerged as one of the important public health problems affecting these groups. Several states have initiated sickle cell control programs, Gujarat leading the way in early 2006, Chhattisgarh in 2008, and Maharashtra in 2011. These screening programs usually have two objectives: firstly, screening of the susceptible populations, seeking to identify carriers in order to conduct education and counselling to reduce affected births; and secondly, identifying patients with the disease in order to improve clinical management. However, there may be a perception that programs imposed on communities from the outside may be less successful than educating communities wherein they recognize the importance of detecting the carrier state and specifically request such screening for the benefit of their villages. This is a concept advanced by the Vision Medical Foundation for Rural Health & Research in Bardoli, Gujarat State under their Sickle Cell Swa (self) Suraksha (protection) Abhiyan (movement).

In the Indian tradition, screening is conducted in a single session or "camp." The village sickle cell committee is responsible for sending written invitations to the villagers to attend the camp which takes place on a predesignated day. The format usually includes a formal welcome, opening prayers, entertainment in the form of dances or songs performed by the children, and speeches on the importance and genetics of sickle cell disease followed by blood sampling. Clerical stations are set up to register patients, allocating unique ID numbers and supplying a blood tube; after which, the villagers move to bleeding stations each staffed by a team of two nurses experienced in vein punctures. Using 2-ml syringes and gauge 22 needles, 2 ml of venous blood is drawn from the antecubital vein into tubes prepared with EDTA(Ethylenediaminetetraacetic Acid), marked with the person's name and ID number, and kept in cool storage pending return to the laboratory. India has the largest concentration of tribal populations globally. They are believed to be the early settlers in the country and are considered to be the original inhabitants. According to the Census of India 2011, the tribal population of India is 8.6 per cent of the total population which is about 67.8 million people.

The states of Madhya Pradesh, Maharashtra, Odisha, Gujarat, Rajasthan, Jharkhand, Chhattisgarh, Andhra Pradesh, West Bengal and Karnataka account for around 83 per cent of the total scheduled tribe population in the country and majority of these tribal groups live in rural areas. In all, 461 scheduled tribes have been listed and they have their own characteristic cultural patterns, languages and social systems, by and large keeping to themselves. However, Reich *et al* concluded that "several thousand years

ago, the entire subcontinent underwent a period of massive intermarriage, shuffling its population's genetic deck so thoroughly that it left clear traces even in the genomes of today's most isolated tribes".

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II. Materials and Methods

The following statistical linear and nonlinear modelling has been carried out by using SPSS (ver.19).

Linear. Model whose equation is Y = b0 + (b1 * t).

Logarithmic. Model whose equation is Y = b0 + (b1 * ln(t)).

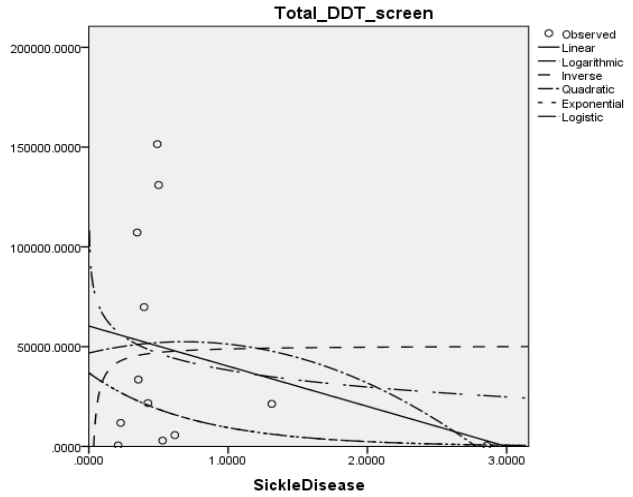
Inverse. Model whose equation is Y = b0 + (b1 / t).

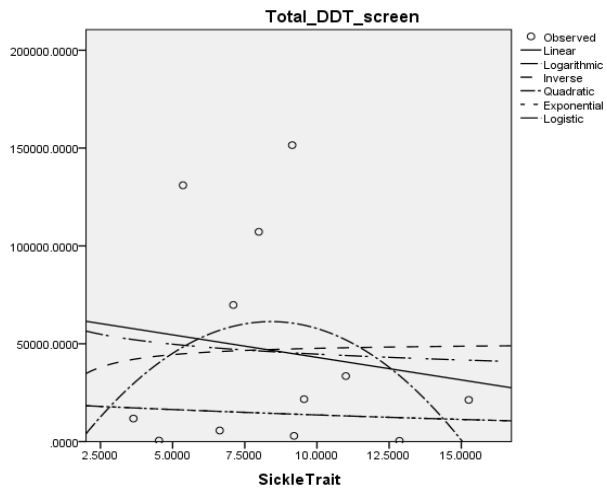
Quadratic. Model whose equation is Y = b0 + (b1 * t) + (b2 * t**2).

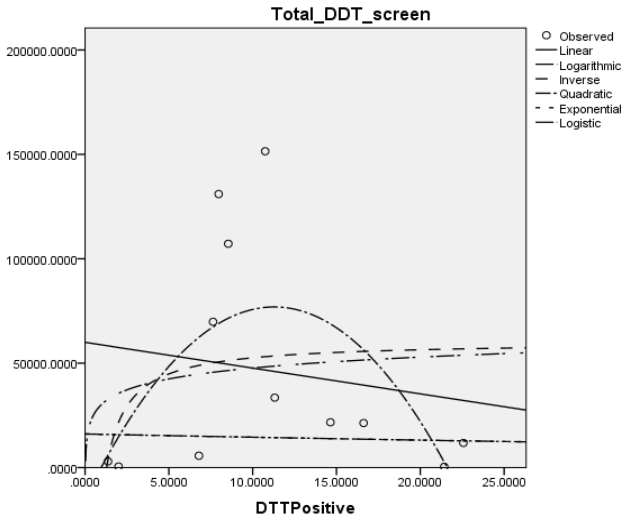
Logistic. Model whose equation is Y = 1 / (1/u + (b0 * (b1**t))) or ln(1/y-1/u) = ln (b0) + (ln(b1) * t) where u is the upper boundary value.

Exponential. Model whose equation is Y = b0 * (e**(b1 * t)) or ln(Y) = ln(b0) + (b1 * t).

Place	Total DDT screen	DTT Positive	Sickle Trait	Sickle Disease
Surat	131000	7.9695	5.3588	0.5008
Tapi	11800	22.5714	3.6429	0.2286
Navsari	107200	8.5448	7.9851	0.3470
Valsad	151500	10.7427	9.1423	0.4916
Dang	5670	6.7901	6.6314	0.6173
Sabarkantha	500	2.0000	4.5263	0.2105
Banaskantha	33500	11.3134	11.0000	0.3552
Panchmahal	21682	14.6389	9.5517	0.4243
Dahod	69810	7.6350	7.1021	0.3968
Vadodara	350	21.4286	12.8571	2.8571
Bharauch	2925	1.3675	9.2059	0.5294
Narmada	21320	16.6182	15.2580	1.3133







III. Conclusion:

Among the total patient screened at various places , the highest percentage of DTT Positive Patients were reported from Vadodara and minimum from Surat whereas in Sickle Trait the highest percentage were reported from Vadodara and minimum from Surat and finally Sickle Disease the maximum patients were reported from Vadodara and minimum from Navsari.

References:

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