"A HOSPITAL BASED CROSS SECTIONAL STUDY TO DETECT DEFORMITIES/DISABILITIES IN PATIENTS WITH LEPROSY"

Submitted by

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LIST OF ABBREVIATIONS

WHO	-	World Health Organization
NLEP	-	National Leprosy Eradication Programme
SWMT	-	Semmes- Weinsten monofilaments
SD	-	Standard Deviation
TT	-	Tuberculoid
BT	-	Borderline tuberculoid
BB	-	Mid borderline
BL	-	Borderline lepromatous
LL	-	Lepromatous leprosy
MA	-	Maculo- anaesthetic
PN	-	Pure neural
I	-	Indeterminate
ENL	-	Erythema nodosum leprosum
DPMR	-	Disability Prevention & Medical Rehabilitation
MCP	-	Metacarpophalangeal Joint
MB	-	Multibacillary
PB	-	Paucibacillary

RFT	-	Released from treatment
NFI	-	Nerve function impairment
NA	-	Not applicable
SDUL	-	Specific deformity upper limb
SDLL	-	Specific deformity lower limb
ADUL	-	Anaesthetic deformity upper limb
ADLL	-	Anaesthetic deformity lower limb
VPDUL	-	Visible paralytic deformity upper limb
VPDLL	-	Visible paralytic deformity lower limb

ABSTRACT

Background

Leprosy is a common infectious disease causing as much social problem as a medical one. It leads to variety of disabilities resulting from nerve damage, immunological reactions and bacillary infiltration. Among communicable diseases, it remains a leading cause of peripheral neuropathy and disability worldwide. Disabilities and deformities are of major concern as it triggers social, economic and psychosocial problems of leprosy patients. Early identification can lead to prevention of progression of the deformities and also help in providing rehabilitation in advanced cases.

Objectives

To detect deformities and disabilities in leprosy patients and grading them according to WHO deformity and disability grading system (2007).

Method

It was a hospital-based, cross sectional study. One hundred and forty six patients with leprosy attending the Dermatology, Venereology and Leprosy out-patient department of a tertiary care hospital were included in the study. Detailed history was taken and all patients were examined for all kinds of deformities of hands, feet and face. Slit skin smear and biopsy was done in all new cases.

Results

Among the 146 patients enrolled in the study, 85 were male and 61 were female, 10 were children, with a mean age of 38.1(±15.6) years. The mean duration of disease was 2.6 (±4.1) years. A statistically significant ($p<0.001$) number of patients with deformity presented to hospital by 2 years of onset. Proportion of deformities was greater in males, in farmers and in people belonging to lower socio-

economic status (p=0.008). Multibacillary patients had higher rate of deformities of hands and feet and a statistically significant (p=0.006) number of MB patients had grade 2 ocular deformity (WHO 2007).

Conclusion

Various deformities can be detected by clinical examination and simple tests. Early identification of disease and deformities can help in educating the patients about leprosy and thus prevention of progression to adverse sequelae.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION

Leprosy is a common infectious disease of mankind since the time unknown. There has been mention of leprosy in the Indian literature as early as 600 BC.[1] The discovery of Lepra bacillus by Sir Gerhard Henrik Armauer Hansen in 1873 opened a new vista in the understanding of the disease.[1]

Leprosy is a chronic granulomatous infection caused by *Mycobacterium leprae*. The organism is a rod shaped acid fast bacilli mainly affecting the peripheral nerves and skin.[2,3] When the disease is left untreated, various deformities may develop.[4] World Health Organization (WHO) has declared leprosy as a major public health problem as it is known to be associated with crippling deformities.[5]

Deformities are the loss or abnormality of psychological, physiological or anatomical structure or function.[6] It may be either visible impairments or consequences of invisible impairments.[6] Disability is the inability to perform certain activities, which were normally possible, but become difficult or impossible to carry out because of deformities.[6]

The deformities due to leprosy result in extensive loss of man power and economic loss to the society.[7] Leprosy remains a public health problem in fifty five countries but thirteen countries account for 94% of total registered cases.[8] India, Brazil and Indonesia report more than 10,000 new patients annually. Globally about 21,3899 new cases were detected with Grade 2 deformity corresponding to 6.6% of the total number of newly diagnosed patients and to a rate of 2.5 cases per million (WHO 2015).[5]

One of the objectives of the leprosy control programmes is to prevent onset of deformities (WHO 1982, NLEP 1987) and to pay particular attention to the number

and proportion of new cases with severe disabilities since they represent failure of case detection system (WHO 1985).[9]

Various factors seem to determine development of the disease and deformities. As these deformities are recognizable due to leprosy, presence of these result in social stigma.[10,11]

There are many Indian studies to detect proportion of deformities and disabilities among leprosy patients. The results of these studies provide a highly variable range of deformities among leprosy patients (9.2% to 50%).[34-41] However, the variables like study location, study population, study period, inclusion criteria etc. are widely different in these studies; hence it is not possible to estimate the accurate epidemiology of leprosy-related deformities and disabilities in the country from these studies. The present study has been planned to assess the burden of deformities and disabilities in patients suffering from leprosy in northern Karnataka in post-elimination era.

OBJECTIVES OF STUDY

To detect deformities and disabilities in leprosy patients and grading them according to WHO deformity and disability grading system (2007).

REVIEW OF LITERATURE

INTRODUCTION

Leprosy is a chronic granulomatous infection caused by *Mycobacterium leprae* affecting mainly peripheral nerves and skin.[3,12] Lepra bacillus was discovered by Hansen in 1873.[1] It was the first bacterium to be etiologically associated with human disease. However it remains one of the few bacterial species that has not been cultivated on artificial medium or tissue culture as yet.[13] The optimum temperature for multiplication of *M. leprae* is lower than 37^{o}C resulting in its apparent predilection for the cooler areas of the skin and peripheral nerves.[13,14] It has a long incubation period and the first signs of the disease appear 2-10 years after the infection. The clinical spectrum of leprosy varies from a single skin patch to widespread damage to the nerves, bones, and eyes.[15] The unique tropism of *M. leprae* for the peripheral nerves (from large nerve trunks to microscopic dermal nerves) and certain immunologically mediated reactional states are the major causes of morbidity in leprosy.[6,16]

Cardinal features of leprosy

The seventh WHO expert committee on leprosy defined "case of leprosy" as "a disease in a person having one or more of the following features and who is yet to complete a full course of treatment"; these features are designated as the "cardinal features" of leprosy and include :

- Hypopigmented or reddish skin lesions with definite loss of sensation.
- Involvement of peripheral nerves (as demonstrated by thickening with loss of sensation)
- Skin smears positive for acid fast bacilli.

Of these cardinal features presence of at least one is essential for the diagnosis of leprosy.[17]

Classification

The most commonly used classification system for leprosy is Ridley-Jopling classification.[18] In this system, based on immunological parameters, leprosy patients have been grouped as:

a)Tuberculoid (TT),

b) Borderline tuberculoid (BT),

c) Mid-borderline (BB),

d) Borderline lepromatous (BL), and

e) Lepromatous (LL)

The other commonly used classification system in this country is the Indian classification,[19] which includes the following groups:

a) Lepromatous (L)

b) Tuberculoid (T)

c) Maculoanesthetic (MA)

d) Pure neuritic (P)

e) Borderline (B)

f) Indeterminate (I)

For therapeutic purpose patients with leprosy are categorized as paucibacillary (</= 5 skin lesions) and multibacillary (>5 skin lesions), (WHO, 1998).[19]

Skin involvement in leprosy

Skin lesions of leprosy are variable depending upon the immunological spectrum of the disease. Lesions are large, solitary or multiple but countable in

asymmetrical distribution at higher spectrum (TT, BT) whereas small, numerous and symmetrically distributed at lower spectrum of the disease.[15] A brief description of skin lesions has been presented in table 1.

Table 1: Characteristics of skin lesions of leprosy

Type of leprosy	Skin lesions
TT	Usually single, large erythematous plaque with dry, hairless surface and complete anaesthesia.
BT	Single to multiple hypopigmented patch with dry surface and loss of hair. There may be feeding nerve twig along the border of the patch and near total loss of sensation is present. Pseudopodia and satellite lesions may be seen at the border.
BB	The lesions are transient, annular and classically inverted saucer-shaped.
BL	Multiple ill-defined, hypopigmented macular lesions with minimal loss of sensation.
LL	Numerous symmetrically distributed, shiny coppery/ hypopigmented macules with minimal or no loss of sensation.
Indeterminate	Few very ill-defined, hypopigmented macules with or without loss of sensation distributed on face or limbs. Mostly seen in children.
Pure neuritic	Skin lesions are absent. Patients present with single or multiple peripheral nerve enlargement with loss of sensation along its distribution, with or without motor weakness.[15]

Reactions in leprosy

Leprosy reactions are immunologically mediated episodes of acute or subacute inflammation which interrupt the relatively uneventful usual chronic course of the disease.[16]

There are two types of reactions in leprosy:

Type 1- It is a type IV hypersensitivity reaction with shift of immunological status of the patient. Neuritis and resultant nerve palsies are the major clinical features. It may occur in any spectrum of the disease but mostly in the borderline spectrum (BT, BB, BL).[16]

Type 2- It is a type III hypersensitivity reaction, presenting with multi-system involvement. The classical cutaneous feature is erythema nodosum leprosum (ENL). It occurs in patients with BL or LL disease.[16]

Nerve involvement in leprosy

Leprosy is unique among the bacterial infections in that the peripheral nerves are invaded by the bacterium.[20] This is the pathognomonic feature of leprosy. Peripheral nerves those are superficially located are more susceptible to infection by *M. leprae*.[21] In addition, episodes of lepra reactions, mostly type 1 and often type 2 reaction also result in nerve damage in the form of neuritis.[21] Loss of sensation along the course of the nerve is the major feature of direct invasion by *M. leprae*.[22] Neuritis resulting from reactions cause acute-onset nerve palsy or slowly-progressive nerve palsy. Paralysis of major motor nerve trunks is the prime cause of motor deformity in leprosy.[22]

DEFORMITIES AND DISABILITIES IN LEPROSY

Leprosy is known to cause various deformities. A list of various deformities associated with leprosy has been presented in table 2. The incidence of deformity is higher in males than in females and more in multibacillary than in paucibacillary leprosy.[7]

Deformities: These are the loss or abnormality of psychological, physiological or anatomical structure or function. It may be either visible impairments or consequences of invisible impairments.[6]

Primary impairment: Changes in the structures and functions of the body tissues directly due to disease process like damage to the nerve, e.g., anaesthesia to the area supplied by the nerve.[6]

Secondary impairment: Changes in the structure and function of the body parts due to neglect, excessive use, carelessness and improper care of body parts with primary impairment; e.g., weak/paralysed parts, leading to joint stiffness or formation of contractures.[6]

Handicap: These are the disadvantages that limit or prevent the patients from fulfilling their normal role in society (e.g., unemployment, economic and physical dependence).[6]

The risk factors for developing deformities and disabilities in leprosy are:

1)*Type of leprosy:* More extensive and bacilliferous types like borderline and lepromatous leprosy carry a high risk of deformities unlike the more circumscribed and low bacilliferous types like indeterminate and tuberculoid leprosy. In the latter group the risk of deformity is absent or very low.[7]

2) *Duration of active disease:* The longer the disease remains active, the greater is the risk of developing disability.[7]

3) *Number of peripheral nerves involved:* Patients with involvement of three or more nerves have a higher risk of developing a significant disability.[7]

Depending upon the causation, deformities can be categorized as:

1) Specific deformities: These arise due to local invasion by *M. leprae*. These are seen most often on the face (e.g.,loss of eyebrows, nasal deformity), less often in the hands (e.g.,'banana fingers','reaction hand'deformities) and occasionally in the feet.[7]

2) Paralytic deformities: These result from damage to motor nerves. These are seen most often in the hands (e.g., claw fingers), less often in the feet (e.g., claw toes, foot drop), and only occasionally in the face (e.g., lagophthalmos).[7,18]

3) Anaesthetic deformities: These occur as late sequelae of neglected injuries in parts rendered insensitive because of damage to sensory nerves, e.g., trophic ulcers, scar contractures, shortening of digits, mutilation, and disorganization of tarsus.[7,18]

Deformities are found most often on the hands and feet. Specific and paralytic deformities are examples of primary impairments caused directly by the disease. Anaesthetic deformities are secondary impairments since these are due to sensory loss. When anaesthesia is considered, feet are more affected but when grade II deformity is considered, hand deformities are found almost twice as often as that of feet.[23]

Causes of deformities

Damage to the components of the peripheral nerves is followed by anaesthesia, dryness of skin and muscle paralysis.[12] These three factors precede deformity of hands and feet in patients with leprosy. These predispose the affected limbs to misuse, ulceration and scar formation.[12] Secondary infection ensues and create a vicious cycle of events which causes loss of deep tissue and results in severe deformity.[12] A further cause of damage in lepromatous patients is due to direct invasion of tissues by *M. leprae.*[12] The causes of deformities are:

Table 2: Various deformities in patients with leprosy[7]

	Specific deformities	**Paralytic deformities**	**Anaesthetic deformities**
Upper limb	Banana fingers. Shortening of fingers. Reaction hand.	**Ulnar nerve**- partial claw hand(ulnar claw hand). **Median nerve**- median claw hand. **Ulnar and median nerve**- complete claw hand. **Radial nerve**- wrist drop. **Triple nerve paralysis**- complete claw hand and wrist drop.	Cracks, fissures, trophic ulcer.
Lower limb	Fixed deformities of toes and feet. Tarsal disorganization	Foot drop. Clawing of toes.	Cracks, fissures, trophic ulcer.
Face	Loss of eyebrows (madarosis). Premature senility. Nasal deformity: collapse of nasal bridge.	-	-
Eyes	Lepromata formation, glaucoma, and anterior and posterior synechiae.	Lagophthalmos.	Corneal ulceration, corneal anaesthesia, punctate keratitis , blindness.

Anaesthesia: This is the most devastating complication of leprosy and by far the most important cause of disability. It greatly increases the risk of disability following motor and autonomic nerve damage and is the main factor predisposing to secondary complications. Patients become clumsy, have difficulty in handling things and cannot do fine works. Most of them give up some activities such as sewing or gardening or

sport, and a sense of social separation is established even before physical disability develops.[12]

Dryness of skin: Damage to sympathetic nerve fibres impairs sweating and the skin becomes dry, inflexible and brittle. Fissures are formed easily and a cycle of ulceration and scarring starts.[12]

Muscle paralysis: It is a disability in itself. Additionally it produces muscle imbalance that results in abnormal position of the joints. This exposes the hands and feet to abnormal stress. In anaesthetic limbs destruction of the deeper tissues and ulceration of the skin ensues.[24]

Misuse: Most of the injuries in anaesthetic hands and feet result from misuse. Misuse of an anaesthetic limb leads to injury without the patient's recognition. The injury is neglected, complications set in, and the vicious cycle of tissue destruction and disability begins.[24]

Injuries that are common due to repeated, prolonged or excessive force are;

- Bruises from minimal repeated trauma
- Necrosis from prolonged or abnormal pressure
- Puncture wounds and cuts
- Burns
- Blisters due to friction
- Dislocation of joints

Ulcers: Minimal repeated trauma is the most important cause for development of ulcers in anaesthetic limbs. Plantar ulcer is possibly the commonest secondary complication in leprosy.[24]

Scar formation: Defects caused by ulceration are replaced by scar tissue, which is weaker and has a poor blood supply than healthy tissue. As the scar contracts the blood supply becomes still poorer and the scar may break down due to minor injury or even spontaneously.[23]

Secondary infection: Anaesthesia delays recognition of mechanical injury. It also delays recognition of infection that commonly complicates injury.[23]

Invasion of tissues by M. leprae: In lepromatous leprosy all the tissues of hands and feet may be infiltrated with *M.leprae* and may not function normally. Bones may fracture. Inflammation due to lepra reactions may increase tissue damage and it is followed by stiff joints, contributing to disability.[23]

Stages of nerve damage

Peripheral nerves those are proximal to the sites of entrapment and superficially located are more susceptible to *M. leprae* infection.[20] Various stages of peripheral nerve involvement has been presented in table 3.

Three kinds of nerves may be affected in leprosy. Dermal nerve twigs in the skin lesions, cutaneous nerves and peripheral nerve trunks (cranial and spinal).[22] From the view point of development of deformities and disabilities, involvement of the nerve trunks of the limbs and face are important.[22] In limbs, some nerves at certain sites are affected more often than the others. In upper limb, the ulnar nerve is affected most commonly in the ulnar groove behind the elbow and above it, or in the forearm, little above the wrist.[25] The median nerve is less commonly affected. When affected, damage usually occurs in the forearm a little above the wrist and only rarely in the cubital fossa or arm. In lower limb the common peroneal nerve below the knee and the posterior tibial nerve lower down in the leg are affected frequently.[22] The latter is

damaged quite often unlike the common peroneal nerve that gets damaged only occasionally. The other nerves of the upper and lower limbs are rarely, if ever, damaged. Among the cranial nerves, the facial nerve is occasionally damaged, especially its upper zygomatic branches. The risk of damage is greatly increased when a facial skin lesion is in reaction.[16]

HAND DEFORMITIES IN LEPROSY

The hands are very often affected in leprosy. In patients having BL and LL leprosy, with repeated reactions, the hand is directly affected by the disease and reactions.[16] The consequences of nerve damage and reactions in hands are presented in table 4.

Specific deformities of hand

- Banana fingers (due to heavy infiltration and subsequent cutaneous atrophy with fat deposition)
- Shortening of fingers (due to fragmentation and resorption of terminal phalanges)
- Reaction hand[23]

FOOT DEFORMITIES

- Plantar ulceration
- Foot drop
- Fixed deformities of toes and feet
- Tarsal disorganization[23]

Table 3: Stages of peripheral nerve involvement in leprosy[23]

Stage of nerve involvement	Characteristics
Parasitization	A few *M. leprae* found in the nerve, but no other change
Tissue response	Host tissue response ranges from indeterminate to tuberculoid and borderline to lepromatous leprosy
Clinical involvement	Nerve thickening with or without pain or tenderness No evidence of nerve function deficit at this stage
Nerve damage	Nerve function deficit present; recovery is possible at this stage
Nerve destruction	Nerve elements completely destroyed Irreversible nerve function loss Long standing paralysis with severe wasting of muscles

Table 4: Consequences of nerve damage and reactions in hands[23]

Impairment	Direct consequences	Late consequences
Damage to somatic sensory fibres	Loss of sensation	Anaesthetic deformities
Damage to motor fibres	Muscle paralysis	Paralytic deformities and contractures
Damage to autonomic fibres	Xerosis	Cracks and fissures
Acute inflammation i.e. reaction hand	Inflammatory edema Osteoporosis (diffuse or juxta-articular), bone destruction	Severe fixed deformities Hand infections Specific deformities

Plantar ulcers

This is the most common deformity of feet. Plantar trophic ulcers are found in 15- 20% of the leprosy patients. These are characterized by spontaneous occurrence, lack of pain, chronicity and tendency to recurrence. Plantar ulcer is a manifestation of the breakdown of a foot having sensory or sensorimotor deficit along with unprotected use. The pattern of distribution of plantar ulcers is; about 80% are found in the forefoot along the metatarsophalangeal joint region, 6.5 – 10% in the midlateral border, another 5 – 10% are in the heel. In less than 5% of cases, the tips of one or more toes are the sites of ulceration. Ulcers in the middle of the sole are rare and, when present, indicate that the arch of the foot has broken down.[24]

Foot drop

About 2% of leprosy patients develop foot drop because of damage to the common peroneal nerve in the popliteal region.[24] The consequences of damage to common peroneal nerve have been presented in table 5.

Tarsal disorganization

Occasionally one or more tarsal bones are damaged and are progressively destroyed endangering the entire foot in patients with leprosy.[12] In most cases, the damage is caused by spread of secondary infection from an overlying chronic neglected plantar ulcer (septic disorganization).[12] The calcaneum (from an ulcer in heel) and cuboid (from an ulcer in the mid-lateral part of the sole in the cubometatarsal joint region) are commonly damaged in this manner.[12] However, in a grossly infected foot, any bone may be involved, and sometimes an entire bone such as the talus may be extruded as a sequestrum, leaving the foot quite unstable. In a

small proportion of cases, tarsal disorganization occur *de novo* as a consequence of trauma, either a major trauma or repeated microtrauma. Persistent swelling of the foot along with persistent warmth is the presenting sign in the early stages. Later the foot becomes unstable and grossly swollen, with disjunction of the anterior and posterior parts from the middle part.[12]

Table 5: Consequences of damage to common peroneal nerve[23]

Paralysis of	**Consequences**
Anterior (dorsiflexor) group of muscles	Loss of dorsiflexion of the toes Loss of dorsiflexion of foot Foot drop ("High stepping gait")
Lateral (evertor) group of muscles	Altered pattern of loading of foot Overloading of outer part of foot Ulcers over 5th metatarsal head and base Destruction of outer part of foot due to repeated ulceration

Fixed deformities of the feet and toes

The most common fixed deformity seen in the feet of leprosy patients is flexion contracture of the clawed toe. A neglected foot drop becomes stiff in inversion and plantar flexion.[25] A number of other deformities resulting from repeated ulceration are also observed in these feet. Any deformity of the foot should be viewed with reference to its potential to cause plantar ulcer.[25]

EYE DAMAGE

Eye damage in leprosy often starts insidiously. Corneal anaesthesia is among the most common impairment of eyes followed by lagophthalmos.[27]

Mechanism

Damage to the seventh nerve produces paralysis of orbicularis oculi. It is usually common in association with TT or BT lesions on face especially during Type 1 reaction and also in late untreated lepromatous leprosy.[16] Scarring of the tarsal plate leads to development of entropion and trichiasis. Damage to the ophthalmic branch of fifth nerve results in anaesthesia of cornea and conjunctiva. With more profound anaesthesia blink reflex is lost causing corneal ulcer. In untreated cases complications like endophthalmitis and panophthalmitis may develop leading to blindness. Iridocyclitis, when left untreated, leads to blindness.[27] Secondary open angle glaucoma can produce irreversible damage to optic nerve. This results in visual field defects without the patient being aware of it and may lead to blindness.[27]

EXAMINATION OF LEPROSY PATIENTS TO DETECT DEFORMITY/DISABILITY

Various examination modalities are employed to detect deformities and disabilities in leprosy patient. Each patient with leprosy must be examined in detail to detect any deformity.

Following steps are followed:

Eye examination: The corneal reflex is tested with a wisp of sterile cotton wool. Absence of blinking indicates damage to the trigeminal nerve. Visual acuity is assessed by finger-count test and thereafter using a Snellen's chart.[28]

Palpation of peripheral nerves:

Peripheral nerves are palpated at designated body sites (against fixed bony landmarks), as displayed in figure 3. The thickness of the nerves may vary depending upon the individual patient's muscularity, occupation, gender, obesity etc. Very exceptionally, in long standing cases the affected nerve may appear thin and firm due to fibrosis.[28]

While examining a peripheral nerve following points are noted:

- Whether the nerve is palpable or not in comparison to the opposite side and normal individuals.
- Whether there is nerve tenderness; if the nerve is tender, the patient winces on gentle pressure.
- Whether there is any swelling along the course of the nerve, indicative of nerve abscess.
- Whether the consistency of the nerve is soft or firm, the latter indicating repeated episodes of reactions.[28]

Sensory testing

Sensations are to be tested on skin lesions, distal extremities and along the distribution of enlarged peripheral nerves. Following sensory modalities are to be tested:

1. Temperature (using hot/ cold water in test tubes)
2. Touch (with a wisp of cotton-wool or nylon monofilaments for objective sensory testing)
3. Pain (pin prick test)

Before starting the test, the patient should be explained the procedure in vernacular and a trial of the method is conducted with the patient's eyes open. The patient is asked to count loudly each time the stimulus is felt. Once followed correctly, the patient is instructed to close the eyes, and the test is repeated to interpret. The sites for testing the sensation in the hands as well as in the feet (NLEP) is depicted in figures 1 and 2.[29] Impairment or absence of sensation at any of these points needs testing of the sensation at more points in that area to identify the exact extent of sensory loss.[29]

Touch sensation is tested by following methods:

Cotton wool test- This is to test a person's ability to perceive fine touch. Here wisp of cotton is used for testing fine touch.[28]

Figure 1: Four points of sensory testing on hands and feet (NLEP)

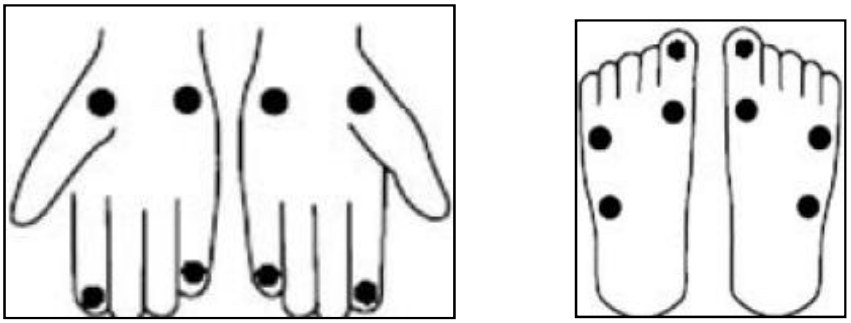


Figure 2: Areas of detailed sensory testing on hands and feet (NLEP)

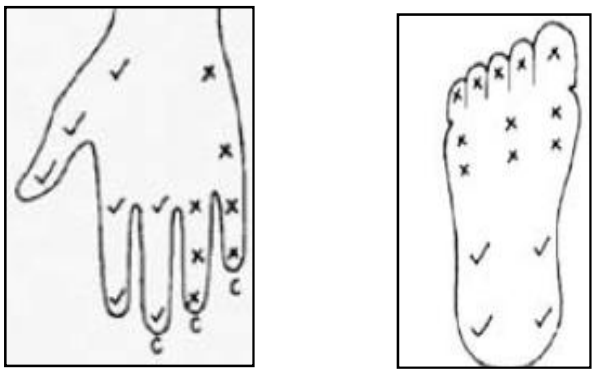
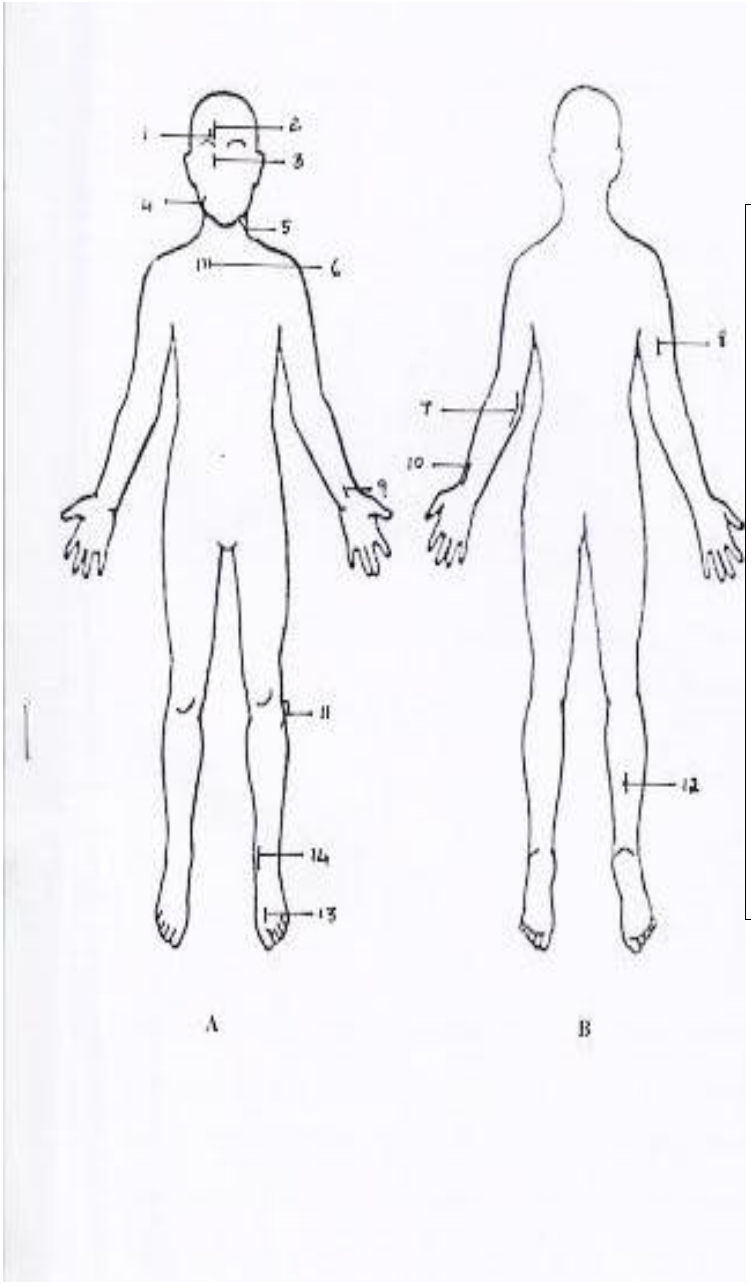


Figure 3 : Body sites to palpate various peripheral nerves.



1. Supraorbital nerve
2.Supratrochlear nerve
3.Infraorbital nerve
4.Cervical branch of facial nerve
5.Greater auricular nerve
6.Clavicular nerves(3 sets)
7.Ulnar nerve
8.Radial nerve
9.Median nerve
10.Radial cutaneous nerve
11.Lateral popliteal nerve
12.Sural nerve
13.Anterior tibial nerve
14.Posterior tibial nerve

Semmes Weinstein monofilament testing (SWMT)- In SWMT, nylon monofilaments are used which bend at a force of 200 mg, 2 g and 10 g. The length of the monofilament should be 2 cm. The normal sensory threshold of the hands is 200 mg and that of the feet is 2 g.[30] If 2 g and 10 g are not felt over the hands and the feet respectively, there is a loss of protective sensation.[30] The filament should be kept on the skin for about 1.5 seconds and the patient is asked to respond by pointing with the index finger to the area touched. When the patient starts responding, the procedure should be repeated with his eyes closed. The hands and feet are tested at fixed points.[31]

Moving 2 Point Discrimination (M2PD)- This is the ability to discern that two nearby objects touching the skin are truly two distinct points, and not one.[31]

Pin prick test (PP)- This is to test a person's ability to detect cutaneous pain sensation and to differentiate this from pressure stimuli. Here paper pins cleaned with spirit or alcohol may be used for testing pain. The absence of pain is recorded as anaesthesia. A paper pin should be pressed sufficiently so that patient perceives pain but there is no bleeding. Testing with a paper pin is subjective. If it is not available, a ball point pen tip is used to test whether the protective sensation is present or lost.[28]

Van Brakel *et al*, had compared M2PD, SWMT and PP in patients with leprosy. It was found that M2PD is the most sensitive method for all sites except on the feet. There was a good correlation among M2PD, SWMT and PP. The only limitation of M2PD is that it is difficult to explain to the patient.[31]

Testing thermal sensation is crucial in early lesions of leprosy as it may be the only sensation impaired. It is traditionally carried out by applying test tubes containing cold tap water (5-10^{0}C) and warm water (40-50^{0}C). On a hot day, one may need to add ice to tap water or water kept in a refrigerator to test for cold sensation.

The patient is allowed to feel the test tubes containing cold and hot water at random.[28] Inability or delay in appreciation indicates absent or impaired sensation. A thermal testing device standardized by WHO is handy and useful. This pen torch like device has two ends and is battery operated.[32]

Motor testing to detect deformities of hands, feet and eyes

Before performing the muscle power testing for hands and feet, these areas must be inspected for certain findings which may provide clues towards underlying muscle paralysis.[28] The examining physician must look for,

- Clawing of hands and feet
- Guttering of interosseous spaces.
- Presence of paralytic deformities like,

  -Ape thumb deformity.

  -Ochsner's sign.

  -Benediction sign.

  -Wartberg's sign.

  -Wrist drop/ foot drop.

There are several tests to demonstrate the power of individual muscles of hands and feet. Gross assessment of muscle power can be done by performing one standard test for a group of muscles innervated by a particular nerve. Few such tests for upper and lower extremities have been presented in table 6. Hands, feet and ocular muscles are to be tested for power and graded. Traditionally muscle power is tested manually and graded according to Medical Research Council (MRC) Scale as follows :

Grade 0- No movement

Grade 1- Flicker of movement

Grade 2- Active movement when gravity is eliminated

Grade 3- Movement possible without resistance

Grade 4- Muscle contraction against slight resistance but power subnormal

Grade 5- Normal power (with full resistance)[28]

DEFORMITY/ DISABILITY GRADING IN LEPROSY

WHO in 1970 had categorized disabilities in leprosy. The main drawback of it was failure to recognize the significance of individual defects which seem to have a lot of bearing on the overall function of the body part. Thus in 1998 it was revised, considered only three grades. In their sixth report (2007),[32] WHO expert committee recommended a new grading system as presented in table 7.

Table 7: Deformity/ disability grading of leprosy patients (WHO, 2007)

GRADING	HANDS AND FEET	EYES
GRADE 0	No disability found.	No disability found
GRADE 1	Non visible damage (Loss of sensation)	No grade 1 for eye
GRADE 2	Visible damage [Disability, wounds (ulcers), deformity due to muscle weakness, (such as foot drop, claw hand, loss or partial resorption of fingers/toes, etc.)]	Inability to close, obvious redness, visual impairment, blindness.

Current status of leprosy in India

India has entered the elimination phase of leprosy eradication programme in December 2005. National Leprosy Eradication Programme (NLEP) is a centrally sponsored National Health Programme. Disability Prevention & Medical Rehabilitation (DPMR) is a priority of this national programme; removal of stigma and discrimination is a part of it's strategy. The

Table 6: Examination of muscles of upper extremities, lower extremities and eyes[28]

	Muscle tested	Nerves	Test	Deformity
Upper limb	Thenar	Median nerve	Ochsner's test Pen test Opposition against resistance	Benediction sign Ape thumb deformity
	Lumbricals + interossei	1st and 2nd: median nerve; 3rd and 4th: deep branch of ulnar nerve	Flex fingers at MCP joint against resistance	Claw hand: partial/complete
	Dorsal interossei	Deep branch of ulnar nerve	Spread fingers against resistance	Guttering of interosseous spaces
	Palmar interossei	Deep branch of ulnar nerve	Card test	Wartberg's sign
	1st palmar interossei+ adductor pollicis	Deep branch of ulnar nerve	Book test	Froment's sign Guttering of 1st interosseous space
	Wrist extensors	Radial nerve	Weakness: Inability to extend wrist and fingers	Wrist drop
	Combined functions of ulnar, median, radial nerve supply	Ulnar nerve Median nerve Radial nerve	Beak test	Inability to maintain the position for 30 seconds.Little finger will stand out in ulnar nerve weakness. Person will not be able to maintain position of thumb in median nerve weakness and wrist will not remain extended in radial nerve weakness.
Lower limb	Dorsiflexors	Common peroneal nerve	Dorsiflexion at ankle Extension of great toe	Foot drop Equino-varus deformity
	Plantar flexors	Tibial nerve	Eversion of foot Plantar flexion at ankle	Foot drop
	Intrinsic muscles of feet	Medial and lateral branches of tibial nerve	Adduction/ abduct toes against resistance	Collapse of arch Guttering of spaces Clawing of toes
Eyes	Orbicularis oculi	Zygomatic and temporal branches of facial nerve	Forceful closure of eyelid	Lagophthalmos

present prevalence rate of leprosy in India (NLEP, 2014-'15) is 0.69 per 10,000 population. Among the 1,25,785 newly detected leprosy patients(2014-'15), visible deformities were recorded in 5,799 (4.61%) cases.[33] In Karnataka, the current prevalence rate of leprosy is 0.42 per 10,000 population (2014-'15).[33] Among the newly detected cases, grade 1 deformities were recorded in 9.23% and grade 2 deformities in 4.41%.[33]

There are few Indian studies on deformities and disabilities among leprosy patients.

In an institution based retrospective study on childhood leprosy by Kar *et al*, (1994-2003), at Karigiri, Tamil Nadu, 275 new cases were detected. Of these 163 (59.2%) were boys and 112 (41.8%) were girls. Thirteen patients were below the age of 4 years, 71 were between 5- 9 years, and 191 were between 10-15 years. Majority of the deformities detected were among the children in the age group of 10-15 years. Of them, 238 (86.5%) were PB and 37 (13.4%) were MB cases. Out of 238 PB patients 20 (8.4%), and among 37 MB cases 9 (24.3%) had deformities. In 24 (82.7%) patients, deformities involved the upper limb, whereas lower limbs were involved in 3 (10.3%). Grade 2 deformity was seen in 29 (10.5%) children affected with leprosy.[34]

In a field-based study by Kumar *et al*, (1999-2002), conducted in Agra, Uttar Pradesh, a total of 573 patients were included. The patient population comprised of newly diagnosed patients, patients who had received incomplete treatment and those who were under treatment. Only visible paralytic deformities were taken into account. Out of 58 patients with grade 2 deformities, 45 (77%) had paralytic deformities. The overall disability rate was 7.9%. MB patients had significantly higher disability rate than PB patients (17% *vs.* 3.8%). Ulnar palsy/ claw hand alone or in combination with foot drop were the commonest paralytic deformities (n=37, 82%). Even though 57

(10%) patients had facial lesions, none had lagophthalmos. None of the children (<15 years) had any paralytic deformity. Proportion of deformity increased significantly from 5.4% in young adults (15-34years) to 13% in patients above 54 years. Male patients had more paralytic deformities (n=31, 9.9%) than in the females (n=14, 5.5%). Deformities were highest in pure neuritic leprosy. [35]

In an institution based cross-sectional study conducted in Nagpur, Maharashtra,(2004-2005) by Chavan *et al,*[36] 105 new cases of leprosy were studied. Of them 13 patients (12.39%) had grade 2 disability. The average age of disease onset was 32.81 years (range 5-80 years). The disability rate for hands and feet was 38.10 %. Eye disability was not found in any of the patients. Overall disability rate was more in MB patients as compared to PB. Subjects with diagnosis delayed beyond 12 months had significantly more grade 2 disabilities than those diagnosed within one year. Most common type of grade 2 deformity was ulcer (n=8, 61.53 %), which was significantly higher in females than males.[36]

Jain *et al,*[37] conducted an institution based retrospective study (2004-'13) in Bhopal, Madhya Pradesh. A total of 304 new cases were studied. There were 177 (58.2%) males and 127 (41.8%) females. The average age of disease onset was 35.73 years (range 6 to 75 years). Majority of the patients (n=173, 56.9%) belonged to multibacillary group while 131 (43.1%) patients were paucibacillary. Twenty nine (9.5%) patients suffered from various deformities. Prevalence of disability (both grade 1 and grade 2) was more in males than in females. Disability rate was more in MB leprosy patients than in PB. Prevalence of grade 2 deformity was higher than grade 1 deformities. Nine patients (3 %) had grade 1 and 20 patients (6.6%) had grade 2 deformity. Among the patients with grade 2 deformities, most common types observed were claw hand in 12 (60%), and plantar ulcer in 7 (35%) patients. This was

followed by ulcers in hands (n=2, 10%), foot drop (n=1, 5%) and loss of tissue in the form of absorption of toes in 1 (5%) patient. Eye involvement was present in 2 patients; lagophthalmos and chorioretinitis in 1 patient each.[37]

Sukumar *et al*,[38] conducted a community-based cross-sectional study (2005-2006) on 259 leprosy patients in Chamrajnagar district, Bangalore (South Karnataka). Proportion of deformity among the new cases was 0.62% in 2005-2006 and 4.94% at 2006-2007. Hence, according to the study results, the number of cases with deformity had increased more than eight fold in two years. Out of 259 patients 22 (8.5 %) had grade 1 and 30 (11.6%) had grade 2 deformities. In patients with grade 2 deformity, the patterns observed were; ulcers in hands in 17 (56.7%), claw hand in 18 (60%), scars/ cracks in hands in 17 (56%), plantar ulcers in 6 (20%) and foot drop in 1 (3.3%) patient.[38]

In a field-based retrospective cohort study conducted in Chennai, Tamil Nadu (2005-2010) by Prabhu *et al*,[39] 2177 "Released from treatment (RFT)" patients were included. Among them 1206 (55%) patients were males and 41% had MB leprosy. Out of 58 relapse cases 18 (31%) developed deformity at follow up. Four of the relapsed patients developed new deformity (after RFT) and grade 2 deformity was recorded in 2 of them.

In an institution based cross-sectional study conducted in Kolkata, West Bengal from August 2006 to June 2007 by Sarkar *et al*,[40] out of 244 newly diagnosed leprosy patients 49 (20.1%) had disability. Among these 28 (11.5%) had grade 1 and 21 (8.6%) had grade 2 disability. Of the newly diagnosed patients, 23 (9.4%) were of pure neuritic type. These patients were diagnosed on the basis of thickened peripheral nerves with sensory or motor NFI or presence of both. Both grade 1 (n=9, 39.1%) and

grade 2 (n=5, 21.8%) disability were more among pure neuritic leprosy patients. Patients with more than five skin lesions also had more disability than patients with ≤5 lesions. MB patients had significantly more disability (n=36, 31.6%) than PB patients (n=13, 10%). Manual labourers like rickshaw‑pullers, agricultural labourers, carpenters, barbers, etc. had significantly more disabilities than those who were engaged in other occupations. Other associated factors for increased proportion of disability among new leprosy patients found in this study were older age, male gender, and illiteracy. Feet were commonly involved site of disability among the new leprosy patients followed by hands. Sensory NFI was the commonly found disability both in hands (n=25, 10.3%) and feet (n=34, 13.9%) followed by motor NFI (hands; n=23, 9.4%, feet; n=27, 11.1%). Both sensory (hands; n=17, 11.8% *vs.* n=8, 8%, feet; n =22, 15.3% *vs.* n=12, 12%) and motor NFI (hands; n=17, 11.8% *vs.* n=6, 6%, feet; n=19, 13.2% *vs.* n=8, 8%) of hands and feet were commoner in males. Cracks/wounds (grade 2) were found more in the feet than in hands (n=17, 7% vs n=7, 2.9%). In eyes 7 patients (2.9%) had loss of corneal sensation (grade 1), and 3 patients (1.2%) each had lagophthalmos and severe visual impairment (acuity of vision <6/60, i.e., grade 2). These eye disabilities were almost equal for both genders.

In a hospital-based cross sectional study by Singh *et al* (2012-'13),[41]conducted in Lucknow, Uttar Pradesh, 302 patients of leprosy were included. These included the patients on treatment visiting the outpatients' department of the hospital and those from the nearby villages and leprosaria. Of these patients, 76 (25.17%) were females and 226 (74.83%) were males. Age range of the patients was 7 to 80 years (mean 36.5 years). MB patients were 222 (73.51%) and PB were 80 (26.49%) in number. Out of 302 patients, in 131 (43.38%), duration of the disease was less than 1 year, and in 79 (26.16%) it was more than 1 year. Ocular disability was recorded in 119 (39.4%)

patients; it was unilateral in 39 (12.91%) cases and bilateral in 80 (26.40%) cases. In unilateral group grade 1 disability was seen in 10 (3.31%) and in bilateral group it was in 28 (9.27%) patients. Grade 2 disability was seen in 29 (9.6%) patients in unilateral group and 52 (17.21%) patients in bilateral group.

From the review of literature it is evident that deformities in leprosy occur mostly in long standing and untreated cases of leprosy. It is commoner in males, and manual workers.[35,40] In some studies only visible deformities were taken into account, grade 1 deformity being commoner in one study and grade 2 deformity in another study.[37,38,40,41] The present study is undertaken to detect the prevalence of deformities and disabilities in leprosy patients in the Vijayapur district and surrounding areas in North Karnataka.

METHODOLOGY

SOURCE OF DATA:

A hospital-based, cross sectional study to detect deformities/disabilities in patients with leprosy was conducted in the department of Dermatology Venereology and Leprosy of B.L.D.E.U's Shri. B.M. Patil Medical College Hospital and Research Centre, Vijayapur, Karnataka. One hundred and forty six cases were included in the study. The study duration was from November 2014 to September 2016.

METHOD OF COLLECTION OF DATA:

Inclusion criteria:

All leprosy patients irrespective of age, gender and treatment status were included in the study.

METHOD:

Detailed history of the patient was taken in respect to duration of disease and deformity, history of contact, episodes of reactions if any, and treatment. Each patient was subjected to complete cutaneous examination and palpation of peripheral nerves. Presence or absence of deformities were recorded.

All patients underwent following steps of clinical examination:

- Detailed inspection of hands, feet, face and eyes for lesions and any visible deformity.
- Examination of peripheral nerves.
- Sensory tests done on hands and feet:

  1) Temperature test with hot and cold water.

2) Pin prick test

3) Cotton wool test

4) Semmes Weinstein monofilament test (SWMT)

- Tests for muscle power:

1) Hands:

  - Pen test (Abductor pollicis, median nerve)
  - Card test (Interossei and lumbricals, ulnar nerve)
  - Book test (Deep branch of ulnar nerve)
  - Extension of wrist against resistance (wrist extensors, radial nerve)
  - Beak test (Triple nerve test).

2) Feet:

  - Extension of great toe against resistance (Anterior tibial nerve)
  - Dorsi-flexion and plantar-flexion of ankle against resistance (Common peroneal nerve)
  - Inversion and eversion of foot (Posterior tibial nerve)
  - Adduction and abduction of toes against resistance (Medial and lateral branches of tibial nerve)

Examination of face and eyes:

- Inspected for any visible deformity.
- Tested for corneal sensation.
- Tested for visual acuity.

Type of deformity was noted down from head to toe and grading of deformity was done according to WHO classification of disability measurement proposed in the year 2007.

INVESTIGATIONS :

Slit skin smear and biopsy were carried out in all newly diagnosed cases and in already diagnosed and treated cases whenever indicated.

STATISTICAL ANALYSIS :

All characteristics were summarized descriptively. For continuous variables, the summary statistics of N, mean, standard deviation (SD) were used. For categorical data, the number and percentage were used in the data summaries. Chi-square (χ^2) test was employed to determine the significance of differences between groups for categorical data. The difference of the proportion of analysis variables was tested with the z-test. If the p-value was < 0.05, then the results were considered to be significant. Data were analyzed using SPSS software v.24.0.

ETHICAL CLEARANCE:

Institutional ethical committee clearance was undertaken for the study.

Figure A: Banana fingers in a lepromatous leprosy patient

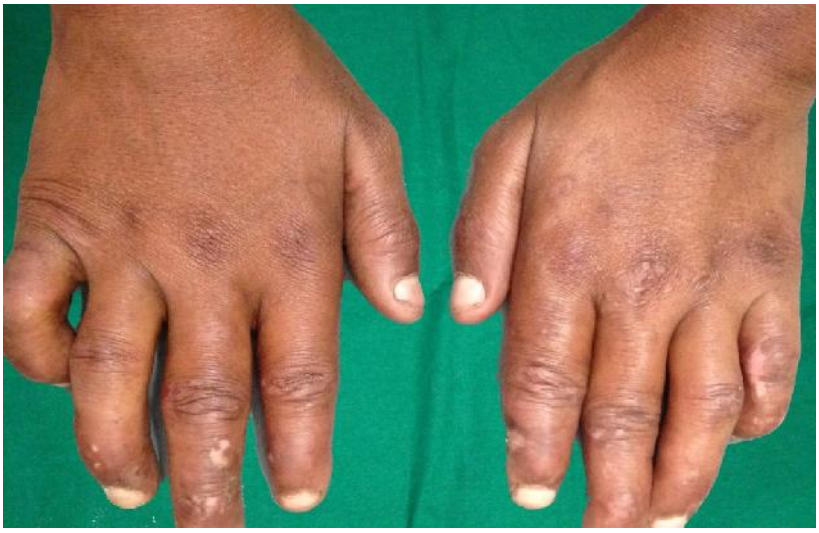


Figure B: Shortening of fingers with wasting of thenar and hypothenar eminences

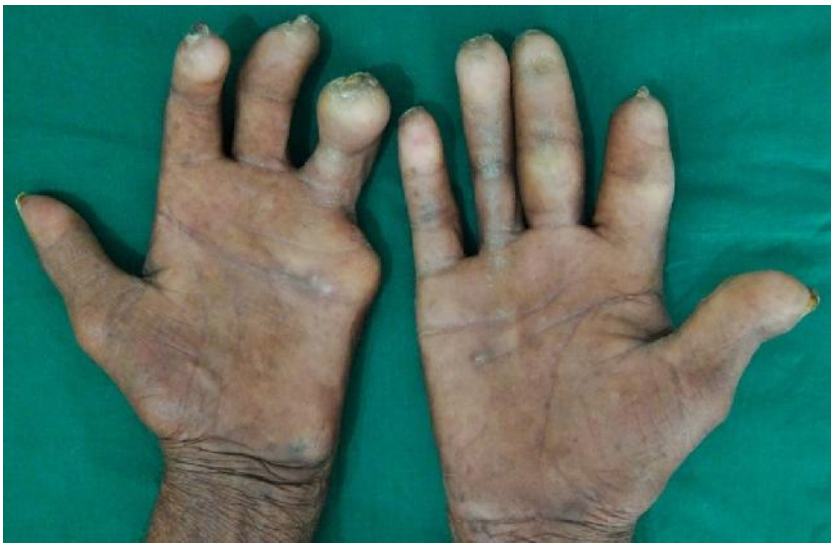


Figure C: Disorganised feet with fixed deformity of toes

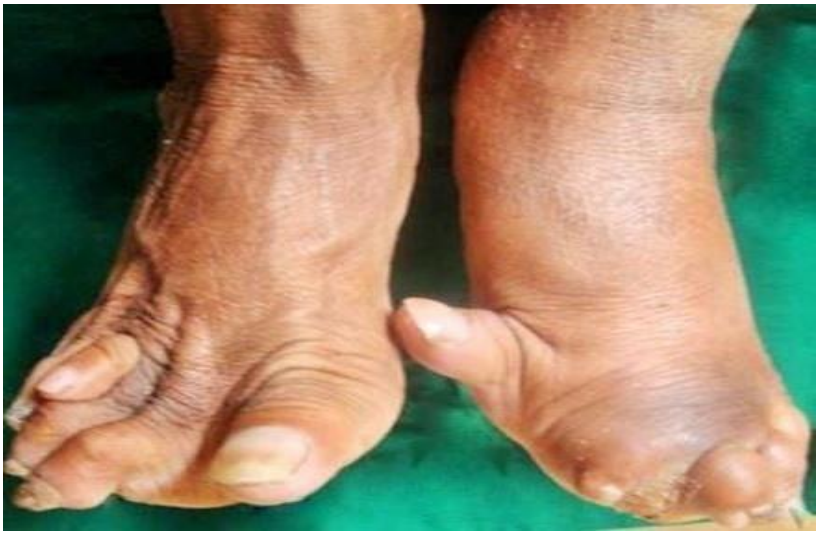


Figure D: Trophic ulcer on hypothenar eminence of left hand

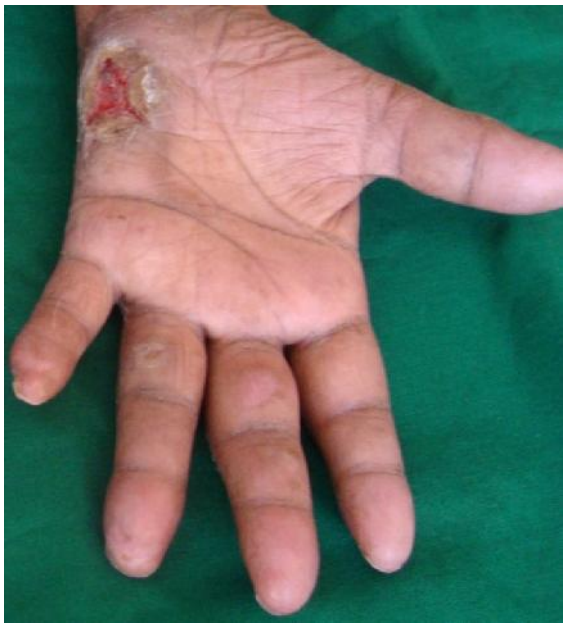


Figure E: Cracks in soles

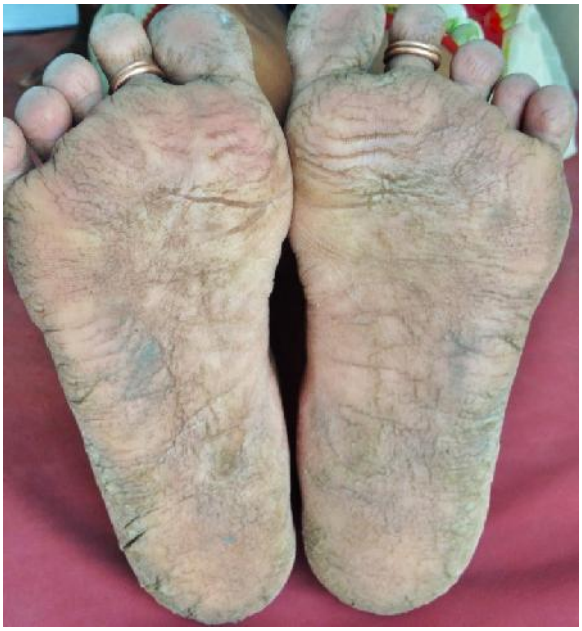


Figure F: Fissure in foot

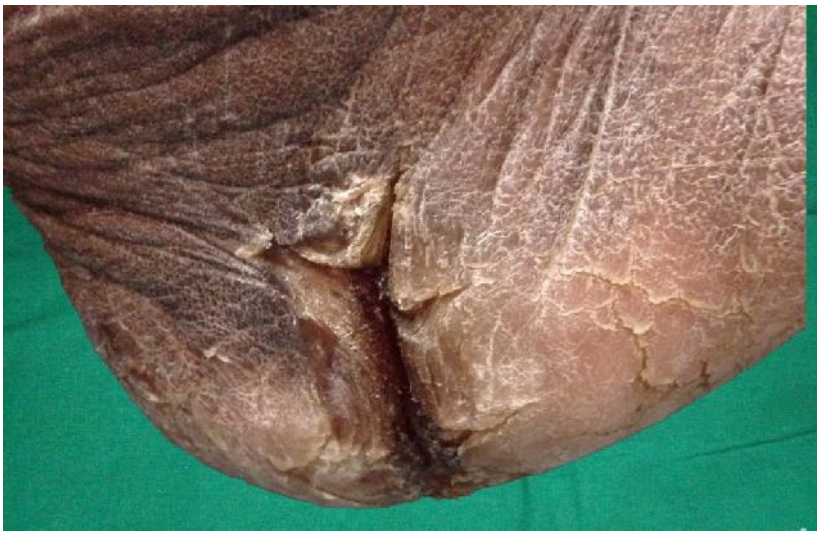


Figure G: Trophic ulcers and callosity of feet with amputation of great toe

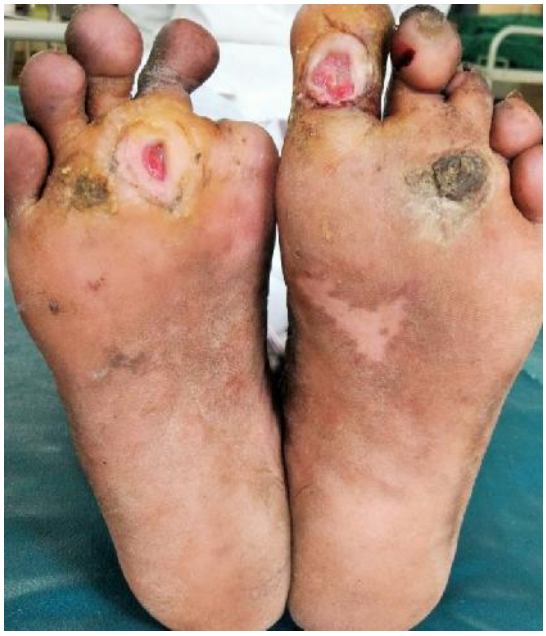


Figure H: Ulnar claw hand

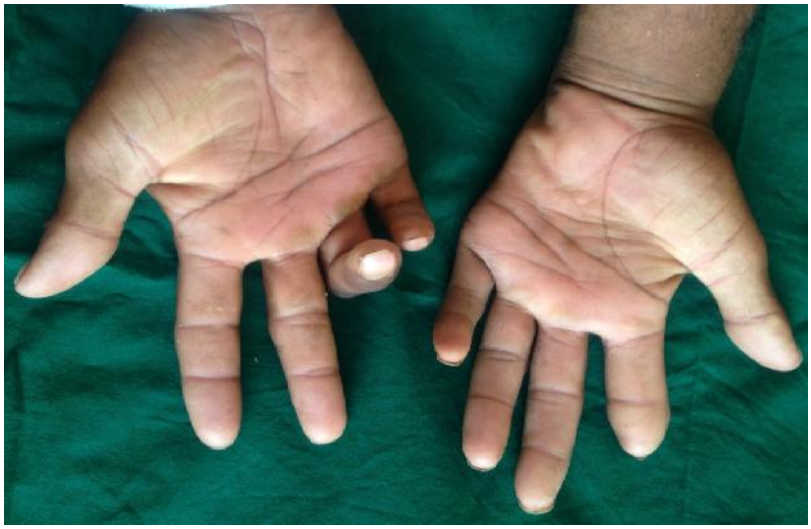


Figure I: Complete claw hand with ape thumb

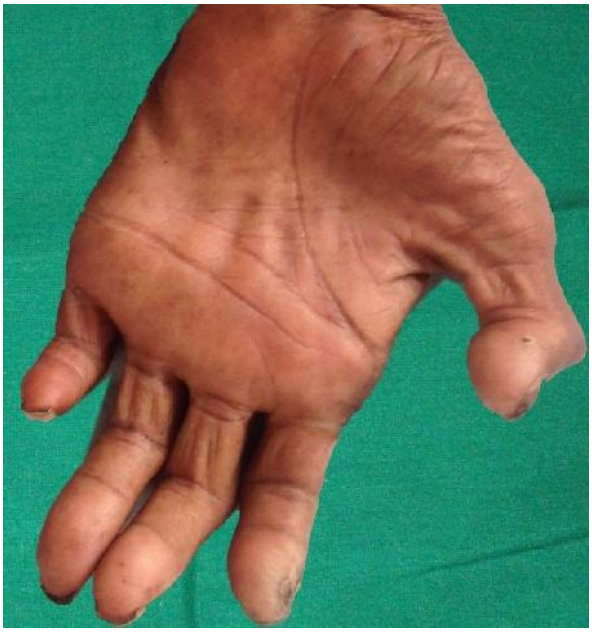


Figure J: Guttering of interosseous spaces in hands

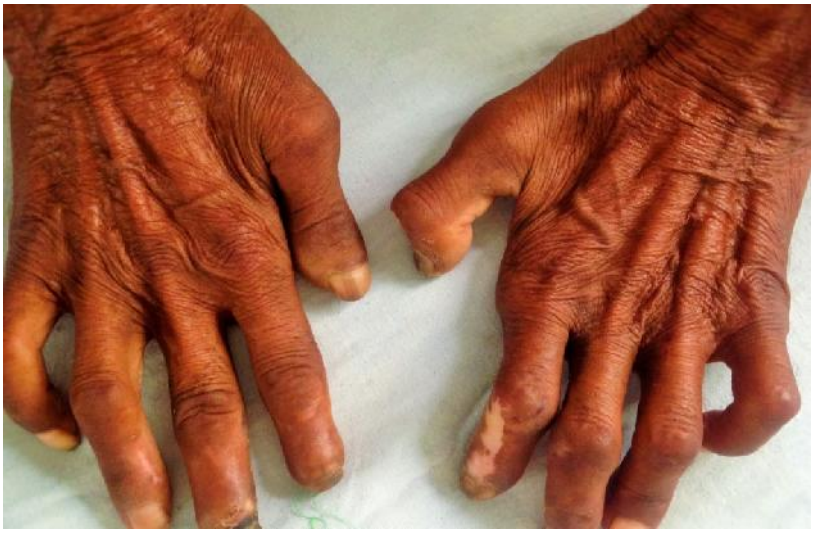


Figure K: Wartberg's sign

Figure L: Claw toes

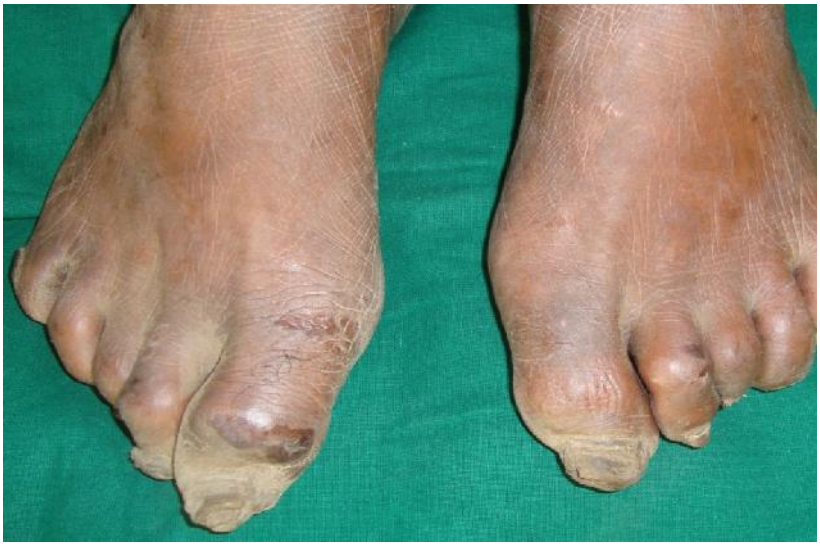


Figure M: Guttering of intertarsal spaces in feet

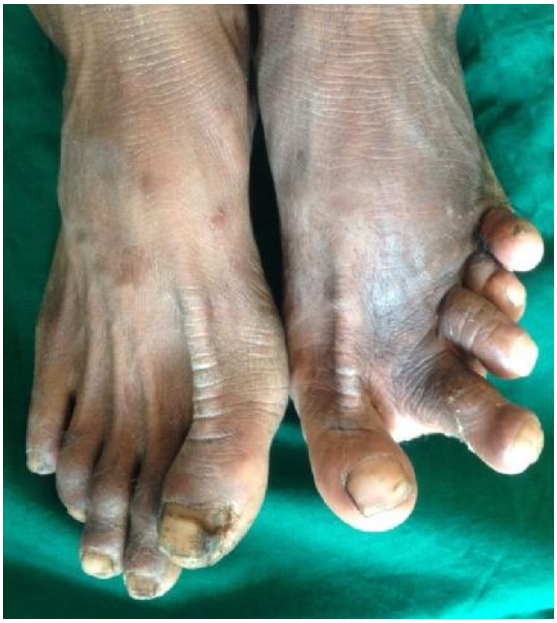


Figure N: Superciliary and ciliary madarosis and collapse of nasal bridge in a patient of lepromatous leprosy

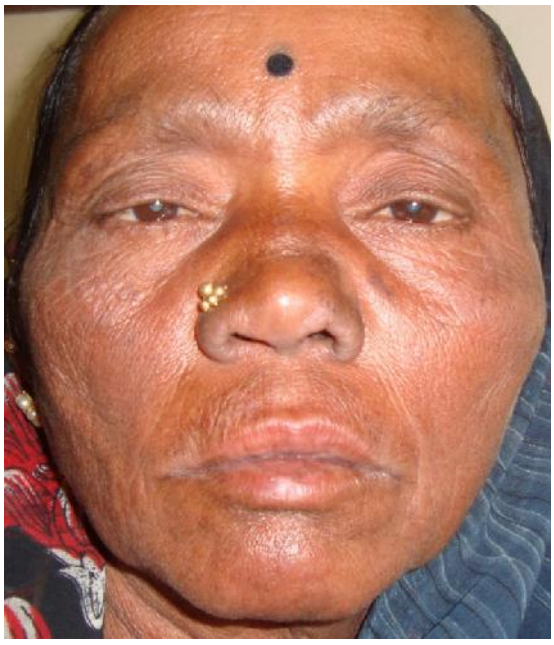


Figure O: Side view of collapse of nasal bridge

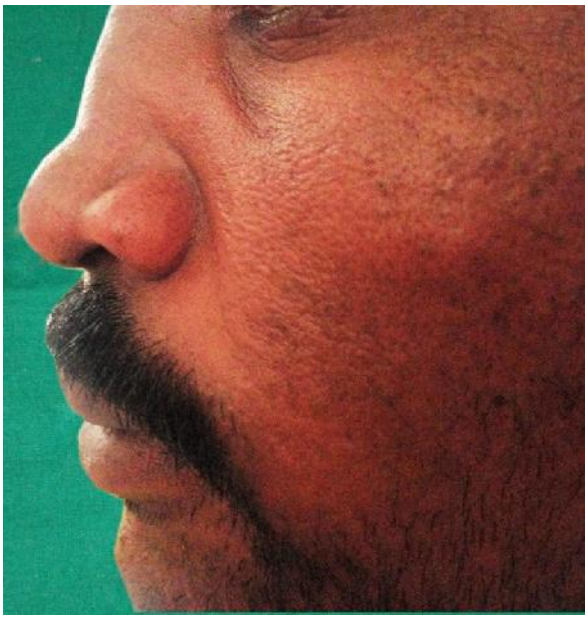


Figure P: Nodularity on face in a lepromatous leprosy patient

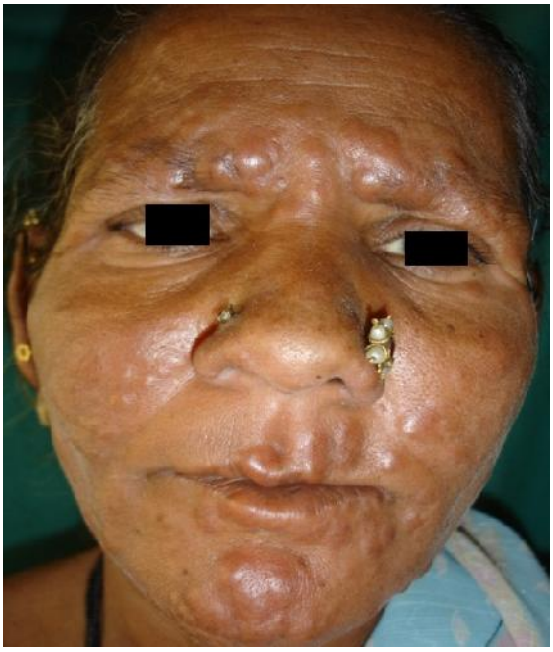


Figure Q: Redness of eyes due to episcleritis

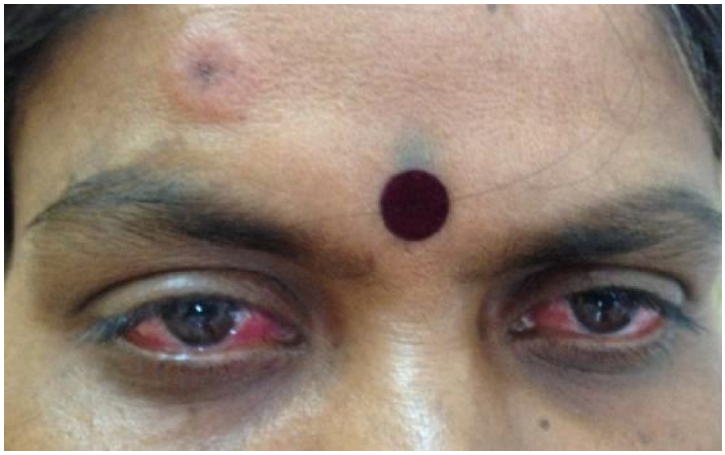


Figure R: Materials used for sensory and motor testing

Figure S: Sensory testing with Semmes-weinsten monofilaments

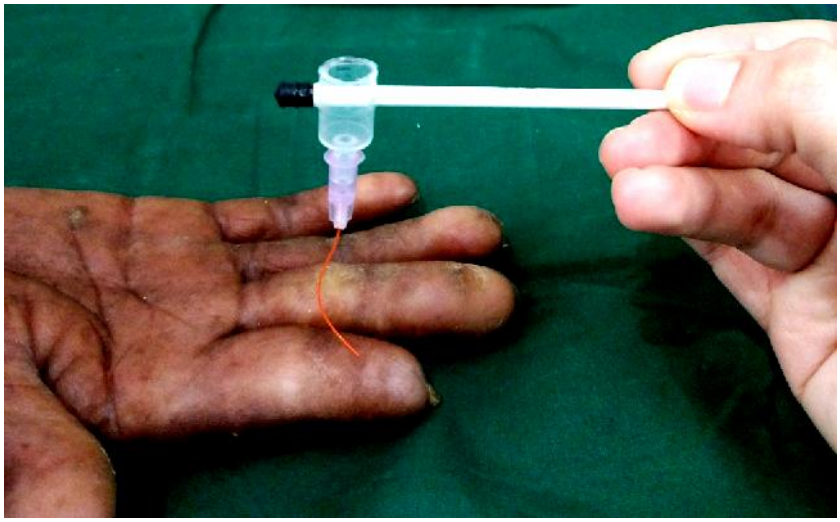


Figure T: Foot drop splint

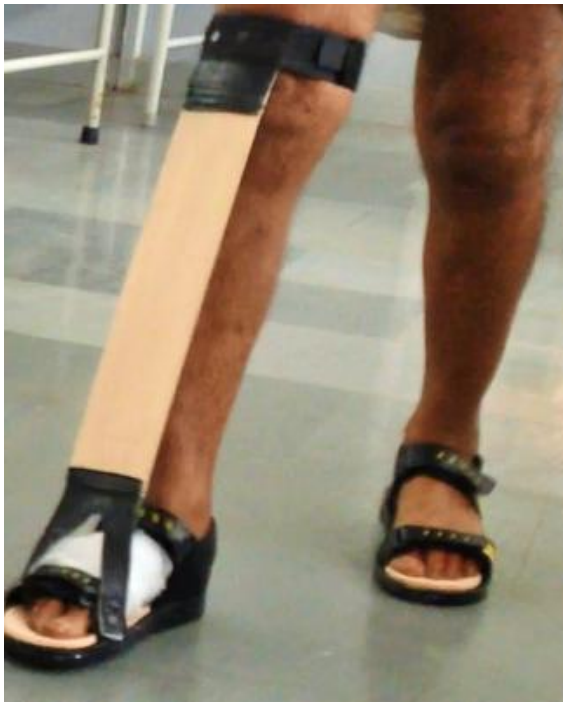
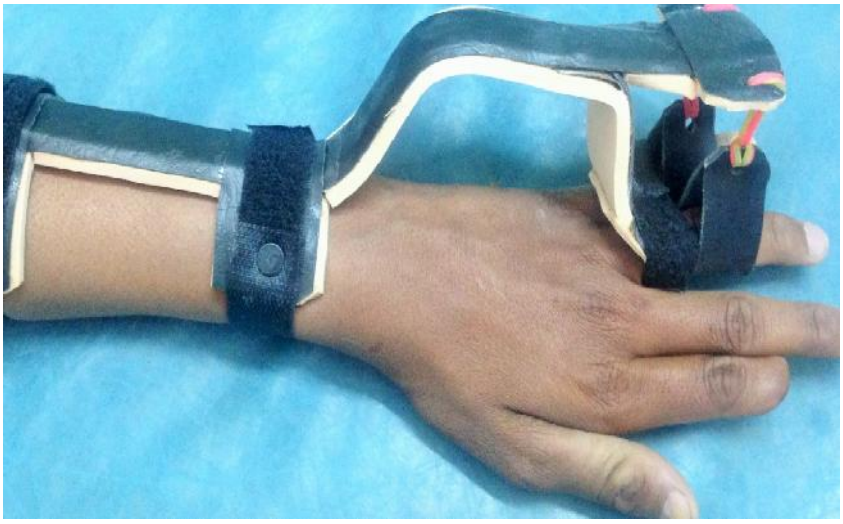


Figure U: Claw hand splint



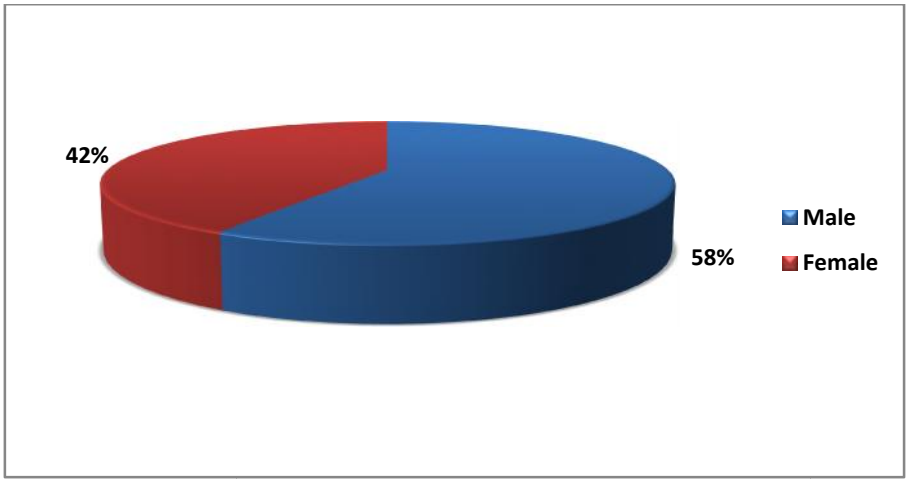
RESULTS

A hospital based cross-sectional study was conducted from November 2014 to September 2016. A total of 146 patients with leprosy were included in the study.

Gender distribution

Among 146 patients, 85 were males (58.2%) and 61 were females (41.8%). Figure 4 presents the gender distribution of the patients included in the study.

Figure 4: Gender distribution of patients with leprosy



Age distribution

The age of the patients enrolled in the study ranged from 8 to 84 years. The mean age (± SD) of the study population was 38.1 (±15.6) years. Figure 5 presents the age distribution of the patients.

Clinical types of leprosy

Most prevalent clinical type was borderline tuberculoid leprosy in 54 (37%) patients, followed by lepromatous leprosy in 49 (33.6%), borderline lepromatous in 22 (15.1%), pure neural in 6 (4.1%), tuberculoid and histoid types in 5 (3.4%) patients

each, mid-borderline in 3 (2.1%) and indeterminate in 2 (1.4%) patients. The percentage distribution of clinical types of leprosy has been presented in figure 6.

Figure 5: Age distribution of patients with leprosy

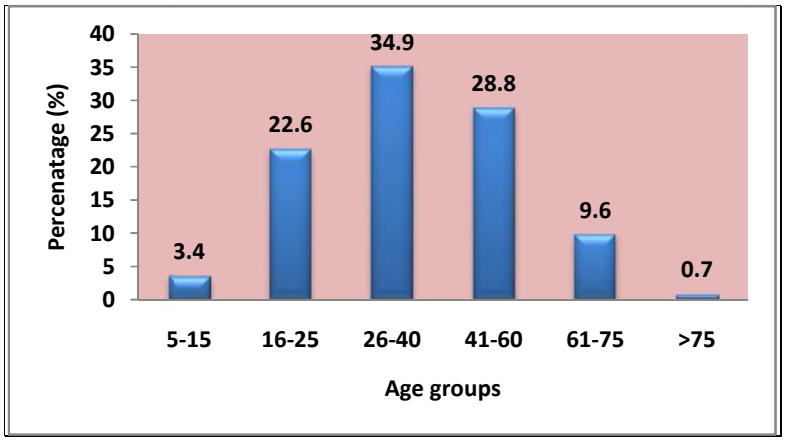
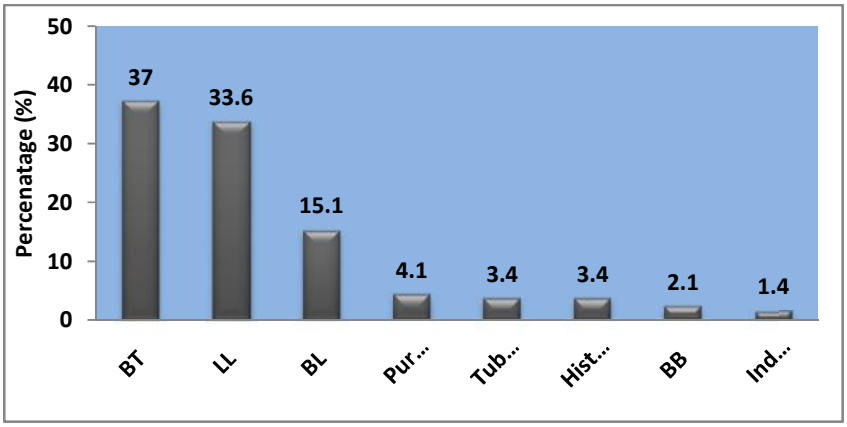


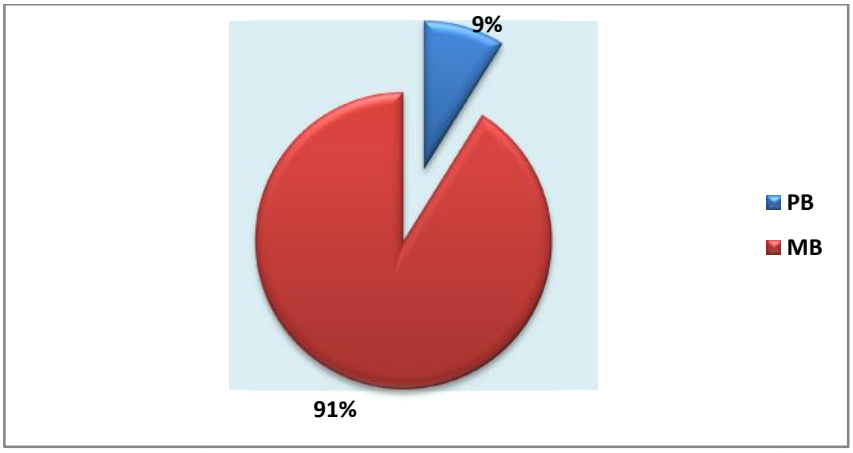
Figure 6: Clinical types of leprosy in the study subjects



Distribution based on WHO classification of disease

Most common type was multibacillary in 133 (91.1%) patients followed by paucibacillary in 13 (8.9%) patients. The percentage distribution of the patients according to WHO classification of disease has been presented in figure 7.

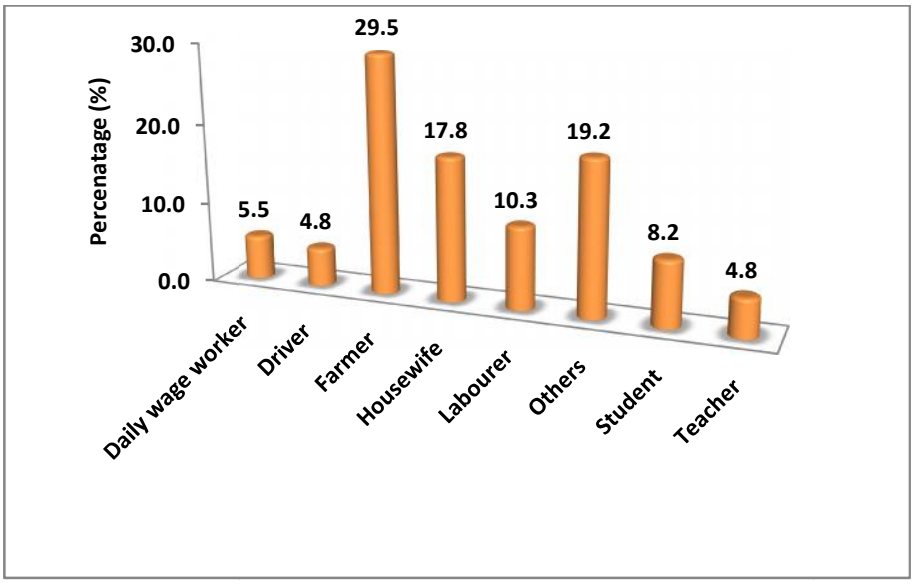
Figure 7: Distribution of patients based on WHO classification



Occupation of study subjects

Among 146 patients, majority were farmers (n=43; 29.5%), next common being housewives (n=26; 17.8%), labourers (n=15;10.3%) and students (n=12; 8.2%). Daily wage workers were 8 (5.5%), and drivers and teachers were 7 (4.8%) each. Remaining 28 (19.2%) patients had other occupations. The percentage distribution of the patients based on occupation has been presented in figure 8.

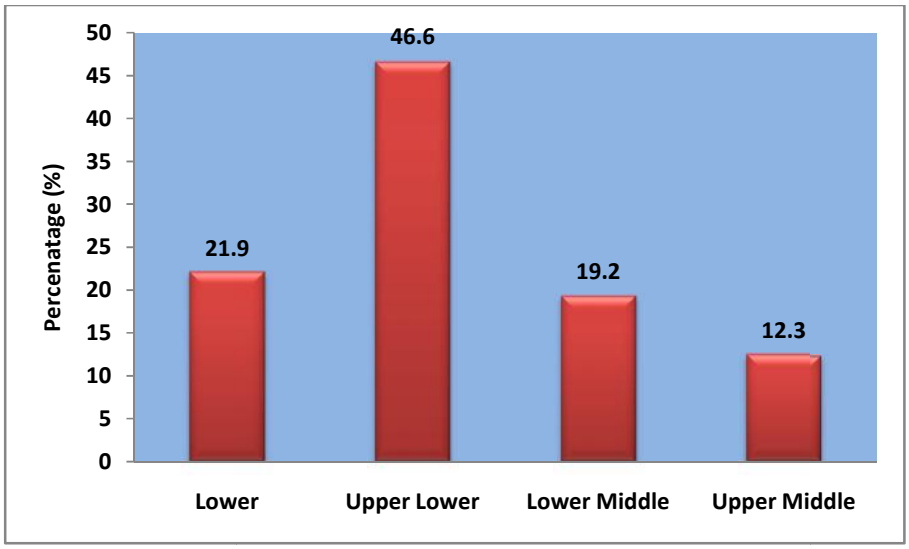
Figure 8: Occupation-wise distribution of patients



Distribution of patients based on Socio-economic status

Majority of the patients belonged to lower socioeconomic (S-E) status (n=100, 68.5%) followed by middle (n=46, 31.5%). The socio-economic status-wise distribution of the patients has been shown in figure 9. Out of the 146 patients, 110 (75.3%) belonged to rural areas and 36 (24.7%) were from urban areas. Seventy six (52.1%) patients were illiterate and 70 (47.9%) were educated at least till fourth standard.

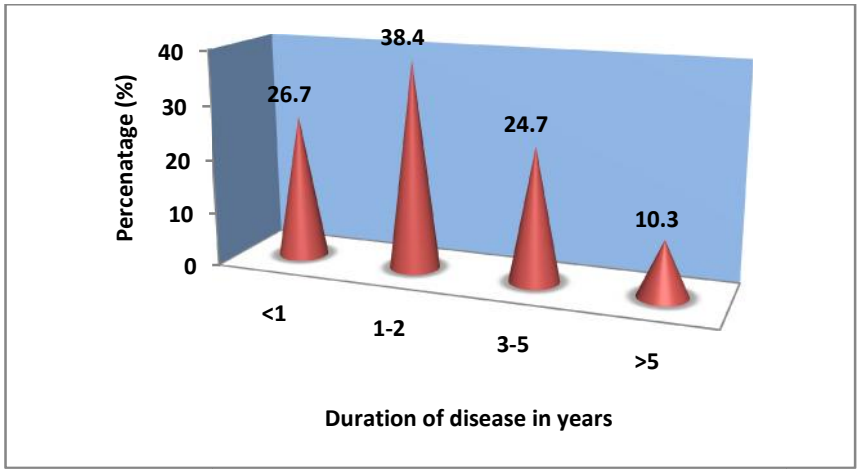
Figure 9: Socio-economic status-wise distribution of patients



Duration of disease

Out of 146 patients, 56 (38.4%) had the disease for 1-2 years, followed by 39 (26.7%) patients, whose disease duration was less than one year. Thirty six (24.7%) patients had the disease for 3-5 years, and 15 (10.3%) patients had disease duration for more than 5 years. The distribution of patients based on duration of disease has been presented in figure 10. Among 146 patients, 41 (28.1%) had type 2 reaction, and 22 (15.1%) had type 1 reaction.

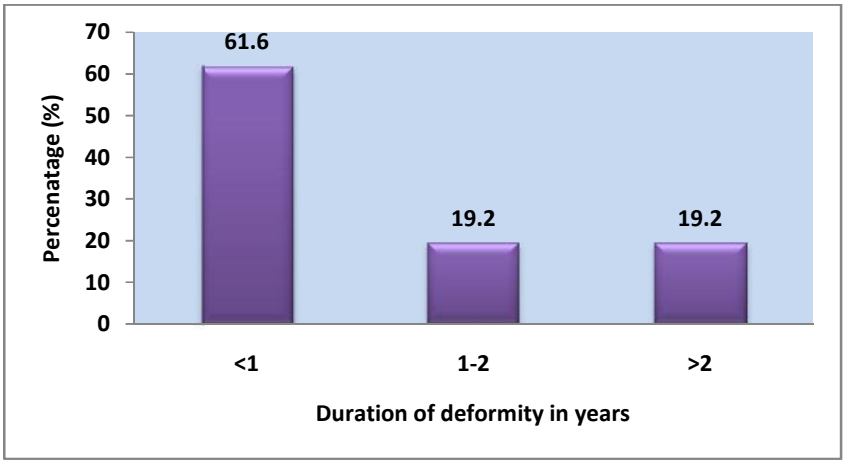
Figure 10: Percentage distribution of duration of disease in years



Duration of deformity

Duration of deformity was less than a year in 90 (61.6%) patients. Twenty eight (19.2%) patients each, had deformities for 1-2 years, and more than 2 years. The distribution of patients based on duration of deformity has been presented in figure 11.

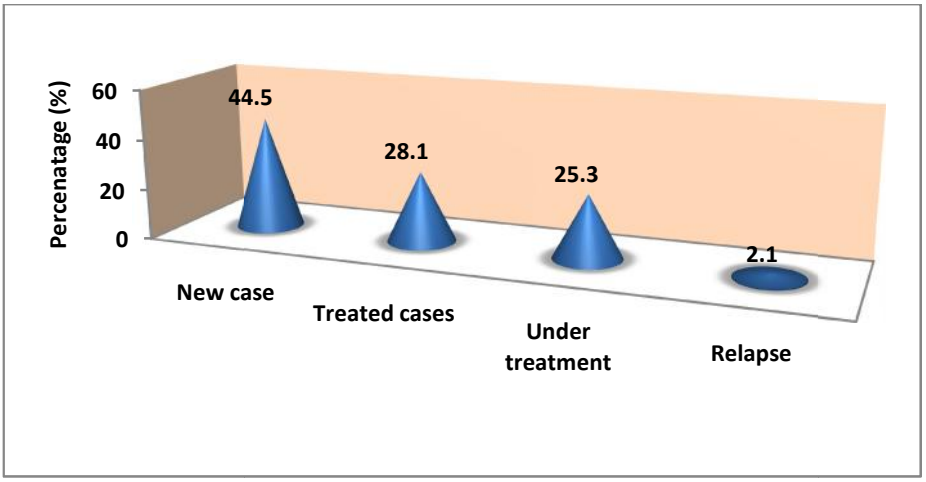
Figure 11: Percentage distribution of duration of deformity in years



Distribution of patients based on treatment

Among 146 patients, 65 (44.5%) were newly detected cases, 41 (28.1%) were treated cases, 37 (25.3%) were under treatment, and 3 (2.1%) had relapse. The distribution of patients based on treatment has been presented in figure 12.

Figure 12: Percentage distribution of treatment



Distribution of specific deformities of limbs

In the hands, shortening of fingers was seen in 13 (8.9%) patients, banana fingers were seen in 10 (6.8%) patients, reaction hand in 2 (1.4%) patients and swan neck deformity in 1 (0.7%) patient. In the feet, fixed foot deformity was present in 10 (6.8%) patients, tarsal disorganization was seen in 2 (1.4%) patients. The distribution of specific deformities among patients has been presented in table 8.

Table 8: Percentage distribution of specific deformities of limbs

Specific deformity	No. of patients	Percentage (%)
UPPER LIMB		
Banana Fingers (Fig A)	10	6.8
Reaction hand	2	1.4
Shortening of fingers(Fig B)	13	8.9
Swan neck deformity	1	0.7
LOWER LIMB		
Fixed deformity of toe and feet(Fig C)	10	6.8
Tarsal Disorganization	2	1.4

Distribution of anaesthetic deformities of limbs

In the hands, majority of the patients had xerosis (n=113, 77.4%), followed by trophic ulcer (n=20, 13.7%). Cracks (n=13, 8.9%), fissures (n=2, 1.4%), and other (n=10, 6.8%) deformities were also noted. In the feet, most of the patients had xerosis (n=115, 78.8%). Cracks (n=44, 30.1%) and fissures (n=10, 6.8%) were also noted. Trophic ulcer was present in 26 (17.8%) patients. The distribution of anaesthetic deformities of limbs among patients has been presented in table 9.

Table 9: Percentage distribution of anaesthetic deformities of limbs

Anaesthetic deformity	No. of patients	Percentage (%)
UPPER LIMB		
Xerosis	113	77.4
Cracks	13	8.9
Fissures	2	1.4
Trophic ulcer(Fig D)	20	13.7
Others	10	6.8
LOWER LIMB		
Xerosis	115	78.8
Cracks(Fig E)	44	30.1
Fissures(Fig F)	10	6.8
Trophic ulcer(Fig G)	26	17.8
Others	17	11.6

Distribution of visible paralytic deformities of limbs

In the hands, claw hand was the commonest deformity seen in 24 (16.5%) patients, flattening of thenar and hypothenar eminences in 24 (16.4%) patients, guttering in 18 (12.3%) patients. Wartberg's sign was present in 7 (4.8%) patients, ape thumb in 3 (2.1%), wrist drop and Benediction's sign in 1 (0.7%) patient each. In the feet, claw toes was seen in 18 (12.3%) patients, guttering in 15 (10.3%), fanning

of toes in 11 (7.5%), collapse of arch in 6 (4.1%), foot drop in 2 (2.7%) patients. The distribution of visible paralytic deformities among patients has been presented in table 10.

Table 10: Percentage distribution of visible paralytic deformities of limbs

Visible paralytic deformity	No. of patients	Percentage (%)
UPPER LIMB		
Claw Hand (ulnar) [Fig H]	22	15.1
Claw Hand (median)	1	0.7
Claw Hand (complete) [Fig I]	1	0.7
Wrist drop	1	0.7
Gutttering(Fig J)	18	12.3
Ape thumb	3	2.1
Wartberg's sign(Fig K)	7	4.8
Benediction's sign	1	0.7
Others	24	16.4
LOWER LIMB		
Claw toes(Fig L)	18	12.3
Fanning of toes	11	7.5
Foot drop	2	1.4
Guttering(Fig M)	15	10.3
Collapse of arch	6	4.12
Others	4	2.7

Distribution of deformities in face

Among 146 patients, 28 (19.2%) patients had madarosis and nodularity of face was seen in 23 (15.8%) patients, collapse of nose in 8 (5.5%), mega lobules and premature senility in 12 (8.2%) patients each. In the eyes, corneal sensation was lost in 3 (2.1%) patients, visible redness in 4 (2.7%)[Fig Q], visual impairment in 6

(4.1%). The distribution of facial deformities among patients has been presented in table 11.

Table 11: Percentage distribution of deformities of face

FACE	No. of patients	Percentage (%)
Madarosis(Fig N)	28	19.2
Collapse of nose(Fig O)	8	5.5
Nodularity(Fig P)	23	15.8
Others	24	16.4

Distribution based on sensory testing in upper and lower limbs

Out of 146 patients, 2 (1.3%) patients had loss of temperature sensation alone in the hands and 3 (2%) patients in the feet. Loss of temperature and cotton wool sensation in the hands was seen in 19 (13%) patients and 17 (11.6%) patients in feet. Sixty three (43.1%) patients had loss of temperature, cotton wool, pin-prick sensation along with impaired sensations as tested by Semmes-Weinsten monofilaments (SWMF) in the hands (Fig S) and , 68 (46.5%) patients in the feet.

Distribution based on ability to perform motor tests of upper and lower limbs

Out of 146 patients, 50 (34.2%) patients were unable to perform card test, 31 (21.2%) the beak test, 25 (17.1%) the book test, 17 (11.6%) the pen test, and 10 (6.8%) were unable to perform extension of wrist against resistance. In the lower limbs, 34 (23.3%) patients were not able to perform adduction and abduction of toes, 31 (21.1%) were not able to perform flexion and extension of toes against resistance, 10 (6.8%) were not able to perform flexion and extension of ankle against resistance.

Distribution of grade of deformity (hands and feet):

The distribution of deformities of hands, feet and eyes have been shown in tables 12 and 13 respectively. Epidemiological and clinical data on childhood leprosy cases has been presented in table 14.

Table 12: Percentage distribution of grade of deformity (hands and feet)

Grade of deformity	No. of patients	Percentage (%)
0	49	33.6
1	36	24.7
2	61	41.8
Total	146	100

Table 13: Percentage distribution of grade of deformity (eyes)

Grade of deformity	No. of patients	Percentage (%)
0	132	90.4
2	14	9.6
Total	146	100

Comparison of grade of deformity (hands and feet) with selected variables

Comparison of deformities (hands and feet) with variables like age, gender, occupation, socio-economic status, duration of disease and duration of deformities has been shown in table 15. Comparison of deformities (hands and feet) with other variables like reaction and type of disease, and treatment status has been presented in tables 16 and 17 respectively.

Table 14: Epidemiological and clinical data on children with leprosy

Variables	No. of patients	Percentage (%)
Gender		
Male	7	8.2
Female	3	4.9
Total	10	13.11
Age(years)		
6-15	5	3.4
16-18	5	3.4
Occupation		
Student	9	75
Agriculturist	1	2.3
Treatment		
New case	6	9.2
Treated cases	2	4.8
Under treatment	2	5.4
Types of disease		
Tuberculoid	1	20
BT	5	9.2
BB	1	33.3
BL	1	4.5
LL	2	4
Grade of deformity		
Grade 0	5	10.2
Grade 1	1	2.7
Grade 2	4	6.5
Contacts		
Both parents	2	20
Mother	1	10

Table 15: Level of significance of grade of deformity (hands and feet) with selected parameters

Parameters	Grade 0		Grade 1		Grade 2		p value
Gender	**No. of patients**	**Percentage (%)**	**No. of patients**	**Percentage (%)**	**No. of patients**	**Percentage (%)**	
Male	24	28.2	23	27.1	38	44.7	0.111
Female	25	41.0	13	21.3	23	37.7	
Age group							
5-15	3	60.0	0	0.0	2	40.0	0.611
16-25	13	39.4	7	21.2	13	39.4	
26-40	16	31.4	15	29.4	20	39.2	
41-60	14	33.3	9	21.4	19	45.2	
61-75	2	14.3	5	35.7	7	50.0	
>75	1	100.0	0	0.0	0	0.0	
Occupation							
Daily wage worker	2	25.0	1	12.5	5	62.5	0.401
Driver	3	42.9	1	14.3	3	42.9	
Farmer	11	25.6	13	30.2	19	44.2	
Housewife	10	38.5	5	19.2	11	42.3	
Labourer	3	20.0	3	20.0	9	60.0	
Others	12	42.9	8	28.6	8	28.6	
Student	6	50.0	1	8.3	5	41.7	
Teacher	2	28.6	4	57.1	1	14.3	
S-E status							
Lower	12	37.5	6	18.8	14	43.8	0.008*
Upper Lower	15	22.1	19	27.9	34	50.0	
Lower Middle	12	42.9	7	25.0	9	32.1	
Upper Middle	10	55.6	4	22.2	4	22.2	
Duration of deformity in years							
<1	47	52.2	17	18.9	26	28.9	<0.001*
1-2	1	3.6	10	35.7	17	60.7	
>2	1	3.6	9	32.1	18	64.3	
Duration of disease in years							
<1	21	53.8	6	15.4	12	30.8	0.082
1-2	13	23.2	17	30.4	26	46.4	
3-5	11	30.6	8	22.2	17	47.2	
>5	4	26.7	5	33.3	6	40.0	

*significant at $p<0.05$

From the data in table 15 it is observed that majority of the patients with deformity of hands and feet belonged to lower socio-economic status. The association of deformity and socio-economic status was statistically significant (p=0.008). The association of disease duration with presence of deformities was statistically non-significant (p=0.082). However, there was variability in this association. Patients with disease duration of < 1 year had lesser deformities (grade 1: n=6, 15.4%; grade 2: n=12, 30.8%). The number of deformities was maximum in patients with disease duration of 1-2 years, followed by 3-5 years. Patients with disease duration of >5 years had least occurence of deformities. A statistically significant (p<0.001) number of patients with deformity presented to hospital by 2 years of onset.

Table 16: Level of significance of grade of deformity (hands and feet) with types of disease and reaction

Parameters		Grade 1		Grade 2		p value
		No. of patients	Percentage (%)	No. of patients	Percentage (%)	
Reaction	Type 1	10	63	6	38	<0.001*
	Type 2	14	52	13	48	>0.05
Types of disease	Tuberculoid	0	0	1	100	<0.001*
	BT	10	29	25	71	<0.001*
	BB	0	0	2	100	<0.001*
	BL	8	62	5	38	<0.001*
	LL	16	42	22	58	>0.05
	Pure neural	0	0	4	100	<0.001*
	Histoid	1	33	2	67	<0.001*

*significant at p<0.05

From the data in table 16 it is observed that association of type 1 reaction was statistically significant (p<0.001) with both grade 1 and grade 2 deformities, whereas this association was not statistically significant for type 2 reaction (p>0.05). Patients

with BT, tuberculoid, BB, pure neural and histoid leprosy were statistically significantly associated with grade 2 deformity ($p<0.001$). In patients with BL, grade 1 deformity was more common and this association was statistically significant ($p<0.001$). In LL patients grade 2 deformities were more as compared to grade 1, but this association was not statistically significant ($p>0.05$).

Table 17: Level of significance of grade of deformity (hands and feet) with treatment status

Parameters	**Grade 0**		**Grade 1**		**Grade 2**		**p value**
Treatment	**No. of patients**	**Percentage (%)**	**No. of patients**	**Percentage (%)**	**No. of patients**	**Percentage (%)**	
New case	28	43.1	12	18.5	25	38.5	0.160
Treated cases	9	22.0	11	26.8	21	51.2	
Relapse	2	66.7	1	33.3	0	0.0	
Under treatment	10	27.0	12	32.4	15	40.5	
MB/PB							
PB	7	53.8	1	7.7	5	38.5	0.178
MB	42	31.6	35	26.3	56	42.1	
Total	49	33.6	36	24.7	61	41.8	

*significant at $p<0.05$

From the data in table 17 it is observed that there was no significant association of deformities of hands and feet with treatment status ($p=0.16$). Similarly association of deformities of hands and feet with MB or PB disease was not statistically significant ($p=0.178$).

Comparison of grade of deformities of eyes with selected variables

The comparison of deformities of eyes with variables like age, gender, occupation, socio-economic status, duration of disease and duration of deformities has been shown in table 18. Comparison of ocular deformities with treatment status and

other variables like reaction and type of disease has been presented in tables 19 and 20 respectively.

Table 18: Level of significance of grade of deformity (eyes) with selected parameters

Parameters	Grade 0		Grade 2		p value
	No. of patients	Percentage (%)	No. of patients	Percentage %)	
Gender					
Male	75	88.2	10	11.8	0.390
Female	57	93.4	4	6.6	
Age					
5-15	5	100.0	0	0.0	NA
16-25	31	93.9	2	6.1	
26-40	46	90.2	5	9.8	
41-60	39	92.9	3	7.1	
61-75	10	71.4	4	28.6	
>75	1	100.0	0	0.0	
Occupation					
Daily wage worker	7	87.5	1	12.5	NA
Driver	6	85.7	1	14.3	
Farmer	40	93.0	3	7.0	
Housewife	25	96.2	1	3.8	
Labourer	12	80.0	3	20.0	
Others	24	85.7	4	14.3	
Student	12	100.0	0	0.0	
Teacher	6	85.7	1	14.3	
S-E status					
Lower	30	93.8	2	6.3	NA
Upper Lower	60	88.2	8	11.8	
Lower Middle	25	89.3	3	10.7	
UpperMiddle	17	94.4	1	5.6	
Duration of deformity in years					
<1	80	88.9	10	11.1	0.863
1-2	26	92.9	2	7.1	
>2	26	92.9	2	7.1	
Duration of disease in years					
<1	35	89.7	4	10.3	0.792
1-2	51	91.1	5	8.9	
3-5	33	91.7	3	8.3	
>5	13	86.7	2	13.3	

*significant at $p<0.05$

NA= χ^2 test is not applicable as > 30% cell frequencies are < 5

From the analysis of data presented in table 18, following facts are evident:

- Male patients had more ocular deformities than females, but this association was not statistically significant (p=0.390).
- Young adults (26-40 years) and elderly (61-75 years) were the common sufferers of ocular complications of leprosy.
- Patients from low socio-economic status had more ocular deformities (n=10, 6.8%).

There was no statistically significant association (p=0.863) between duration of ocular deformity and presentation to the hospital. Similarly duration of the disease and occurrence of grade 2 deformity were not statistically significantly associated (p=0.792).

Table 19: Level of significance of grade of deformity (eyes) with treatment status

Parameters	**Grade 0**		**Grade 2**		**p value**
Treatment	**No. of patients**	**Percentage (%)**	**No. of patients**	**Percentage (%)**	
New case	58	89.2	7	10.8	0.552
Treated cases	35	85.4	6	14.6	
Relapse	3	100.0	0	0.0	
Under treatment	36	97.3	1	2.7	
MB/PB					
PB	12	92.3	1	7.7	0.006*
MB	120	90.2	13	9.8	
Total	132	90.4	14	9.6	

*significant at p<0.05

From table 19 it is observed that there was no significant association of ocular deformities with treatment status (p=0.552). However, association of ocular deformities with MB disease was statistically significant (p=0.006).

Table 20: Distribution of grade of deformity (eyes) in reactions and types of disease

Parameters		Grade 2		Obvious redness		Visual impairment	
		No. of patients	Percentage (%)	No. of patients	Percentage (%)	No. of patients	Percentage (%)
Reaction	Type 1	0	0	0	0	0	0
	Type 2	4	10	4	10	0	0
Types of disease	Tuberculoid	0	0	0	0	0	0
	BT	5	9	3	7	2	5
	BB	0	0	0	0	0	0
	BL	3	14	3	7	0	0
	LL	4	8	2	5	2	5
	Pure Neural	1	17	0	0	1	2
	Histoid	1	20	1	2	0	0

From the data presented in table 20 it is observed that grade 2 deformity was higher in patients with type 2 reaction (n=4, 10%), in patients with BT (n=5, 9%) and LL (n=4, 8%) types of disease.

Co-morbid medical conditions noted in the patients were diabetes mellitus and hypertension in 3 (2%) patients each. Concomitant tuberculosis was present in 3 (2%) patients. Chronic lymphocytic leukaemia, ischemic heart disease, aspergilloma, tinea corporis with cruris were present in 1 (0.7%) patient each.

DISCUSSION

Leprosy is a disabling disease when diagnosed late and left untreated. WHO expert committee on leprosy has recommended in their 6th report that prevention and management of leprosy related impairments and disabilities should be implemented effectively.[32] The best way to prevent disabilities in leprosy is through early detection of patients, early recognition of mild impairments, and provision of appropriate treatment.[42,43,44]

In this hospital based cross sectional study on deformities and disabilities in leprosy, total 146 cases were included. The age of the patients ranged from 8 to 84 years with a mean age of 38.1 (±15.6) years. Most common age group affected was 26 to 40 years followed by 41 to 60 years. In a study by Jain *et al*,[37] the average age of disease onset was 35.73 years (range 6 to 75 years). Singh *et al*,[41] have reported the age range of leprosy patients in their study to be 7 to 80 years (mean 36.5 years).

Male patients were the common sufferers (M:F=1.3:1). Though male patients had more deformities than females, the association of deformities with gender of patients was not statistically significant (p=0.390). Similarly Kumar *et al*,[35] and Jain *et al*[37] have reported higher occurrence of deformities in male patients as compared to females, among their study subjects (p=<0.0001).

Although leprosy affects both the genders, in most parts of the world males are affected more frequently than females often in the ratio of 2:1. This preponderance of leprosy in males has been observed in countries like India, Philippines, Hawaii, Venezuela and Cameron.[45] Relatively lower prevalence of leprosy among females may be due to environmental or biological factors. Epidemiological characteristics of leprosy appears to be like many other communicable diseases where males are more frequently

affected than females.[46] Indian society is male dominated. In general, they take up the occupational burden and hence more out-going. This makes them prone to get exposed to the environment and other leprosy sufferers more closely than females. Occupation related trauma make them more vulnerable to develop deformities. As males are the bread-earners in India, they are considered privileged and they seek health care facilities more often.[47]

In this study, 100 (68.5%) patients belonged to lower socio-economic status and majority had deformities of hands and feet. The association of deformity and socio-economic status was statistically significant (p=0.008). Similar was the finding in an epidemiological study on leprosy conducted in Agra by Kumar *et al.*[35] Majority of the patients with disease and deformities were farmers by occupation. Sarkar *et al*,[40] reported agricultural workers to have significantly more disabilities than those who were engaged in other occupations.[36] The probable reasons for higher prevalence of leprosy among people of low SE status may be related to their large family size and small ill-ventilated households, where overcrowding is inevitable, making them vulnerable to acquire the disease, if there is a contact in the family.[36] Moreover, they have a low literacy level, making delayed appreciation of disease manifestations and hence more occurrence of deformities.[48] Many of these people are daily wagers, and are forced to go for manual work inspite of their anaesthetic hands and feet.[46] This makes their invisible deformities visible in the form of trophic ulcers. Inability to seek medical care due to work-pressure and monetary constraint leads to neglected reactions and consequent motor deformities. This leads to stigma and psychological stress, further enhancing occurrence of reactions and a vicious cycle sets in.[36]

In our study, close contacts of 3 patients had developed leprosy. Of them, two were couples (conjugal leprosy) and in case of the third patient the spouse and two

children were affected. This finding confirms the fact that household contacts are the most important source of acquiring infection. Studies have shown that the risk of acquiring the disease is 8 to 10 times more in households of lepromatous leprosy cases as compared to the surrounding population and 2 to 4 times for tuberculoid disease.[50,51] In a study by Anjum *et al*,[49] 27.6% of the newly diagnosed leprosy patients had an index case in the family; either parents or siblings. Seven patients (12.9%) had multiple index cases in the family and social contacts were detected in fourteen cases.

More than 91% of the patients belonged to MB group and 9% belonged to PB group. Higher incidence of deformities of hands, feet and eyes was seen in MB cases, and association of ocular deformities with MB disease was statistically significant (p=0.006). Kumar *et al*,[35] have reported overall disability rate of 7.9% in their study subjects and among these MB patients had significantly higher disability rate than PB patients (17% *vs.* 3.8%). Chavan *et al*,[36] recorded more disability among MB patients **(**60%) as compared to PB patients (19%). In the study by Jain *et al*,[37] majority of the patients belonged to MB group while 131 (43%) were in the PB group. Disability rate was more in MB leprosy patients (11.6%) than in PB (6.9%). Similarly Sarkar *et al*,[40] noted that MB patients had significantly higher disability (31.6%) than PB patients (10%). So our study results are similar to the published Indian literature.

Majority of the MB cases in our study had BT disease with more than five skin lesions and more than two peripheral nerve involvement. It ascertains the well-known fact that BT leprosy is the commonest spectrum of the disease.[15]

The association of disease duration with presence of deformities was statistically non-significant (p=0.082). However, there was variability in this association. Patients with disease duration of < 1 year had lesser deformities (grade 1:16.7%; grade 2:19.7%). The number of deformities was maximum among patients with disease

duration of 1-2 years, followed by 3-5 years. A statistically significant ($p<0.001$) number of patients with deformity presented to hospital by 2 years of onset. In a study by Kumar *et al,*[35] paralytic deformities were rare in whom duration of disease was less than a year, but increased considerably from 3.9% at 1-3 years to 25% when diagnosed late, i.e >8 years.

In our study 24.7% patients had grade 1 deformity and 41.8% had grade 2 deformity of hands and feet. Sixty one (41.8%) patients had grade 2 deformity of eyes. In a study by Kumar *et al,*[35] the overall disability rate was 7.9% and out of 58 patients with grade 2 deformities of hands and feet, 45 (77%) had paralytic deformities. Chavan *et al,*[36] recorded grade 2 disability in 13 (12.39%) patients and the disability rate for hands and feet was 38.10 %. Eye disability was not found in any of the patients by these authors. Jain *et al* [37] noted higher prevalence of grade 2 deformity than grade 1. Nine patients (3 %) had grade 1 and 20 patients (6.6%) had grade 2 deformity. In a study by Sukumar *et al,*[38] out of 259 patients 22 (8.5 %) had grade 1 and 30 (11.6%) had grade 2 deformities of hands and feet. Sarkar *et al,*[40] had detected 49 (20.1%) patients with disabilities among 244 newly diagnosed cases. Among these 28 (11.5%) had grade 1 and 21 (8.6%) had grade 2 disability. Both grade 1 (n=9, 39.1%) and grade 2 (n=5, 21.8%) disability were more among pure neural leprosy patients. BT patients with more than five skin lesions also had more disability than patients with ≤5 lesions. [27]Hence our study results corroborate to that of other studies. The risk factors for development of deformities are as follows.

i) BT cases with more than five lesions[52]

ii) Lepromatous leprosy cases[52]

iii) Pure neural cases with more than two or more nerve trunk involvement[6]

iv) Lepra reactions[11]

In this study proportion of BT cases and lepromatous leprosy cases were higher compared to other forms of leprosy and there was statistically significant association of BT cases with grade 2 deformity ($p<0.001$). In LL patients grade 2 deformities were more as compared to grade 1, but this association was not statistically significant ($p>0.05$). Grade 2 ocular deformity was higher in patients with type 2 reaction, and in patients with BT and LL disease. In a study by Kumar *et al*,[35] majority were BT cases (n=131) of which grade 2 deformity was present in 3.8%.

Among 146 patients, 63 had lepra reactions out of which type 1 reaction was present in 22 (15.1%) patients. Association of type 1 reaction was statistically significant ($p<0.001$) with both grade 1 and grade 2 deformities. In a study by Kar *et al*,[34] reactions were present in 55(20%) children of which 11 had deformities.

In this study, the proportion of cases with anaesthesia (grade I deformity) is 24.7%. Inflammation and destruction of peripheral nerves following invasion by *M.leprae* are unique features of leprosy. Peripheral neuritis due to leprosy causes sensory loss or motor paralysis or both. The sensory loss may be confined to skin lesions or it may confine to sensory distribution of affected nerve and their branches. In borderline tuberculoid leprosy, damage to peripheral trunk nerve is very much wide spread, also frequently severe. In lepromatous leprosy especially in long standing cases there is glove and stocking distribution of anaesthesia.[12]

Apart from xerosis and cracks which were observed in majority of the patients, trophic ulcer was the next common visible deformity in order. Chavan *et al*,[36] noted trophic ulcer as the most common type of grade 2 deformity which was significantly higher in females than males. In a study by Jain *et al*,[37] planter ulcer was present in 7 (35%) patients. This was followed by ulcers in hands and loss of tissue in the

form of resorption of toes in one patient. Sukumar *et al,*[38] in their study noted ulcers and scars/ cracks in hands in 17 patients each, and plantar ulcers in 6 patients. In this study proportion of claw hand and guttering was higher as compared to other visible deformities. In a study by Kumar *et al,*[35] ulnar palsy/ claw hand alone or in combination with foot drop were the commonest paralytic deformities. In a study by Jain *et al,*[37] among the patients with grade 2 deformities, most common type observed was claw hand. Sukumar *et al,*[38] noted claw hand in 18 patients in their study. Paralytic deformities of hand occur because of destruction of motor fibres in the major nerve trunks supplying the intrinsic and extrinsic muscles of hand. In leprosy the ulnar nerve is damaged most often hence ulnar claw hand is the most common deformity. In the present study, claw toes was seen in 18, guttering in 15, fanning of toes in 11 and collapse of arch of the foot in 6 patients. In the lower limb the posterior tibial nerve and common peroneal nerves were are affected commonly. The possible risk factors for paralytic deformities in the feet are as follows:

i) BT cases with more than five lesions

ii) Lepromatous leprosy cases

iii) Lepra reactions[11]

In this study 2 patients had foot drop. In the studies by Jain *et al,*[37] and Sukumar *et al,*[38] foot drop was seen in 1 patient each.

Specific deformities are a result of direct infiltration of the tissues by *M.leprae*.[12] Commonest specific deformities seen in hands were, shortening of fingers in 13 patients, and banana fingers in 10 patients. In the feet, fixed foot deformity was present in 10 patients. Among 146 patients, 28 had madarosis, 23 had nodularity of face, and collapse of nose was present in 8. Higher number of multibacillary cases in this

study might have contributed to increased number of specific deformities. In the eyes, corneal sensation was lost in 3, redness was seen in 4, and visual impairment was present in 6 patients. In a study by Jain *et al*,[37] eye involvement was present in 2 patients; lagophthalmos and chorioretinitis in 1 patient each. In another study by Sarkar *et al*,[40] 7 patients had loss of corneal sensation (grade 1), and 3 patients each had lagophthalmos and severe visual impairment (acuity of vision <6/60, i.e., grade 2). Singh *et al*,[41] noted ocular disability in 119 patients out of which 38 had grade 1 deformity and 81 had grade 2 deformity of eyes. In a study by Kumar *et al*,[35] even though 57 patients had facial lesions, none had lagophthalmos. In the present study, 10 patients were children of which, 7 were male and 3 were female. Five each belonged to the age group of 6 to 15 years and 16 to 18 years. Majority were students. Commonest clinical type was BT leprosy. Nine were MB, one was PB case. Three children had history of intrafamilial contacts with parents. Four children had grade 2 deformity and 1 had grade 1 deformity of hands and feet.

In a study by Kar *et al*,[34] out of 275 patients, 163 were boys and 112 were girls. Thirteen affected children were below the age of 4 years, 71 were between 5- 9 years, and 191 were between 10-15 years. Majority of the deformities detected were among the children in the age group of 10-15 years. Of them, 238 were PB and 37 were MB cases. Out of 238 PB patients 20, and among 37 MB cases 9 had deformities. Grade 2 deformity of hands and feet was seen in 29 children affected with leprosy.[34] However in a study by Kumar *et al* none of the children (<15 years) had any deformity.[35]

In a retrospective study conducted in this institution (2013-2014) it was noted that, of a total of 309 leprosy cases examined, newly diagnosed childhood cases were 19.7%. Borderline tuberculoid leprosy was the commonest presentation in children. Twenty four were PB and 37 were MB cases. Household contacts were identified in

18·2% and 8·19% children had visible deformity. Deformities were recorded in 5·82%, and 1·79% had WHO Grade 2 deformity of hands and feet.[54] Anjum *et al*[49] noted that out of 257 newly detected cases, 26 were children, indicating continuing transmission of leprosy in that region. Familial and non-familial close contacts play an important role in the epidemiology of childhood leprosy.[55] The type of disease in the contact and proximity to the child i.e. household or neighbourhood are important determining factors in the disease transmission.[55]

In this study among the 97 patients with deformities, 36 were advised care of hands and feet, 25 were advised physiotherapy. Twenty six patients were treated for trophic ulcers of foot with paring and wound care; POP cast immobilization was done in 3 patients. Splints were advised for 1 patient with claw hand (Fig U) and 2 patients with foot drop (Fig T). Fistulectomy, debridement, disarticulation, was done when indicated in selected cases. This emphasizes that in significant number of patients, the development of secondary impairments can be prevented.[56] No doubt surgery plays a major role in presence of motor dysfunction and altered appearance, but it can be performed only in suitable cases. However, it does not influence sensory loss and therefore patients should be instructed about thorough care of hands, feet and eyes.

CONCLUSION

Leprosy is known to cause a plethora of deformities. Detailed history and examination of the patient at presentation is of utmost importance especially when there is sensory loss. Neglecting anaesthetic limbs can lead to progression of deformity leading to untoward consequences.

This study lead to recognition of various deformities in the patients ranging from mild impairment of sensory functions to gross mutilation of hands, feet and face.

Early detection of anaesthesia in the extremities can help in educating the patients regarding the care of limbs and also to identify risk factors. Both treated and newly diagnosed cases of leprosy were included in this study which led to tracing the close contacts especially children and educating the patients about the disease.

This study helped in assessing the burden of leprosy-related deformities and disabilities in this region.

SUMMARY

A hospital-based, cross sectional study to detect deformities/ disabilities in patients with leprosy was conducted from November 2014 to September 2016. All leprosy patients irrespective of age, gender and treatment status were included in the study. Detailed history of the patients was taken with respect to the duration of disease and deformity, history of contact, episodes of reactions if any, and treatment. Each patient was subjected to complete cutaneous examination and palpation of peripheral nerves. Presence or absence of deformities were recorded.

Following were the salient features of this study:

- Male to female ratio was 1.39:1.
- Mean (±) SD age of the patients was 38.1 (±15.6) years. The mean duration of disease was 2.6 (±4.1) years and that of the deformities was 1.2 (±3.6) years.
- Majority of the patients belonged to lower socio-economic status (n=100, 68.5%) followed by middle S-E status (n=46, 31.5%).
- Most prevalent clinical type was borderline tuberculoid leprosy in 54 (37%) patients, followed by lepromatous leprosy in 49 (33.6%).
- Multibacillary cases were 133 (91.1%) and paucibacillary cases were 13 (8.9%).
- Among 146 patients, 36 (24.7%) had grade 1 deformity and 61 (41.8%) had grade 2 deformity of hands and feet. Fourteen (9.6%) had grade 2 deformity of eyes.
- In this study, 10 (6.8%) patients were children among which 3 (2%) had history of contact at home. One (0.6%) child had grade 1 deformity and 4 (2.7%) had grade 2 deformity hands and feet.

- The commonest specific deformities were shortening of fingers in 13 (8.9%) and banana fingers in 10 (6.8%) patients in the upper limbs and fixed deformity of toes and feet in 10 (6.8%) patients in the lower limb.
- The commonest anaesthetic deformity was xerosis in 113 (77.4%) and trophic ulcer in 20 (13.7%) patients in the upper limb and in the feet xerosis and cracks were commonly present in 115 (78.8%) and 44 (30.1%) patients respectively.
- The commonest visible paralytic deformity in hands was claw hand in 24 (16.5%) patients and in the feet it was claw toes in 18 (12.3%) patients.

In this study, obvious redness of the eyes was present in 9 (6.1%) patients and visual impairment in 5 (3.4%) patients.

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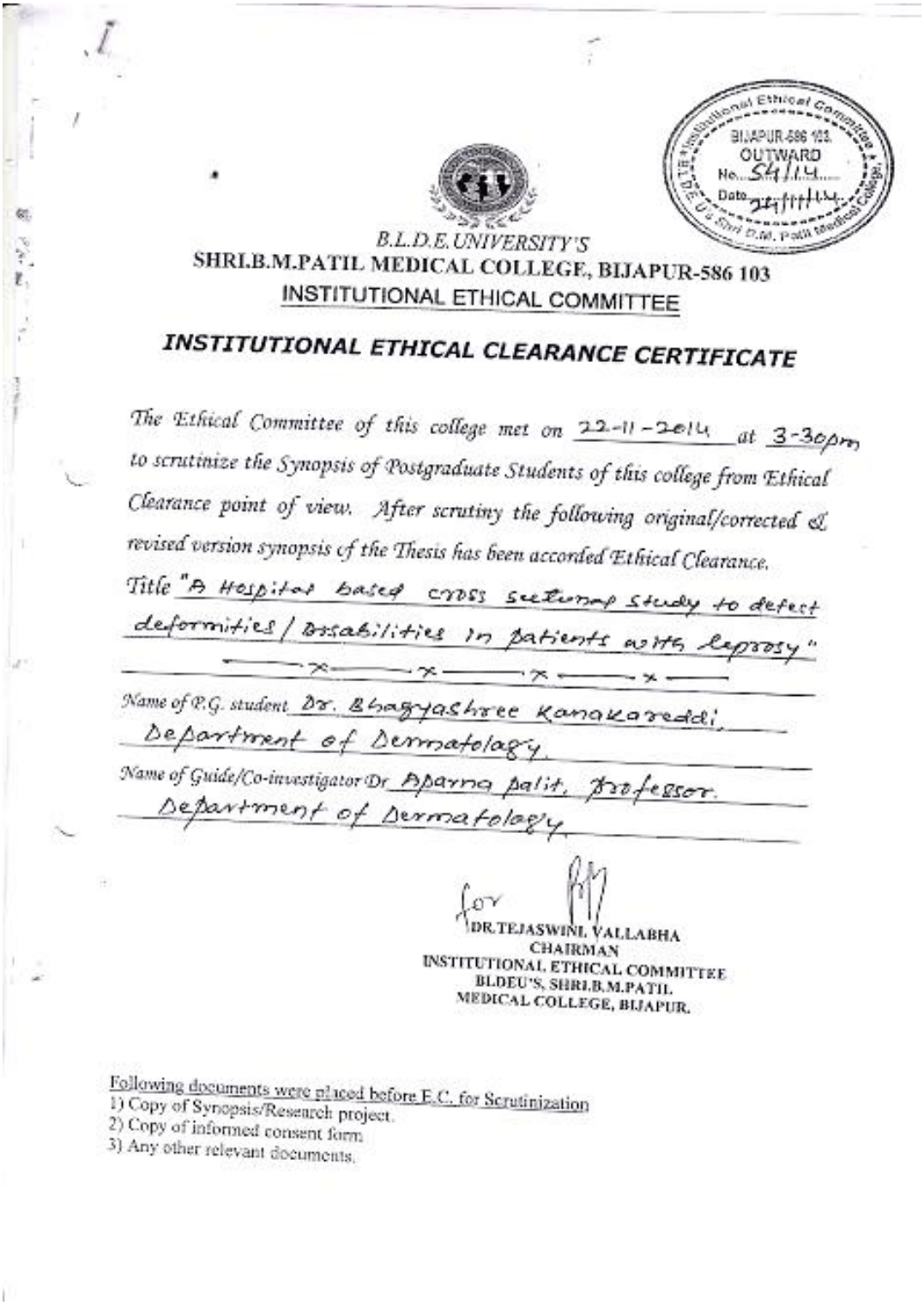
ANNEXURES



B.L.D.E. UNIVERSITY'S
SHRI.B.M.PATIL MEDICAL COLLEGE, BIJAPUR-586 103
INSTITUTIONAL ETHICAL COMMITTEE

BLDE U's Shri B.M. Patil Medical College, Institutional Ethical Committee
BIJAPUR-586 103.
OUTWARD
No. 54/14
Date 24/11/14

INSTITUTIONAL ETHICAL CLEARANCE CERTIFICATE

The Ethical Committee of this college met on 22-11-2014 *at* 3-30pm *to scrutinize the Synopsis of Postgraduate Students of this college from Ethical Clearance point of view. After scrutiny the following original/corrected & revised version synopsis of the Thesis has been accorded Ethical Clearance.*

Title "A Hospital based cross sectional study to detect deformities / disabilities in patients with leprosy"

Name of P.G. student Dr. Bhagyashree Kanakareddi, Department of Dermatology.

Name of Guide/Co-investigator Dr Aparna palit, Professor. Department of Dermatology.

for DR.TEJASWINI VALLABHA
CHAIRMAN
INSTITUTIONAL ETHICAL COMMITTEE
BLDEU'S, SHRI.B.M.PATIL
MEDICAL COLLEGE, BIJAPUR.

Following documents were placed before E.C. for Scrutinization
1) Copy of Synopsis/Research project.
2) Copy of informed consent form
3) Any other relevant documents.

PROFORMA

B.L.D.E.U's SHRI B. M. PATIL MEDICAL COLLEGE HOSPITAL AND RESEARCH CENTRE, VIJAYAPUR.

Department of Dermatology, Venereology and Leprosy.

PERSONAL PARTICULARS:

Name:

Age: Gender: Educational Status:

Income: day / month/ year:

Occupation: Religion:

OPD/IPD NO: DOA/DOD: Address with phone no.:

HISTORY:

- Duration of disease-
- Duration of deformity-
- H/O contact: In family-

  In the locality-
- Habits: Alcohol-

  Tobacco (smoking / chewing)-
- Episodes of reactions:
  - Type 1
  - Type 2
- Treatment:
  - MDT

- Treatment for reaction

- Treatment for deformity

Clinical examination:

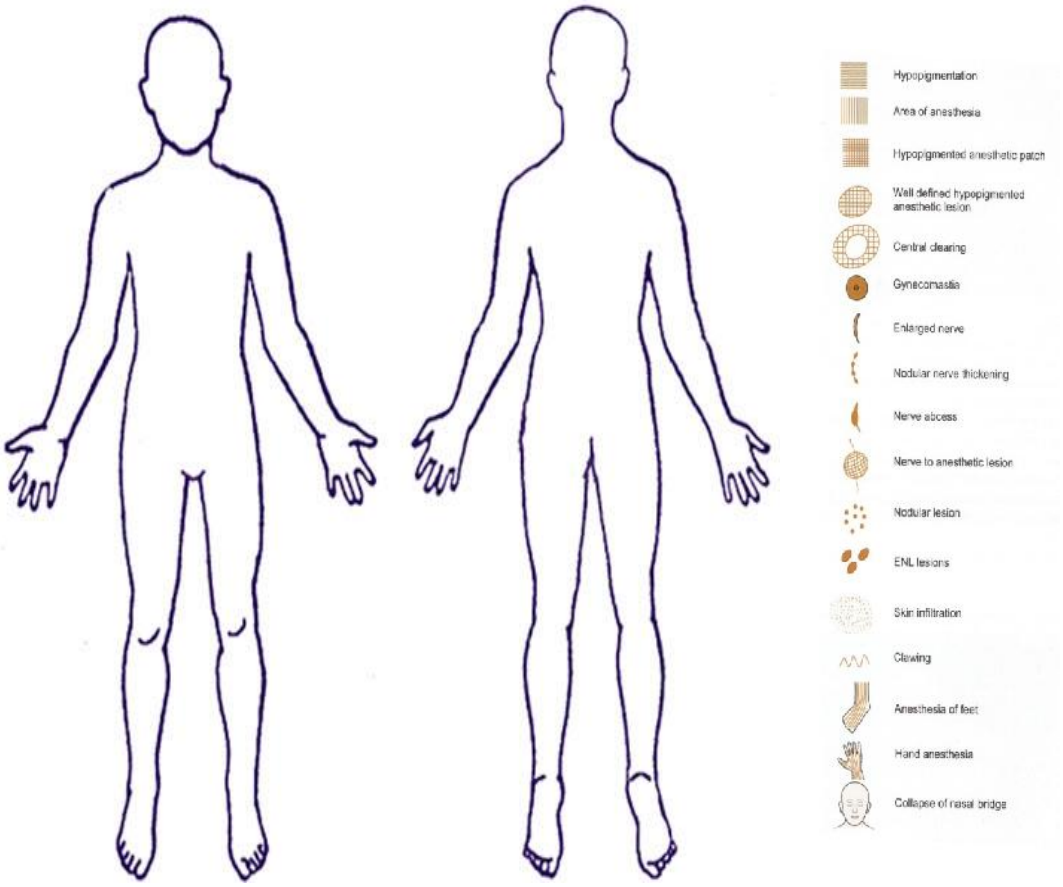
Skin- Type of lesions: } Body chart

Distribution of lesions: } Body chart

Nerves- Peripheral nerves involved } Body chart

Final diagnosis:

Diagram 1: Body chart



Examination for deformities:

Table 1: Specific deformities

	Type of deformity	**Right side**	**Left side**
Upper limb	1. Banana fingers 2. Shortening of fingers 3. Reaction hand		
Lower limb	1. Fixed deformities of toes and feet 2. Tarsal disorganization		

Table 2: Anaesthetic deformities

	Type of deformity	**Right side**	**Left side**
Upper limb	1. Xerosis, cracks, fissures 2. Trophic ulcers 3. Others		
Lower limb	1. Xerosis, cracks, fissures 2. Trophic ulcers 3. Others		

Table 3: Visible paralytic deformities

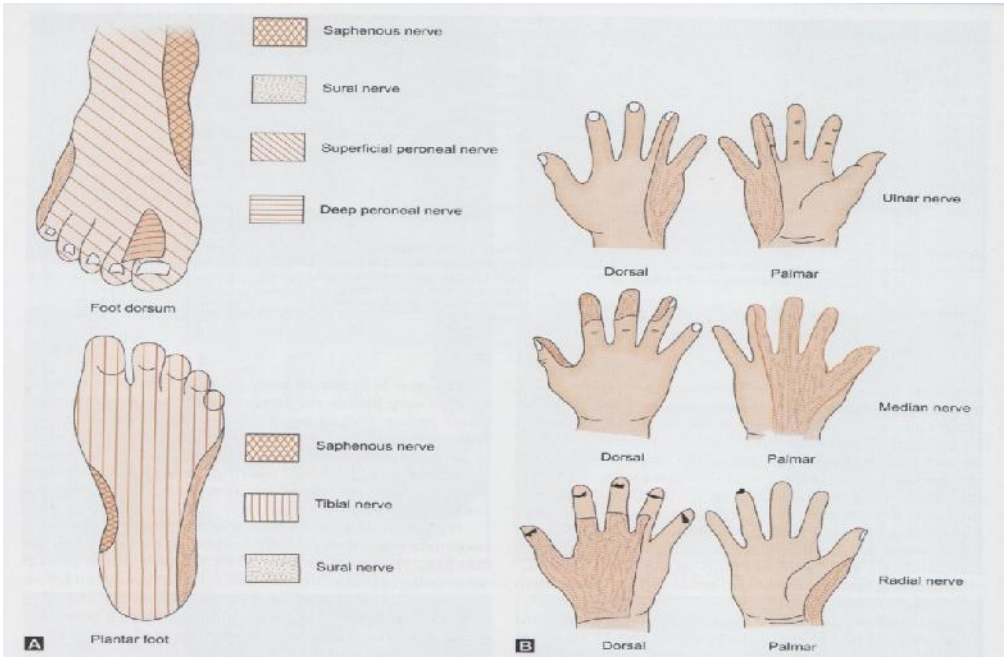
	Type of deformity	Right side	Left side
Upper limb	1. Claw hand Ulnar / median Total 2. Wrist drop 3. Guttering 4. Ape thumb 5. Wartberg's sign 6. Benediction sign 7. Others		
Lower limb	1. Claw toes 2. Fanning of toes 3. Foot drop 4. Guttering 5. Collapse of arch 6. Others		

Table 4: Sensory testing

		Right side	Left side
Upper limb	1. Test tubes with hot & cold water 2. Cotton wool 3. Pin-prick 4. SWMT		
Lower limb	1. Test tubes with hot & cold water 2. Cotton wool 3. Pin-prick 4. SWMT		

Diagram 2: Sensory loss over hands and feet

Right Side



Left side

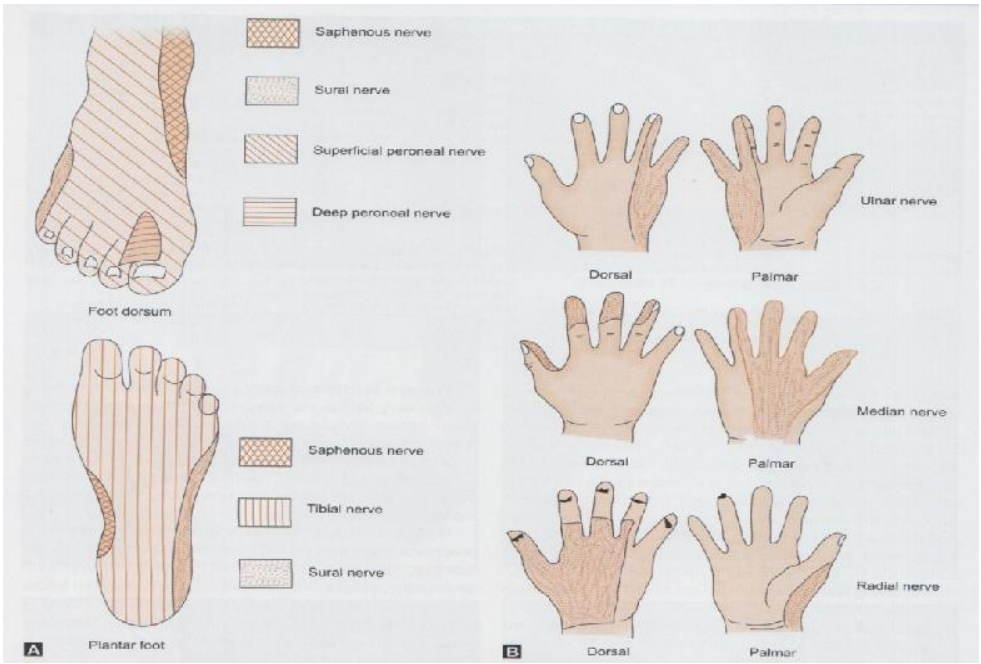


Table 5: Motor testing

		Right side	**Left side**
Upper limb	1. Beak test 2. Pen test 3. Card test 4. Book test 5. Extension of wrist against resistance		
Lower limb	1. Flexion & extension of toe against resistance 2. Flexion & extension of ankle against resistance 3. Adduction & abduction of toes		

Table 6: Tests for face & eyes

		Right side	**Left side**
Face	1. Madarosis 2. Collapse of nose 3. Nodularity 4. Others		
Eyes	1. Lagophthalmos 2. Corneal sensation 3. Others		

Table-7: WHO grading of the deformities/ disabilities of leprosy patients (2007):

GRADING	HANDS AND FEET	EYES
GRADE 0	No disability found	No disability
GRADE 1	Loss of sensation of the hand or foot	-
GRADE 2	Visible damage or disability Wounds (Ulcers) Deformity due to muscle weakness Loss of tissue.	Inability to close Obvious redness Visual impairment Blindness

SAMPLE INFORMED CONSENT FORM

B.L.D.E.U's SHRI B. M. PATIL MEDICAL COLLEGE HOSPITAL AND RESEARCH CENTRE, VIJAYAPUR.

Department of Dermatology, Venereology and Leprosy.

RESEARCH INFORMED CONSENT FORM

TITLE OF THE PROJECT:-		A HOSPITAL BASED CROSS SECTIONAL STUDY TO DETECT DEFORMITIES/ DISABILITIES IN PATIENTS WITH LEPROSY
PG GUIDE	**:-**	DR. APARNA PALIT.
PG STUDENT	**:-**	DR. BHAGYASHREE KANAKAREDDI

PURPOSE OF RESEARCH:-

I have been informed that this project will determine the detection of disability and deformity in patients of leprosy in the hospital.

BENEFITS:-

I understand that my participation in this study will help the investigator in early identification of deformities and disabilities in leprosy patients and thus for the management.

PROCEDURE:-

I understand that relevant history will be taken and I will undergo detailed clinical examination.

RISK AND DISCOMFORTS:-

I understand there is no risk involved and I will experience no discomfort during the clinical examination .

CONFIDENTIALITY:-

I understand that medical information produced by this study will become a part of my hospital records and will be subjected to the confidentiality and privacy

regulation of the said hospital. Information of a sensitive personal nature will not be a part of the medical records, but will be stored in the investigator's research file.

If the data are used for publication in the medical literature or for teaching purposes no names will be used and other identifiers such as photographs and audio or videotapes will be used only with my special written permission. I understand I may see the photographs, videotapes and hear the audiotapes before giving this permission.

REQUEST FOR MORE INFORMATION:-

I understand that I may ask more questions about the study at any time concerned. Dr. Bhagyashree Kanakareddi is available to answer my questions or concerns. I understand that I will be informed of any significant new findings discovered during my participation.

REFUSAL OR WITHDRAWAL OF PARTICIPATION:-

I understand that my participation is voluntary and I may refuse to participate or may withdraw consent and discontinue participation in this study at any time without prejudice.

INJURY STATEMENT:-

I understand that in the unlikely event of injury to me resulting directly from my participation in this study and if such injury were reported promptly, then medical treatment will be available to me, but no further compensation will be provided. I understand that by my agreement for my participation in this study, I am not waiving any of my legal rights.

I have explained to (patient's / relevant guardian's name) the purpose of the study, the procedures required, and the possible outcome to the best of my ability in patient's own language.

_____ _____

Investigator / P. G. Guide Date

I confirm that …….(Name of the PG guide / chief researcher) has explained to me the research, the study procedures that I undergo and the possible risks and discomforts as well as benefits that I may experience. I have read and I understand this consent form. Therefore, I agree to give my consent for my participation as a subject in this research project.

_____	_____
Participant / guardian	Date
_____	_____
Witness to signature	Date

KEY TO MASTER CHART

L	-	Lower class
LM	-	Lower middle
UL	-	Upper lower class
UM	-	Upper middle
MB	-	Multibacillary
PB	-	Paucibacillary
T	-	Treated case
UT	-	Under Treatment
N	-	New case
R	-	Relapse
X	-	Xerosis
C	-	Cracks
F	-	Fissures
TU	-	Trophic ulcer
O	-	Others
CH-U	-	Claw Hand -Ulnar
CH-M	-	Claw Hand -Median
CH-C	-	Claw Hand-Complete
WD	-	Wrist drop
G	-	Guttering
AT	-	Ape thumb
WS	-	Wartberg’s sign
BS	-	Benediction's sign
CT	-	Claw toes
FOT	-	Fanning of toes
FD	-	Foot drop
COA	-	Collapse of arch
M	-	Madarosis
CN	-	Collapse of nose

N	-	Nodularity
L	-	Lagophthalmos
CS	-	Corneal sensation
1	-	Test tubes with hot & cold water test
2	-	Cotton wool test
3	-	Pin-prick test
4	-	Semmes-weinsten monofilament test
5	-	Beak test
6	-	Pen test
7	-	Card test
8	-	Book test
9	-	Extension of wrist against resistance
10	-	Flexion & extension of toe against resistance
11	-	Flexion & extension of ankle against resistance
12	-	Adduction & abduction of toes

SL.NO	NAME	AGE (YEARS)	SEX	OPD/IPD NO.	OCCUPATION	SOCIO-ECONOMIC STATUS	AREA	EDUCATION	DURATION OF DISEASE (YEARS)	DURATION OF DEFORMITY (YEARS)	TYPES	REACTIONS	MB/PB	TREATMENT	SPECIFIC DEFORMITY UPPER LIMB	SPECIFIC DEFORMITY LOWER LIMB	ANAESTHETIC DEFORMITY UPPER LIMB	ANAESTHETIC DEFORMITY LOWER LIMB	VISIBLE PARALYTIC DEFORMITY UPPER LIMB	VISIBLE PARALYTIC DEFORMITY LOWER LIMB	SENSORY TESTS UPPER LIMB	SENSORY TESTS LOWER LIMB	MOTOR TESTS UPPER LIMB	MOTOR TESTS LOWER LIMB	FACE	EYES	GRADE OF DEFORMITY (HANDS/FEET)	GRADE OF DEFORMITY(EYES)
1	Parasappa Malappa Gangor	29	M	O-384920	Teacher	UM	Rural	BA	1.5	1	Indeterminate		PB	UT			X	X, C, O			1,2	1,2,3,4					1	0
2	Somnath Vittal Waghmode	29	M	O-374135	Farmer	LM	Rural	9th	1.5	1	BL	Type 1	MB	UT			X	X			1,2,3,4	1,2,3,4					1	0
3	Tarabai Krishnappa Rathod	40	F	O-383113	Labourer	UL	Rural	Illiterate	1	0.5	LL	Type 2	MB	UT			X	X			1,2	1,2			M, N, O		1	0
4	Renuka Somnath Gudgenur	38	F	O-383264	Housewife	UL	Urban	PUC2	0.6	0	BT		MB	UT			X	X									0	0
5	Madivallappa Kesaratti	65	M	I-33545	Farmer	UL	Rural	Illiterate	3	2.5	BL		MB	T		FD	X	X, C, F, TU	G, O	G	1,2,3,4	1,2,3,4	5,7,8	10,11	M		2	0
6	Saleem Babulal Nagur	20	M	O-386502	Student	LM	Rural	BA	1	1	Pure Neural		PB	N			O		CH-U, WD		1,2,3,4		5,7,8,9				2	0
7	Chanappa Sangappa Hanchinal	64	M	I-33471	Farmer	UL	Rural	Illiterate	4	4	BL		MB	T	SOF		X	X, TU		FD	1	1,2,3,4		10,11,12		O	2	2
8	Savitri Shantagouda Biradar	23	F	O-379407	Farmer	UL	Rural	Illiterate	1	1	LL		MB	N			X, TU	X, C							O	O	0	0
9	Anasavva Rayappa Jamadar	35	F	O-374995	Labourer	L	Rural	Illiterate	1	0.6	BT	Type 1	MB	UT	BF		X	X			1,2,3,4	1,2,3,4	5,6,7,9	10,11,12	CN		2	0
10	Somalabai Nathu Pawar	35	F	O-379046	Farmer	UL	Rural	Illiterate	2	2	BT	Type 2	MB	UT	BF		X, C, F	X, C, F	O		1,2,3,4	1,2,3,4	7		N		1	0
11	Santosh Shivayogappa Talwar	21	M	O-389648	Student	LM	Rural	BA	2	2	LL		MB	UT			X	X, TU, O	CH-U, O	CT, G	1,2,3,4	1,2,3,4	5,6,7,8				2	0
12	Sikandar Bakshisab Halikeri	25	M	O-158831	Teacher	UM	Rural	MSc	8	0	BT	Type 1	MB	T								1					1	0
13	Kasturibai Chanbasappa Kamble	55	F	O-392330	Sweeper	UL	Urban	Illiterate	2	0	LL	Type 2	MB	T			X	X, O							M		0	0
14	Basu Utob Kalyani	45	M	O-395716	Farmer	UL	Rural	Illiterate	0.6	0.08	BL		MB	UT			X, C	X, C, TU				1,2,3,4			M		2	0
15	Gangamma Prabhugouda Nadgoud	22	F	O-398378	Housewife	UM	Rural	10th	2.5	1	LL	Type 1	MB	UT			X, O	X	CH-U, O		1,2	1,2	5,7,8	10			2	0
16	Kenchappa Dharmappa Doddmani	49	M	O-392356	Teacher	UM	Rural	BA, TCH	2	0	BT		MB	N				X								O	1	2
17	Shrishail Karbasappa Akalwadi	45	M	I-35533	Farmer	UM	Rural	4th	3.5	0.5	LL	Type 2	MB	UT		FD		X		FOT				10,12	O		2	0
18	Malanna Guthanna Devarmani	36	M	I-36401	Farmer	UL	Rural	Illiterate	1	1	LL		MB	N			X, F, TU	X			1,2,3,4	1,2,3,4	7	10,12	M		2	0
19	Drupati Ramachandra Chainapur	56	F	O-397107	Housewife	UL	Urban	Illiterate	1.5	0	BL	Type 2	MB	N			X	X									0	0
20	Davalbee Babu Mosalgi	50	F	O-404674	Labourer	L	Rural	Illiterate	6	0	LL	Type 2	MB	T			X, C, TU	X			1,2,3,4	1,2,3,4		10,12	M		2	0
21	Mahalingappa Revappa Bagchalli	30	M	O-414878	Farmer	LM	Urban	BA	7	0	BT		MB	T			X	X									0	0
22	Sidawwa Sharanappa Aloor	30	F	O-413428	Housewife	UL	Rural	5th	0.6	0	BL	Type 2	MB	UT	BF		X	X, C, O							N		0	0
23	Uma Nanagouda Patil	35	F	O-389661	Farmer	UL	Rural	8th	1.5	1	BL	Type 1	MB	T			X, C, O	X, C, O			1,2,3,4	1,2,3,4					1	0
24	Basangouda Bapugouda Chokavi	38	M	O-410238	KSRTC supt	LM	Rural	PUC2	0.3	0	BT		MB	N				X									0	0
25	Akshata Dundappa Bivapgoud	17	F	O-407317	Student	UM	Urban	PUC2	1	0	BT		MB	N													0	0
26	Ismail Babumiya Sheikh	65	M	O-407380	Business	LM	Urban	10th	0.4	0.4	BL		MB	UT			X	X, C, TU	CH-U, O	G	1,2,3,4	1,2,3,4	5,6,7,8,9	10,12	O		2	2
27	Surendar Murlidhar Das	35	M	O-419190	Factory worker	LM	Rural/immigrant	4th	1.5	0.6	BT	Type 2	MB	N			X	X, TU	CH-U, O	O	1,2,3,4	1,2,3,4	5,7,8,9	10,11,12			2	0
28	Mahadevi Sangangouda Biradar	50	F	O-41713	Housewife	UL	Rural	Illiterate	6	6	BT		MB	T	SOF	FD	X	X, TU	CH-T, G	CT, FT	1,2,3,4	1,2,3,4	5,6,7,8	10,12			2	0
29	Sayed Chandavarisab Ashfaq	18	M	O-406304	Student	LM	Rural	Diploma civil	4	0	Tuberculoid		PB	N			X	X									0	0
30	Laxmi Raju Rathod	27	F	O-420514	Farmer	UL	Rural	Illiterate	3	2.5	BB	Type 2	MB	UT	RH		X	X, O									2	0
31	Sambhavi Devandrappa Kambar	28	F	O-417870	Unemployed	UL	Rural	10th	3	0	BT	Type 1	MB	UT			X	X			1,2	1,2,3,4					1	0
32	Noorkhan Lalsab Momin	70	M	O-426561	Weaver	UL	Rural	Illiterate	6	0	Histoid	Type 2	MB	T			X	X, C			1,2	1				O	0	2
33	Neelamma Neelkant Baglur	49	F	O-427223	Housewife	L	Rural	Illiterate	5	2	BT		MB	T			X	X, C, TU		CT, G	1,2,3,4	1,2,3,4		10,12			2	0
34	Savitri Anappa Kamble	40	F	O-427988	Housewife	L	Rural	Illiterate	1.5	1	BT	Type 1	MB	UT	BF		X, O	X, C, O			1,2,3,4	1,2,3,4			O		1	0
35	Shaikh Majid Zakhir	35	M	I-39768	Teacher	UM	Rural	DEd	16	0	BT		MB	T			X, O	X, O	O								1	0
36	Bagubai Rashiram Naik	46	F	O-415083	Labourer	UL	Rural	Illiterate	4	0	LL	Type 2	MB	N			X	X, C							N		0	0
37	Savitri Satappa Saptsagar	61	F	I-38944	Housewife	LM	Rural	Illiterate	15	6	LL		MB	T			X	X, TU	O	CT, COA	1,2,3,4	1,2,3,4		10,11,12			2	0
38	Bibijan Meheboobsab Korbo	25	F	O-439618	Housewife	LM	Rural	Illiterate	1	0	LL	Type 2	MB	T			X	X, O									0	0
39	Savitri Somappa Hugar	21	F	O-441230	Student	UM	Rural	PUC2	3	0	BT		MB	T			X	X									0	0
40	Maruti Hanamanth Kolar	17	M	O-442802	Farmer	UL	Rural	Illiterate	1	0.6	BB	Type 1	MB	UT			X	X, TU		CT, FT	1,2,3,4	1,2,3,4		10,11,12			2	0
41	Basavaraj M Mukartihal	55	M	O-429463	Agriculturist	UM	Urban	LLB	7	0.3	BT		MB	T			X, TU	X									0	0
42	Yogappa Bagewadi	48	M	O-59599	Farmer	UL	Rural	Illiterate	4	0	LL	Type 2	MB	T			X, C	X, C			1,2,3,4	1,2,3,4					1	0
43	Sharada	20	F	O-63468	Farmer	L	Rural	Illiterate	4	0	Pure Neural		PB	T			X	X, O			1	1					0	0
44	Hasina	25	F	O-63259	Fruit vendor	UL	Urban	Illiterate	4	0	BT		MB	UT			X	X, C			1,2	1,2					1	0
45	Maksud Anwar Ali	26	M	I-62422	Painter	UL	Urban	Illiterate	3	1	LL		MB	N		CT	X, TU	X, C, F, TU		CT, FT	1,2,3,4	1,2,3,4	5,7,8,9	12	M, N, O		2	0
46	Kamalamma Chukavi	61	F	O-69603	Housewife	L	Rural	Illiterate	4	4	LL	Type 2	MB	T			X	X			1,2,3,4	1,2,3,4					1	0
47	Motilal Pandurang Jadar	42	M	O-77929	Sub-contractor	UM	Urban	BA	4	0	BT		MB	T			O										0	0
48	Umesh Babu Rathod	14	M	I-12793	Student	UL	Rural	9th	1.5	1	LL	Type 2	MB	T			X, C, TU	X	G	G	1,2,3,4	1,2,3,4	7		M		2	0
49	Hajilal Badakal	33	M	I-14302	Auto driver	UL	Urban	9th	1	0.16	LL		MB	N	BF		X	X			1,2	1,2			M, N	O	1	2
50	Basavaraj Patil	19	M	I-11421	Driver	UL	Rural	4th	3	1	BT		MB	T			X	X, TU			1,2,3,4	1,2,3,4				O	2	2
51	Vijayalaxmi Malappa Jevur	30	F	O-79652	Gardener	UL	Rural	Illiterate	2	0.16	BT		MB	N			X, TU	X			1,2,3,4		5,6,7,8,9		N		2	0
52	Malakayya Jedimath	60	M	I-14535	Farmer	UL	Rural	Illiterate	3	2	BT		MB	T			X	X, C, TU	G, O	G	1,2,3,4	1,2,3,4	5,6,7,8,9				2	0
53	Hussain Mohammadrafiq Bhagwan	25	M	I-6908	Auto driver	UL	Urban	Illiterate	1	1	LL	Type 2	MB	UT			X	X			1,2,3,4	1,2,3,4			M, N		1	0
54	Bhimabai Hadapad	38	F	O-163082	Attender	LM	Urban	5th	2	0	BT		MB	UT													0	0

55	Yallawwa Anchutrao	55	F	O-183086	Labourer	UL	Urban	Illiterate	0.08	0	BT	Type 1	MB	N			X, O				1,2	1,2			N	O	1	0
56	Shreedevi Sindagi Allagi	25	F	O-219610	Teacher	UM	Rural	DEd	1	0	LL	Type 2	MB	N			X	X									2	0
57	Saraswati Irangouda Patil	65	F	O- 183293	Housewife	UL	Rural	Illiterate	5	3	LL	Type 2	MB	T			X	X			1,2,3,4	1,2,3,4					1	0
58	Ladalamish Bashasab Langoti	35	M	I-16813	Labourer	UL	Rural	PUC2	1.5	0.3	BT	Type 2	MB	T	BF, RH		X, TU	X, C, F			1,2,3,4	1,2,3,4	5,6	10,11,12	N, O	O	2	2
59	Siddu Yallappa Logari	35	M	O- 171664	Farmer	UL	Rural/immigrant	5th	4	0	LL	Type 2	MB	T				X, C									0	0
60	Shivakumar Samaru Yadav	22	M	O- 205679	Labourer	LM	Rural	Illiterate	0.16	0.16	LL		MB	N	BF, SOF		X, TU	X, C, F, TU	CH-U	O	1,2,3,4	1,2,3,4	5,6,7,8,9	10,11,12	M, CN, N	CS, O	2	2
61	Shivakumar Acharya	35	M	O- 192712	Asst Librarian	UM	Urban	BA	0.5	0	BT		MB	N													0	0
62	Nagawwa Hanamanth Wadar	55	F	O- 210347	Farmer	UL	Rural	Illiterate	3	1	BT		MB	T			X	X, C	G, O	CT, G	1,2,3,4	1,2,3,4	7,8		CN	O	2	2
63	Parubai Nerul Pawar	35	F	O-13608	Labourer	UL	Rural	Illiterate	0.5	0.08	BT		MB	UT			X, C	X, C	G	G	1,2,3,4	1,2,3,4	7	10,12			2	0
64	Tangyamma Nanagouda Patil	55	F	I-20973	Housewife	L	Rural	Illiterate	5	4	BT		MB	T	SOF		X, C	X, C, F, TU	G, CH-U, O	CT, FT, COA	1,2,3,4	1,2,3,4	5,6,7,8	10,12			2	0
65	kamala Ramachandra Chalawadi	56	F	I-19388	Housewife	L	Rural	Illiterate	1	0.4	LL		MB	N			X	X, C, TU		CT, FT	1,2,3,4	1,2,3,4		10,12	O		2	0
66	Jaishing Dashrath Bildar	32	M	O-258623	Labourer	UL	Rural	Illiterate	2	0.6	BL	Type 2	MB	N			X	X, C	CH-U, G	CT	1,2	1,2	6		N, O	CS, O	2	2
67	Shivasharan Mahadev Jatnal	30	M	I-21697	Farmer	UL	Rural	Illiterate	3	1	BT		MB	T	SOF		X	X, C, F, TU	O	CT, FT	1,2,3,4	1,2,3,4	7	10,12			2	0
68	Shankarguru Sangappa Panchgal	28	M	I-22771	Electrician	LM	Urban	10th	2	0.4	LL	Type 2	MB	N			X	X			1,2	1,2			N, O	O	1	0
69	Rajeev Kumar	28	M	O-279717	Driver	LM	Urban	BA	1	0	BL		MB	N													0	0
70	Sachin Mahadev Banni	18	M	O-269984	Student	UL	Rural	PUC2	1	0	BL		MB	N				X, F			1,2	1,2					1	0
71	Malappa Bhimappa Pujari	23	M	I-24828	Farmer	UL	Rural	4th	0.3	0	Bl	Type 1	MB	N				X, C			1,2	1,2					1	0
72	Dattaray Ganapati Suravanshi	50	M	O-246342	Clerk	LM	Urban	BA	0.5	0.4	Histoid		MB	N					G		1,2	1,2					1	0
73	Prakash Bhagvanth Walekar	23	M	I-27310	Farmer	UL	Rural	9th	3	0	Pure Neural	Type 2	PB	N													0	0
74	Sunil Basavaraj Hosur	14	M	O-360564	Student	L	Rural	9th	4	1	LL		MB	T			X, TU	X, TU	AT, WS, O		1,2,3,4	1,2,3,4	7,9				2	0
75	Sidray Jagadevappa Indi	48	M	I-27721	Farmer	UL	Rural	4th	0.08	0.08	BL	Type 2	MB	N													0	0
76	Shivamma Dadeppa Talakeri	30	F	I-27319	Housewife	UL	Rural	Illiterate	0.5	0.5	Tuberculoid		PB	N			X, TU	X			1,2,3,4	1,2,3,4	6,7				2	0
77	Laxmi Prakash Kapale	21	F	O-370803	Housewife	UL	Rural	10th	5	0	Tuberculoid		PB	UT													0	0
78	Parasappa Timanna Hunchagi	26	M	I-35185	Daily wage worker	UL	Urban	Illiterate	1	1	LL	Type 2	MB	N			X	X, O	CH-U	CT	1,2,3,4	1,2,3,4	5,7	12	N, O		2	0
79	Mohan Somlu Rathod	22	M	O-416861	Driver	LM	Rural	10th	4	0	LL	Type 2	MB	UT			X	X	O								0	0
80	Parsappa Timanna Hunchagi	26	M	I-35185	Daily wage worker	UL	Urban	Illiterate	1	1	LL	Type 2	MB	N			X	X, O	CH-U	CT	1,2,3,4	1,2,3,4	5,7	12	N		2	0
81	Savita Dharmanna Belagali	20	F	I-35125	Housewife	UL	Rural	10th	0.25	0.25	LL	Type 2	MB	N							1,2	1,2			O		1	0
82	Ramesh Mattiyal	39	M	O-423238	Daily wage worker	UL	Rural	PUC2	0.5	0.5	BT		MB	N			X	X, C, O	G, O	COA	1,2,3,4	1,2,3,4	5,7,8	12	M		2	0
83	Maheboob Babusab Sindagi	21	M	O-420561	Daily wage worker	UL	Urban	10th	2	1	Histoid		MB	UT			X	X	CH-U, G		1,2,3,4	1,2,3,4	7		CN		2	0
84	Ramesh Chimanlal Sharma	50	M	O-432608	Salesman	LM	Urban	Illiterate	2	2	LL	Type 2	MB	N	SOF	FD	X, C, TU	X, C, TU	CH-U, G, O	CT, FT, COA	1,2,3,4	1,2,3,4	5,7,8	10,12	M	O	2	0
85	Ramachandra Revappa Nagathan	65	M	I-38437	Farmer	UL	Rural	Illiterate	2	0.1	Pure Neural		PB	N			X	X, O	G, O	CT, G	1,2,3,4	1,2,3,4	5,6,7,8,9	10,11,12		CS, O	2	2
86	Shanta Pujari	60	F	O-441411	Daily wage worker	L	Rural	Illiterate	3	2.5	LL		MB	UT	SOF	FD	X, TU	X, C, TU		CT, FT	1,2,3,4	1,2,3,4	7	12	M, CN, O		2	0
87	Chandrawwa Sangappa Shetimani	11	F	O-446487	Student	L	Rural	5th	0.25	0	BT		MB	N													0	0
88	Appasab Sangappa Shetimani	8	M	O-446488	Student	L	Rural	3rd	0.3	0	BT		MB	N													0	0
89	Nagawwa Sangappa Shetimani	26	F	I-39336	Farmer	L	Rural	Illiterate	0.1	0	Histoid		MB	N											N		0	0
90	Mutappa R Yalakeri	16	M	I-39466	Student	UL	Rural	7th	1	0.08	BT		MB	UT	SOF		X, TU		CH-U, WS		1,2,3,4		5,7				2	0
91	Mallappa Choudappa Morabagi	60	M	I-39729	Farmer	UL	Rural	Illiterate	10	6	BT		MB	T		FD	X	X, C, TU		FT, FD, COA		1,2,3,4		10,11,12			2	0
92	Bhimawwa Basappa Bairwadgi	56	F	O-443886	Cook	UL	Rural	Illiterate	0.3	0	BT		MB	N			X										0	0
93	Gouri Gollar	35	F	O-464191	Daily wage worker	L	Urban	Illiterate	0.1	0.1	LL		MB	N			X	X, C			1,2	1,2			M, O	O	0	2
94	Shivamma Shivanna Uppar	35	F	O-467565	Farmer	L	Rural	Illiterate	9	8	BT		MB	T			X	X, C, O				1,2,3,4					1	0
95	Hulagappa Basappa Madar	50	M	I-30930	Farmer	L	Rural	Illiterate	2	1	LL	Type 2	MB	T			X	X			1,2,3,4	1,2,3,4			N		1	0
96	Chandrashekar Sahebgouda Yalgi	49	M	O-464429	Agriculturist	LM	Rural	BA	3	2	BT	Type 1	MB	T/R			X			G			7				1	0
97	Hussainsab Lalasab Nadaf	32	M	O-437102	Carpenter	LM	Rural	Illiterate	6	3	LL	Type 2	MB	T			X	X	O		1,2,3,4	1,2,3,4	7				1	0
98	Yallappa Honurappa Kollar	25	M	O-472776	Priest	UL	Rural	Illiterate	2	0	BB	Type 1	MB	T/R			X	X									0	0
99	Basamma Gurappa Kambale	50	F	O-380/16	Housewife	L	Rural	Illiterate	1	0	BT	Type 1	MB	UT			X	X		O					O		0	0
100	Hussainsab Rajesab Bhagayat	60	M	O-3557/16	Farmer	UL	Rural	9th	3	1	BT		MB	N			X	X		CT		1,2		10,12			2	0
101	Gourabai Bhimaray Gadadi	70	F	O-12797	Housewife	L	Rural	Illiterate	3	3	Pure Neural	Type 1	PB	UT		FD	X, C	X	O		1,2,3,4	1,2,3,4	6,7,8	12			2	0
102	Mumtaz Bandenawaz Mujawar	40	F	O-16511	Farmer	UL	Rural	Illiterate	3	0	BT	Type 1	MB	T			X	X					7,8				2	0
103	Ramanna Parsappa Giranal	43	M	I-647/16	Farmer	LM	Rural	Illiterate	3	3	BL		MB	T/R			X	X							M		0	0
104	Amir Hajimalang Hawaldar	20	M	O-20573/16	Construction worker	UL	Rural	7th	2	2	Histoid	Type 2	MB	N	BF		X	X									2	0
105	Amir Rapiqahamad Qureshi	31	M	I-706/16	Contractor	UM	Urban	BE Civil	2	0	LL	Type 2	MB	UT				X									0	0
106	Mittesab Ahamadsab Mulla	64	M	I-3021/16	Farmer	UL	Rural	Illiterate	1.5	1.5	LL		MB	N			X	X	WS, O		1,2,3,4	1,2,3,4	5,7	12	M, CN, N, O		1	0
107	Mahadevi Ningappa Gudodgi	65	F	O-29997	Housewife	UL	Urban	Illiterate	0.16	0	Tuberculoid		PB	N													0	0
108	Egappa Pandu Naik	38	M	O-179201	Farmer	UL	Urban	Illiterate	4	4	LL	Type 2	MB	T				X, C				1,2,3,4					1	0
109	Lalita Mittu Pawar	22	F	I-41323	Labourer	L	Rural	Illiterate	2	2	LL		MB	T			X, TU	X, C			1,2,3,4	1,2,3,4	7,8		M		2	0
110	Basavaraj Hanamanth Kalkoddu	25	M	O-42826	Driver	LM	Rural	Puc2	0.5	0.5	LL		MB	N								1,2,3,4					1	0
111	Sanjeev Neelkant Teli	46	M	O-55400	Teacher	UM	Urban	BA, TCH	6	0	BT		MB	UT													0	0
112	Ambubai B Pawar	50	F	I-5734	Housewife	L	Rural	Illiterate	2	1	LL	Type 2	MB	N			X	X	O		1,2	1,2	7		M, N		2	0
113	Vittal Kemu Rathod	55	M	I-7008	Daily wage worker	UL	Rural	Illiterate	1	1	LL	Type 2	MB	UT			X	X, C			1,2	1,2			M, N, O		1	0
114	Anjana Anand Toravi	47	F	O-63660	Teacher	UM	Urban	MA, BeD	1	0	Indeterminate		PB	N													0	0
115	Nagaraj Mallanna Kodekal	27	M	I-6904	Driver	LM	Rural	2nd	4	4	LL		MB	UT	SOF		X, C, TU	X, C, F	O		1,2,3,4	1,2,3,4	7		M, N		2	0
116	Kamalabai Kanthappa Manur	50	F	I-8403	Housewife	L	Urban	Illiterate	8	7	BT		MB	T	SOF	FD	X, C, TU	X, C, TU	CH-U, WS	FT, COA	1,2,3,4	1,2,3,4	5,6,7,8	10,12	M		2	2
117	Sangeeta Chikayya Chanchalkar	28	F	I-8666	Housewife	LM	Urban	7th	4	0	BL		MB	N			X	X, C							O		0	0
118	Savanthri Yallappa Kolar	23	F	O-1516	Daily wage worker	L	Rural	Illiterate	0.08	0	BT		MB	N			X	X									0	0
119	Ramzansab Ansar Bardol	55	M	I-8720	Farmer	UL	Rural	7th	1	1	BL	Type 1	MB	N			X	X, C			1,2,3,4	1,2,3,4			O		1	0
120	Nimbevva Hanamanth Lamani	53	F	O-101497	Housewife	L	Urban	Illiterate	2	0	BL		MB	UT			X	X, C			1,2,3,4	1,2,3,4			M		1	0
121	Manisha Chikayya Chanchalkar	9	F	O-99336	Student	LM	Urban	3rd	0.08	0	BT		MB	N													0	0
122	Shivaputrappa Kumbar Kinagi	62	M	O-101870	Farmer	UL	Rural	Illiterate	1	1	BL	Type 1	MB	UT			X	X			1,2,3,4	1,2,3,4			M		1	0

123	Nagappa Bheemappa Jolad	61	M	I-9390	Inspector	UM	Urban	BA	2.5	0.1	BT		MB	T			X, TU, O	X, C, TU		G	1,2,3,4	1,2,3,4	5,7,8	10	M		2	0
124	Sabeer M Patel	32	M	I-11791	Salesman	LM	Urban	10th	4	4	LL	Type 2	MB	UT			X	X			1,2,3,4	1,2,3,4			M, N		1	0
125	Sumitra Malappa Hokrani	35	F	I-13609	ASHA worker	LM	Rural	PUC2	0.08	0	LL	Type 2	MB	N			X, C	X, C							O		0	2
126	Gajarabai Amasidda Hongond	40	F	I-14524	Housewife	UL	Rural	Illiterate	1.5	1	BT		MB	T			X	X, C, F	CH-U		1,2,3,4	1,2,3,4	5,7				2	0
127	Govindappa Gyanappa Aramani	48	M	I-14188	Farmer	L	Rural	Illiterate	0.5	0	BL	Type 1	MB	N	BF	FD	X, O	X					7,8	10	O		0	0
128	Sumitra Muttu Jadhav	22	F	I-14919	Housewife	L	Rural	4th	0.16	0	LL	Type 2	MB	N			X	X							O		0	0
129	Bhimanna Nataji Salunke	58	M	I-14976	Farmer	L	Rural	Illiterate	1	1	LL		MB	N	SOF	TD	X, TU	X, TU	CH-U, G	CT, G	1,2,3,4	1,2,3,4	5,6,7,8	10,12	O		2	0
130	Mantesh Chidanand Mistri	32	M	I-15028	Contractor	UM	Urban	BA	0.6	0	BT		MB	N													0	0
131	Muttu Jadhav	28	M	O-160624	Labourer	L	Rural	5th	0.08	0	BT		MB	N													0	0
132	Santosh Topanna Rathod	26	M	O-165200	Labourer	L	Rural	4th	0.5	0.16	BT		MB	UT			X	X	CH-U, WS	G	1,2,3,4		5,7				2	0
133	Basappa Ullappa Mallabadi	35	M	I-15180	Farmer	UL	Rural	Illiterate	10	9	BT		MB	T	SOF	FD, TD	X	X, C, TU	CH-U, G	G, O	1,2,3,4	1,2,3,4	5,7,8	10,12			2	0
134	Subhash Bhimappa Kannur	45	F	I-15090	Farmer	UL	Rural	Illiterate	0.16	0.16	LL		MB	N	BF		X, O	X, O	G, AT, WS, O		1,2,3,4	1,2,3,4	5,6,7,8	10,12	M, CN, N, O		2	0
135	Masabee Pashasab Nadaf	65	F	O-216893	Labourer	L	Rural	Illiterate	40	40	LL		MB	T			X				1,2	1,2			CN		1	0
136	Kashipati Pattar	84	M	O-205410	Retired Government official	UM	Urban	Bsc	0.5	0	BT	Type 1	MB	N													0	0
137	Malanbee Maulasab Davalgi	45	F	O-235032	Farmer	UL	Rural	Illiterate	0.08	0.08	BT		MB	N			X	X	CH-U, G, WS		1,2,3,4	1,2,3,4	5,7				2	0
138	Chandrashekar Sharanappa Honalli	22	M	O-231279	Driver	LM	Rural	PUC2	0.04	0	Tuberculoid		PB	N													0	0
139	Subhash Konashirasagi	30	M	I-246296	Farmer	UL	Rural	7th	0.5	0.5	BL	Type 2	MB	N			X	X			1,2,3,4	1,2,3,4	7		M		1	0
140	Meenakshi Mallikarjun Mali	36	F	I-23530	Housewife	L	Rural	10th	1	0	BL	Type 1	MB	UT			X	X									0	0
141	Narsimha Balaswami Panaganti	22	M	O-170638	Labourer	L	Rural	Illiterate	1	1	LL		MB	N	SOF		X	X, TU	CH-U, M, G, AT	G	1,2,3,4	1,2,3,4	5,6,7				2	0
142	Sidappa Shekappa Kadur	37	M	O-20567	Driver	LM	Rural	PUC2	0.75	0.08	BT		MB	N			X, TU	X			1,2,3,4	1,2,3,4	7	10,12			2	0
143	Sidappa Parmanna Dalwai	45	M	O-200019	Labourer	L	Rural	Illiterate	0.33	0	BL	Type 1	MB	N			X	X									0	0
144	Manjunath Amateppa Chalawadi	24	M	O-272553	Painter	UL	Rural	PUC2	0.2	0.2	BT	Type 1	MB	N			X		CH-U, O			1,2,3,4		10,12			2	0
145	Devappa Yankappa Hunargi	52	M	I-25543	Farmer	UL	Rural	Illiterate	1.5	0	LL	Type 2	MB	UT			X	X									0	0
146	Siddanna Sajjan	45	M	O-281207	Farmer	UL	Rural	Illiterate	0.2	0.2	Pure Neural		PB	N					CH-U		1,2	1,2	5,7				2	0