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PREVALENCE OF DISEASES AMONG SELECT TRIBAL POPULATION OF RAJASTHAN: A FOCUS ON TYPE 2 DIABETES AND HYPERTENSION

Bandana Sachdev*

Abstract: *Objective: The present study is aimed to determine the prevalence of type 2 diabetes and hypertension among tribal population of Rajasthan. Methods: A pilot study, consisting of a total sample 310 participants comprising both non-tribals (44.2%) and tribal (55.8%) of age ≥18 years, was conducted. All participants live in different locations of Jhunjhunu district of Rajasthan. Blood glucose levels, blood pressure, height, weight, waist girth, and hip circumference were measured. Results: The crude prevalence of type 2 diabetes was 5.2% among tribal population and 0.7% in non–tribal subjects. Prevalence of pre-hypertension and hypertension was found to be 36.4% and 19.7% among tribals and 23.5% and 17.5% in non-tribal population. The risk for diabetes was equal in both tribesmen (3.0%) and tribeswomen (2.8%), while that for high blood pressure was higher among females (20.9%) as compared to males (15.8 %). The number of participants with BMI between 23-25 (for non-tribal) was 7.3 % and for >25 was 16.8%. Among the tribal population the percent participants with BMI between 23-25 was 19.7% and >25 was 15.0%. Females were found to have a higher BMI as compared to males in both the groups. Prevalence of liquor consumption was (57.6 %) among tribal population and 42.4 % in non-tribal category. Conclusion: The prevalence of prediabetes and diabetes in the tribal population was found to be higher than that in non-tribal population in Rajasthan.*

Conflicts of interest: None

INTRODUCTION

Widespread poverty, illiteracy and undernourishment, lack of sanitary conditions, safe drinking water, personal hygiene, poor maternal and child health services, and ineffective coverage by national health and nutritional services, are responsible for the poor health status. Tribal settlements tend to be small, isolated, and with no access to health facilities and services. Even when rural tribal people live in large villages, they may be segregated due to social pressures. Some tribal groups are nomadic and undertake seasonal migration seeking livelihood or employment discarding their traditional habitats to cities, and form large agglomerations.

An increasing trend in type 2 diabetes is common in developing nations especially the Southeast Asian countries.[1] Tribal or aboriginal populations show an accelerated increase of diabetes worldwide.[2] Very high prevalence of diabetes has been reported among the natives of America, Alaska, Canada and the aborigines of Australia.[3–6] These tribes

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and aborigines were also reported to have a high prevalence of metabolic syndrome.[3,4,7] Similar findings have also been reported among the tribal populations from northern Sudan,[8] United Arab Emirates[9] and Taiwan.[10] Very little information is available in the literature regarding the prevalence of diabetes among the different tribes living in Rajasthan. A study conducted in 2004, on Raica tribe by Agrawal et al, [11] reported a very low incidence (<0.5%) in this particular tribe. The group attributed this to consumption of camel milk which is believed to have some protective effect against diabetes. Keeping this in mind we studied the prevalence of diabetes and hypertension among different castes of tribal population covering Natt, Sapera and the Banjara communities and made a comparison with non-tribal population from the same geographical region.

METHODS

The present study was conducted during September to November 2009 in the Jhunjhunu district of Rajasthan, one of the 32 districts in this state. The initial information regarding tribal living conditions and life styles were obtained through elders of tribal community and other people living in and around the tribal habitations. Nearby villages with similar living environment were selected as control. The local villagers were used as interpreters, as required. The objectives and procedural details of the study were explained to the subjects in their local language. Each step of the investigation was demonstrated, e.g. interviewing, measuring height, weight, waist and hip circumference, checking blood pressure, and collecting blood samples following which only the consenting subjects were recruited for this study. The study was approved by the institutional human ethics committee at BITS, Pilani and performed according to the Declaration of Helsinki. All study members received detailed explanation of the study in their regional language before their written consent.

Diabetes Survey and Data Collection

A survey questionnaire was designed and finalized after a field trial. The variables included were age, gender, education, occupation, annual family income, family size, religion, and housing condition. Men and women ≥18 years of age were considered eligible except pregnant women, seriously ill subjects, and those who were on herbal medication or other drugs such as corticosteroids, oral contraceptive pills, etc. Informed consent was obtained from subjects who agreed to participate in the study. Each subject was asked to report at a selected investigation site after an overnight fasting for blood draw.

Each participant was interviewed to know about occupation, education, housing, sanitation, family income and number of members in the family. Their status of physical activities, family history of diabetes, hypertension, and other kinds of diseases was also taken into account. Other investigations included anthropometry, systolic and diastolic blood pressure, fasting plasma glucose and/or random plasma glucose test. Measurements of height, weight, and waist and hip circumference were taken

with light clothes and without shoes. The weighing tools were calibrated daily using known standard weights. For height, the subject stood in an erect posture vertically with the occiput, back, hip, and heels touching the wall behind while gazing horizontally in front and keeping the tragus and lateral orbital margin in the same horizontal plane. Waist circumference was measured at the belly button or just above it. Similarly, the hip circumference was measured at its widest part. Blood pressure was taken after a 10-min rest using a digital blood pressure monitor. Classification of hypertension was based on American Diabetes Association guidelines. Healthy blood pressure was taken to be ≤120/80, early high blood pressure was taken to be between 120/80 and 140/90 while blood pressure 140/90 or higher was considered to be hypertensive. For diabetes also the diagnostic criteria of the American Diabetes Association was used.[12]

RESULTS

The present study was carried out with 310 participants comprising of 173 tribal and 137 non tribals. Tribal population consisted of 91 females (mean age, 41.48±17.46) and 82 males (mean age, 35.67±16.19 and non-tribals consisted of 86 females (mean age, 55.80±14.69) and 51 males (mean age 63.27±11.68) respectively. Table 1 shows demographic, anthropometric and other clinical characteristics of both the tribal and non-tribal categories.

Table 1: Baseline characteristics of study participants

Variables	Tribal (N = 173)		Non-Tribal (N = 137)	
	Females N = 91	Males N = 82	Females N = 86	Males N = 51
Age (in yr)	41.48 ± 17.46	35.67 ± 16.19	55.80 ± 14.69	63.27 ± 11.68
Height (cm)	153.38 ± 7.53	164.11 ± 6.51	158.29 ±7.68	167.58 ± 10.2
Weight (Kg)	51.32 ± 10.79	56.77 ± 9.90	53.34 ± 12.8	54.62 ± 11.6
Hip Circumference (cm)	82.59 ±11.57	84.57 ±10.1	88.70 ±13.69	85.59 ±10.27
Waist Circumference (cm)	74.09 ±12.55	75.64 ±11.59	78.22 ±13.2	76.19 ±13.26
BMI (Kg/m^2)	21.79 ±4.44	21.19 ±3.23	21.30 ±4.93	19.41 ±3.46
SBP (mm/Hg)	126.46 ±21.42	126.15 ±15.66	123.80 ±18.11	119.58 ±16
DBP (mm/Hg)	81.27 ±13.23	80.40 ±10.71	81.01 ±12.6	75.58 ±12.6
Liquor Consumption (ml)	0.00	356.71±192.57	0.00	431.37±234.93
FBG levels (mg/dl)	109.55±36.31	104.44±30.61	103.38±16.66	107.73±15.86

Table 2 presents the prevalence of obesity and overweight among tribals and non-tribals. Among tribals prevalence of underweight, normal, overweight and obese individuals was 19.1%, 46.2%, 19.7% and 15.0 % respectively. There was nearly equal representation of underweight and overweight individuals among the tribals (19.7% vs. 19.1%).

Table 2: Prevalence of Obesity and Overweight among Tribal and Non tribal population

		Body Mass Index#				Total
		18 – 22.9 (Normal)	23 - 25 (Over weight)	over 25 (Obese)	below 18 (under weight)	
Population	Non-tribals	66 (48.2%)	10 (7.3%)	23 (16.8%)	38 (27.7%)	137
Gender	Male	30 (24.6%)	1 (3.7%)	5 (8.6%)	15 (14.1%)	51
	Female	36 (41.4%)	9 (6.3%)	18 (14.4%)	23 (23.9%)	86
Population	Tribals	80 (46.2%)	34 (19.7%)	26 (15.0%)	33 (19.1%)	173
Gender	Male	44 (53.7%)	16 (19.5%)	8 (9.8%)	14 (17.1%)	82
	Female	36 (39.6%)	18 (19.8%)	18 (19.8%)	19 (20.1%)	91

(Misra A, 2003)

Among non-tribal population prevalence of underweight, normal, overweight, and obese individuals were 27.7%, 48.2%, 7.3 % and 16.8 %. There were nearly equal number of obese individuals among the tribals and non-tribals i.e. 15.0% vs 16.8 % respectively, but there were more overweight individuals among tribal participants (19.7%) as compared to non-tribal participants (7.3%). Significant difference (χ^2 =10.936, p <0.012) in the distribution of BMI among tribal and non-tribal subjects was observed. It was found that a higher number of females were overweight in both tribal and non tribal population i.e. 6.3% and 19.8% as compared to males in both population i.e. 3.7% and 19.5%. Similarly higher numbers of obese females were observed i.e.14.4% and 19.8% respectively in both population as compared to males i.e. 8.6% and 9.8 %. Thus, a significant relation was observed between gender and body mass index. (Chi-square = 9.421, p<0.024).

Prevalence of hypertension among tribals and non tribals was analyzed according to ADA guidelines as shown in Table 3. In non-tribal population the prevalence of early high blood pressure and high blood pressure was 23.4% and 17.5%, whereas in tribal population the prevalence of early high blood pressure and high blood pressure was 36.4% and 19.7% and significant at χ^2= 7.925,p=0.019. Females were found to be at a marginally higher risk than males and the trend was similar in both the tribal and non tribal populations.

Table 3: Prevalence of hypertension among tribals and non-tribals in different sexes

		Blood pressure		
		Healthy blood pressure N (%)	**Early high blood pressure N (%)**	**High blood pressure N (%)**
Population	Non-tribal category (N =137)	81 (59.1%)	32 (23.4%)	24 (17.5%)
	Tribal category (N =173)	76 (43.9%)	63 (36.4%)	34 (19.7%)
Gender	Male (N =133)	68 (51.1%)	44 (33.1%)	21 (15.8%)
	Female (N =177)	89 (50.3%)	51 (28.8%)	37 (20.9%)

Linear regression was carried out to identify the correlation between age and systolic blood pressure. A positive relationship (r=0.199) was observed between systolic blood pressure and age. Based on the t-value (3.511) and p-value (0.001), we can conclude that this relationship is statistically significant (Fig-1).

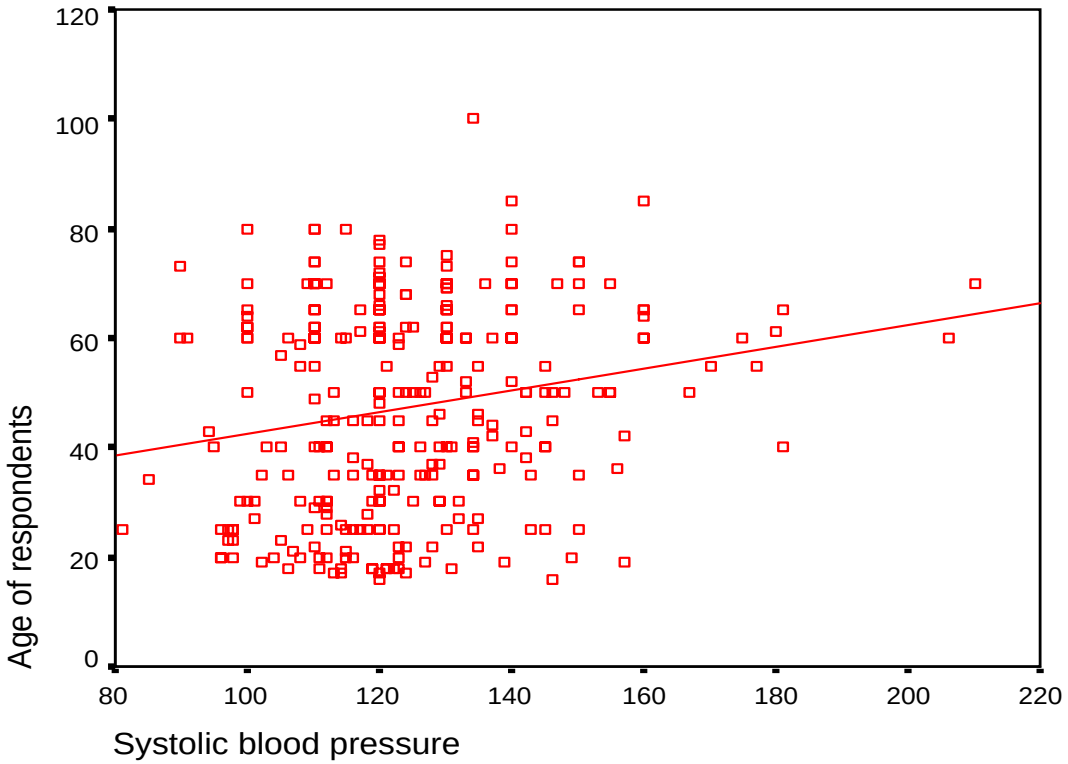

Fig 1: Correlation between age of respondents and systolic blood pressure among tribals and non-tribals

As can be seen from Table 4 the prevalence of pre diabetes and diabetes in tribals was 5.2% and 5.8% respectively. The prevalence of pre diabetes and diabetes in non-tribals was 0.7% and 3.6% respectively. Chi-square was calculated between tribal and non tribal group and it was found to be statistically significant $\chi^2 = 5.821, p < 0.05$.

Table 4 also presents the prevalence of pre diabetes and diabetes according to gender among tribals and non tribals. It was found that there was equal representation of both pre diabetes and diabetes test in both sexes. (Males vs. Females chi-square =.316, p=.854). Correlation analysis was calculated to find out the positive relationship between increasing age and prevalence of pre diabetes and diabetes among tribal and non-tribal population. There was found a strong positive correlation between the age of respondents and prevalence of T2DM disease. (r = .115, p= .044). (Fig-2)

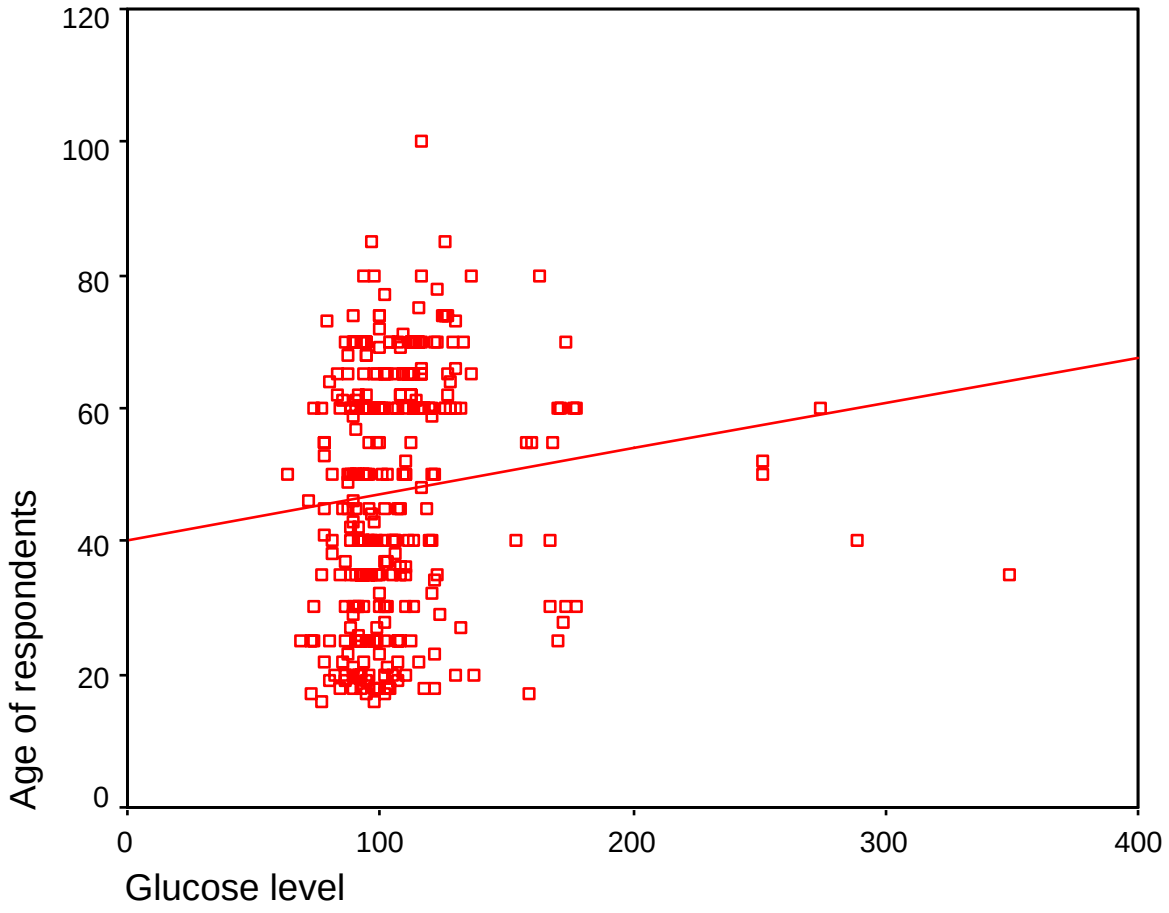

Fig 2: Corretation between age of respondents and Glucose level among tribals and non tribals

Table 4: Prevalence of pre-diabetes (risk zone) and diabetes among tribal and non tribal population

		Random Blood Glucose test		
		Negative< 200 mg/dl N (%)	**Positive > 200 mg/dl N (%)**	**At risk zone (>140, <200 mg/dl) N (%)**
Population	Non-tribal category (N = 137)	131 (95.6%)	1 (.7%)	5 (3.6%)
	Tribal category (N =173)	154 (89.0%)	9 (5.2%)	10 (5.8%)
Gender	Male (N= 133)	122 (91.7%)	4 (3.0%)	7 (5.3%)
	Female (N=177)	164 (92.7%)	5 (2.8%)	8 (4.5%)

The prevalence of liquor consumption among tribal and non-tribal population was found to differ with tribal males consuming more liquor (57.6%) as compared to non-tribal males (42.4%).

DISCUSSION

The prevalence of diabetes is rising all over the globe at an alarming rate.[13] Over the past 30 years, the status of diabetes has changed from being considered a mild disorder of the elderly to one of the major causes of morbidity and mortality affecting the youth and the middle aged.[14] The major driver of the epidemic is the more common form of diabetes namely type 2 diabetes, which accounts for more than 90% of all diabetic cases. India leads the world with largest number of diabetic subjects thus earning it the dubious distinction of being termed the "Diabetes capital of the world". According to the Diabetes Atlas 2006 published by the International Diabetes Federation, the number of people with diabetes in India is currently around 40 million and this number is expected to rise to 70 million by 2025, unless urgent preventive steps are taken.[15] The so called "Asian Indian Phenotype" refers to certain unique clinical and biochemical abnormalities among Indians which include increased insulin resistance, greater abdominal adiposity i.e., higher waist circumference despite lower body mass index, lower adiponectin and higher C-reactive protein levels.[16] This phenotype makes Asian Indians more prone to diabetes and premature coronary artery disease.[17] Our study addressed the prevalence of prediabetes, diabetes prehypertension and hypertension among the indigenous tribal and non-tribal population in Rajasthan. The prevalence of prediabetes (5.8%), diabetes, (5.2%), prehypertension (36.4%) and hypertension (19.7%) among tribal

population observed in this study is comparable to the prevalence found in Alaskan Natives,[5] Canadian Saskatchewan First Nations,[6] Danagla community of Sudan[8] and those of Bedouin origin in the Arab Emirates.[9] The incidence of prediabetes, diabetes and hypertension was higher in the tribal than the non- tribal population owing to stressful living in a disowned territory and adoption of significant lifestyle changes different from ancestral indigenous lifestyle.

It is noteworthy that tribal ancestral lifestyle was dependent on hunting and gathering food together with cultivation of limited food crops. They have now been forced to adopt a lifestyle based on cultivation of different crops, low-wage livelihoods in business, service, and other mixed occupations like labor etc. Among the investigated risk factors, increasing age, general obesity (BMI), and consumption of liquor were found to have a higher contribution to risk for developing diabetes and hypertension. These findings are consistent with other tribal and non tribal populations.[5–9,18,19] The prevalence of diabetes varies considerably throughout the world. In different parts of India, the prevalence has been reported to vary between 2.4%[20] and 4.9%[21] for rural areas and 3.2%[22] and 15.4%[23] for urban areas. However, these studies used different diagnostic criteria for arriving at their conclusions. Sayeed *et al.*[24] found a prevalence of 4.3% in rural Bangladesh based on the 1997 American Diabetes Association diagnostic criteria. Our study showed a higher prevalence as compared to other studies from rural India. With growing urbanization and sedentary lifestyle tribal population are also residing in and around villages and have adopted a lifestyle similar to them, and for that reason they have similar prevalence as rural population as shown in other studies.

The results of our screening suggest that large scale epidemiological studies be undertaken to ascertain the causes of the rising T2DM epidemic, for either stopping or possibly even reversing this trend by concerted preventive measures through public health policy and active support of all concerned stakeholders.

CONCLUSION

The present study revealed that the prevalence of prediabetes, diabetes, pre-hypertension and hypertension among the tribes is high. Increased BMl and obesity were identified as independent risk factors. Advancing age and liquor consumption might play associated role in the development of T2DM and hypertension. It may be predicted that prevalence of diabetes and its complications will continue to increase because there is lack of access to diabetes care and education among these communities. Based on the study results, we expect that health care planners and professionals may develop strategies to make diabetes care accessible to the tribal populations.

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LONG-LASTING INSECTICIDAL NETS, AN APPROPRIATE TECHNOLOGY FOR MALARIA VECTOR CONTROL IN TRIBAL INDIA

Vas Dev*

Abstract: *Malaria is endemic in India and despite decades of attempted vector control using insecticide residual spraying, malaria transmission remained uninterrupted in many parts of the country. The advent of long–lasting insecticidal net (popularly known as LLIN) has revolutionized the concept of insect disease vector control. LLIN is ready-to-use factory treated mosquito net that is wash-resistant and retain residual bio-efficacy against the target insect vector species for 4–5 years (the expected life span of net). LLIN employs pyrethroid, a class of insecticide, that have been recommended for use in public health for having relatively low toxicity to humans, rapid knock-down effect, extended longevity of residual effect and comparative low costs. This technology has been field evaluated against malaria vectors in India and proven to be an evidence-based intervention which not only deterred entry of mosquito vector species into houses but also served as personal guard against infective mosquito bites disrupting malaria transmission. It has been held the most appropriate technology in outreach marginalized population groups living in remote inaccessible/ forest fringe pockets reporting most cases and deaths. This technology is assessed to be operationally feasible, community-based and sustainable, and being advocated as the key intervention for universal coverage against malaria. LLINs are increasingly popular for which community compliance and acceptance is high and forthcoming. Mass distribution of LLIN distribution is strongly advocated prioritizing high-risk population groups by innovative strategies including indigenous production, social marketing, promoting partnership between government, NGOs, donors and the corporate sector for making LLIN an affordable commodity to combat malaria illness and preventing spread of drug-resistant malaria*

Keywords: Malaria, mosquito, vector control, long-lasting insecticidal net, residual bio-efficacy

Conflict of Interest: None declared

Malaria in India is complex and evolved infectious disease characterized by diverse ecology and multiple disease vectors. [1] Nearly 88% of population is estimated to be living at risk of malaria, but disease is unevenly distributed with large concentration of cases (80%) in just 20% of the population living in tribal belts, hilly, difficult and inaccessible pockets.[2] In 2013, the National Vector Borne Disease Control Programme reported 0.83 million microscopically confirmed cases of which nearly 50% were *Plasmodium falciparum* and remaining were *P. vivax*. There are 6 major mosquito vector species in India, i.e., *Anopheles culicifacies, An. fluviatilis, An. minimus, An. dirus, An. sundaicus* and *An. stephensi* which exhibit varied

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insecticide susceptibility status.[3] For vector control, indoor residual spraying (IRS) is the main stay but despite its over 50 years of operation, malaria remains major public health problem in many parts of the country. It is becoming increasingly less effective on account of insecticide resistance and operationally difficult proposition due to poor community acceptance and coverage (<50% of the target population). This has necessitated the vector control programme managers to evaluate new efficacious interventions which are cost effective, community-based and sustainable. Long–lasting insecticidal net (popularly known as LLIN) is one such technology that has revolutionized the concept of vector control and is being advocated by WHO as cost-effective and sustainable intervention against malaria.[4] This article is for general information on this new technology proving answers to some frequently asked questions for benefit of researcher, programme/ policy managers and end users.

What is long-lasting insecticidal net?

Long-lasting insecticidal net (LLIN) is ready-to-use factory treated mosquito net which do not require re-treatment for 4–5 years, the expected life span of net. [5,6] Insecticide (pyrethroid) is either coated around polyester netting fiber (type–1) or incorporated into polyethylene polymer before fiber extrusion (type–2). These nets can be washed many times and still retain bio-efficacy against target disease vector species. The efficacy of these LLINs is expressed in terms of wash-resistance for maintaining sufficient insecticide concentration for = 95% knockdown and =80% mortality of target mosquito vector species for at least 20 serial washings under laboratory and 3 years of continuous use under field conditions without re-treatment. In type-1 LLIN, insecticide is generally mixed in resin coating fibre, and in type–2 insecticide migrates to the surface of the fibre in concentration sufficient to be active against target mosquito vector species. In both types of LLINs, adequate insecticide is available on net fibre at any given point of time to provide expected bio-efficacy during the life span of net despite repeated washings. All LLINs employ pyrethroid, a class of insecticides, viz., deltamethrin, alpha-cypermethrin, permethrin, which have been recommended for use in public health for having relatively low toxicity to humans, rapid knock-down effect, extended longevity of residual effect and comparative low costs. Pyrethroids are neurotoxic compounds and have multiple modes of action against the mosquito vectors/ insect pests. They open the sodium channels resulting in continuous nerve excitation, paralysis and death of the mosquito. They also have an irritant effect resulting in hyperactivity, rapid knock-down effect, feeding inhibition and shorter landing period; all of which help reduce mosquito vector population density and infective bites.

Why do we need long-lasting insecticidal net?

For decades of attempted vector control using insecticide residual spraying, malaria transmission remained uninterrupted in many parts of the country. *P. falciparum* (the deadly parasite) proportion are rising and estimated disease burden is manifold than reported.[7,8] Among alternative approaches to residual spraying, village

scale field trials with insecticide-treated nets (ITNs) in malaria endemic states were runaway success in reducing malaria transmission.[9,10] Community acceptance was high and the beneficiaries preferred ITNs in lieu of indoor residual spraying.[11,12] ITNs were proven to avert 50% of malaria episodes within one year of usage and their protective efficacy was held significantly higher than conventionally used untreated nets. However, these nets need to be re-impregnated manually every six-months, but re-treatment rates remained <5% in the target coverage areas owing to operational constraints including difficult terrain, incessant rains and recurrent floods limiting access to outreach population groups.[5] This limitation has now been overcome by advent of long-lasting insecticidal net obviating the need for re-treatment exercises of the community-owned mosquito nets optimizing much needed community compliance. The ITNs and LLINs look physically alike but LLINs is the one that ensure long-term protection against malaria transmitting mosquitoes. Use of LLIN is a well-tested intervention for disease vector control in many countries with considerable success and is being promoted for being advantageous over indoor residual sprays and existing community-owned mosquito net/ insecticide-treated nets that require periodic repeated impregnations. It has been documented that modest coverage with LLINs (>60% of population) accord community mass effect including all those who do not sleep under net.[13]

Long-lasting insecticidal nets recommended by WHO

Varieties of long-lasting insecticidal nets (all employing pyrethorid) are in the offing which has been given either full or interim recommendation under WHO Pesticide Evaluation Scheme (Table 1). The World Health Organization regularly provides technical information update on the subject for procurement and quality control.[14] These include both polyester LLINs (type–1) and polyethylene LLINs (type–2), and very recently a third category of mosaic LLINs, i.e., combination of both these technologies and/or different insecticides, viz., PermaNet® 3 and Olyset® plus, have been introduced/granted interim recommendation to overcome reported insecticide resistance in some disease vectors.[15,16] LLINs are being strongly advocated by the World Health Organization for effective vector control and are increasingly in demand for use in health systems to target high-risk population groups. LLINs for use in India must be field evaluated for bio-efficacy in different geographical areas and registered by the Central Insecticide Board as prerequisite requirement for large scale procurement. The National Vector Borne Disease Control Programme (NVBDCP) of government of India has developed technical specification and detailed action plan for procurement, storage, transportation, distribution, monitoring and evaluation, and quality control for benefit of state health services. [17]

Table 1: WHO recommended long-lasting insecticidal mosquito nets

Product name	Product type	Status of WHO recommendation
DawaPlus® 2.0	Deltamethrin coated on polyester	Interim
Duranet®	Alpha-cypermethrin incorporated into polyethylene	Interim
Interceptor®	Alpha-cypermethrin coated on polyester	Full
LifeNet®	Deltamethrin incorporated into polyethylene	Interim
MAGNet™	Alpha-cypermethrin incorporated into polyethylene	Interim
Netprotect®	Deltamethrin incorporated into polyethylene	Interim
Olyset®	Permethrin incorporated into polyethylene	Full
Olyset® Plus	Permethrin and PBO incorporated into polyethylene	Interim
PermaNet® 2.0	Deltamethrin coated on polyester	Full
PermaNet® 2.5	Deltamethrin coated on polyester with strengthened border	Interim
PermaNet® 3.0	Combination of deltamethrin coated on polyester with strengthened border (side panels) and deltamethrin and PBO incorporated into polyethylene (roof)	Interim
Royal Sentry®	Alpha-cypermethrin incorporated into polyethylene	Interim
Yorkool® LN	Deltamethrin coated on polyester	Full

Source: Report of the WHO Pesticide Evaluation Scheme (WHOPES) update of May 2013 (http://www.who.int/whopes/).

Monitoring residual efficacy of long-lasting insecticidal net

Long-lasting insecticidal nets are assessed by the WHO Pesticide Evaluation Scheme (WHOPES) through fully standardized washing and testing procedures for effective life duration under different ecological conditions. [18,19] Many of these products have been accorded interim or full recommendation by WHOPES were subjected to field evaluation in India against different disease vectors for extended residual efficacy, impact on malaria transmission and community acceptance for research based data under different ecological conditions.[20] Among these, Olyset® net that are made of high-density polyethylene monofilament yarn with 2% w/w permethrin incorporated (corresponding to 1g/m^2) and Duranet®, alpha-cypermethrin incorporated into polyethylene (type-2 LLINs), Interceptor® net, alpha-cypermethrin coated polyester netting and PermaNet® 2.0, deltamethrin coated on polyester (type–1LLINs) were

subject to field evaluation in different malaria endemic states including Assam, Odisha, Chhattisgarh and Uttar Pradesh.[21–26] These LLINs were proven to be effective intervention tool for the given criteria, e.g., Olyset® net were observed to be wash-resistant up to 20th serial washings done at fortnightly interval (Figure 1), and for retention of residual bio-efficacy (= 80%) for over three years

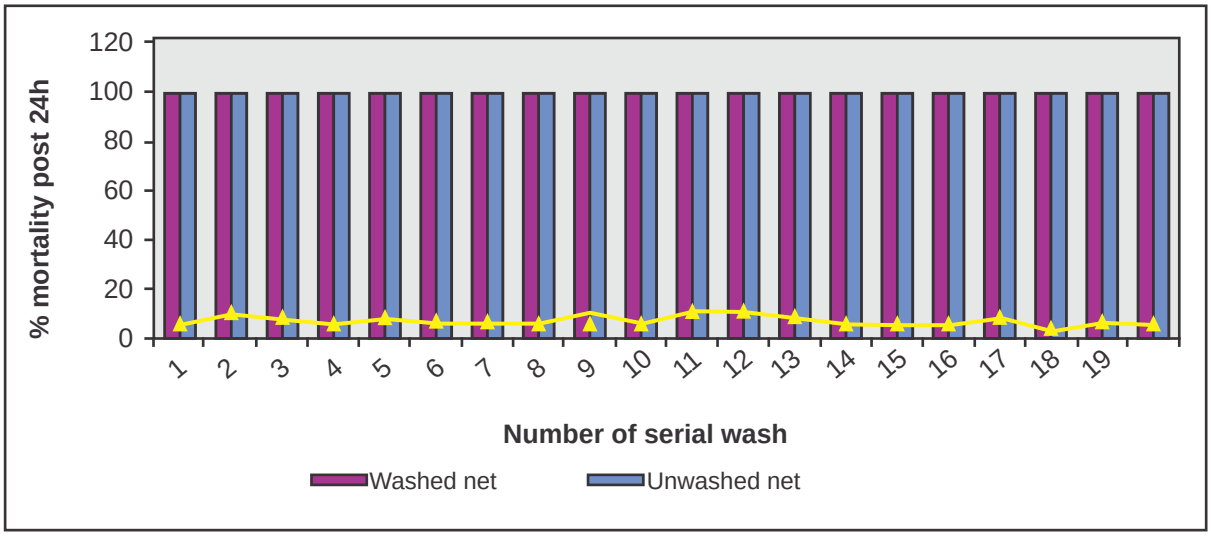

Figure 1: Wash-resistance of Olyset® net expressed in terms of per cent mortality of *Anopheles minimus* group of mosquito vector species monitored by bioassay test cone method post 3 minutes exposure and 24 hour recovery period in laboratory conditions subjected to serial washing at fortnightly intervals.

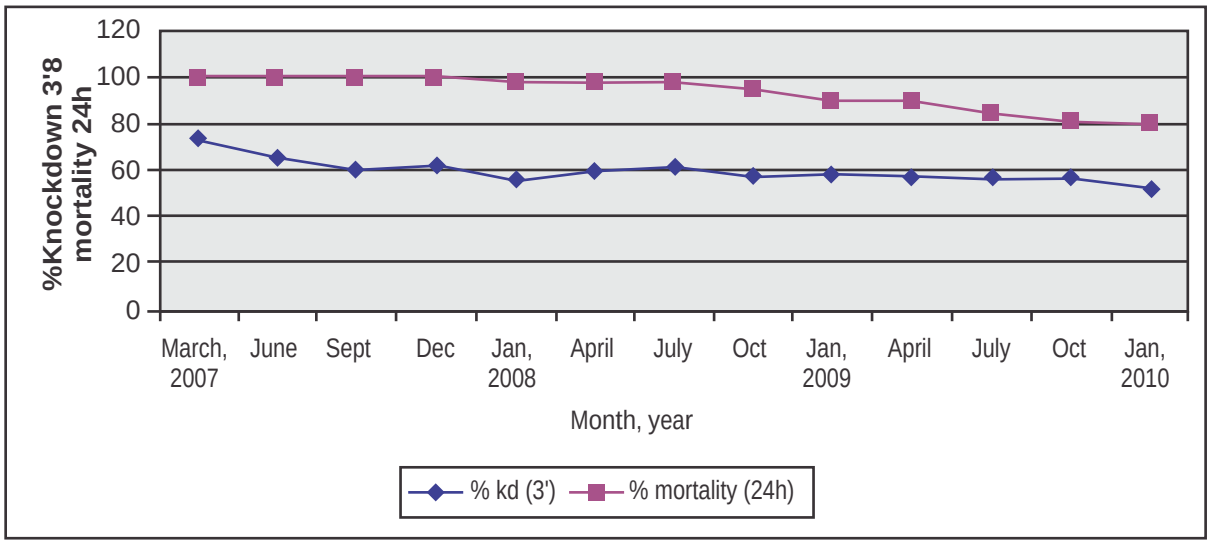

Figure 2: Residual bio-efficacy of field distributed Olyset® net in use by the communities expressed in terms of per cent knockdown (kd) of *Anopheles minimus* group of mosquito vector species monitored by bioassay test cone method post 3 minutes exposure and mortality 24 hours recovery for the study period from March 2007–January 2010.

(2007–2010) of continuous use in field conditions against *An. minimus* transmitted malaria in Assam, northeast India (Figure 2). Research findings were reported to be similar in field distributed Interceptor® net, PermaNet® 2.0, and Duranet® LLINs[20]. All these LLINs were assessed to be operationally feasible and user friendly for which community compliance and acceptance were high and forthcoming.

Impact on mosquito vector density & malaria transmission

Monitoring and evaluation of field distributed LLINs is an integral component of the national control programme. Extended follow up study on mosquito vector density in LLIN beneficiary villages in Assam revealed that even though there was gradual depletion of insecticide subjected to continuous use and washings by the communities in real life situations, *An. minimus* mosquito vector species had virtually disappeared in Olyset® net (type-2) intervention villages (Figure 3); the observations that were corroborated by data on human bait mosquito-landing catches (data not shown). It was revealing that LLIN based intervention not only deterred entry of mosquito vector species but also served as personal guard against infective mosquito bites. Similar experiences were observed in field distributed alpha-cypermethrin coated polyester netting Interceptor® net (type-1) beneficiary villages. Thus both types of LLINs (type 1 & 2) were proven to be and evidence-based intervention between human host and the mosquito vector disrupting malaria transmission.

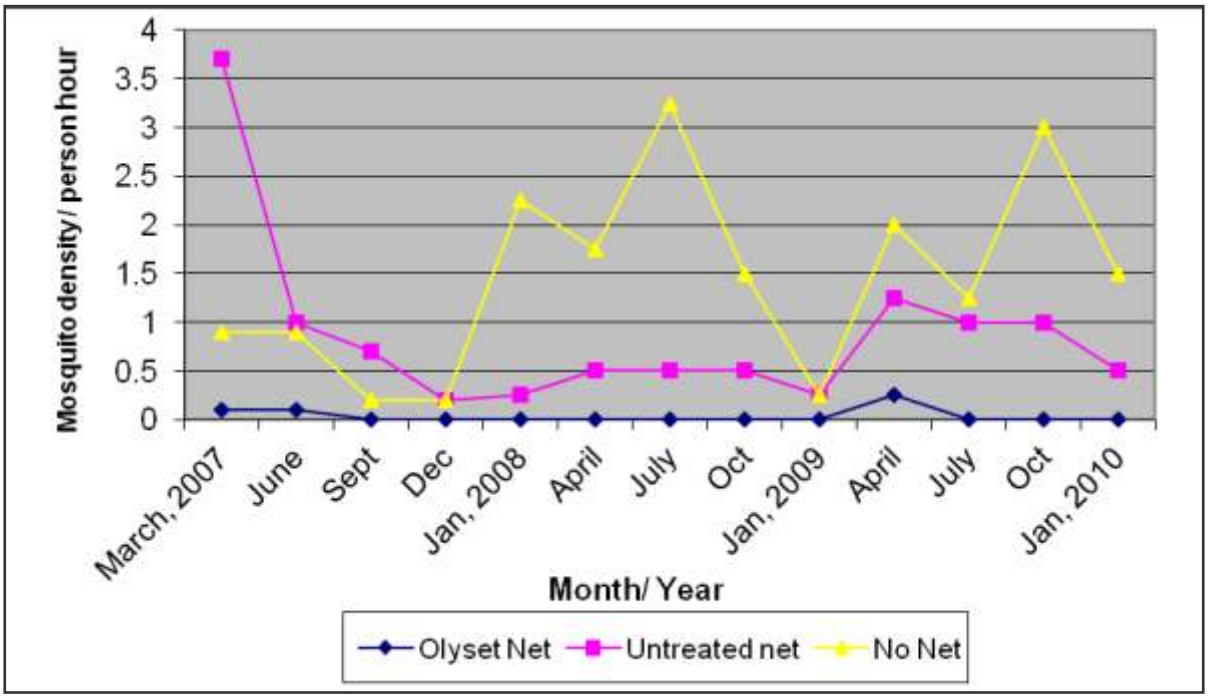

Figure 3: Relative abundance of *Anopheles minimus* mosquito vector species per person hour in experimental study area including Olyset net users, untreated net intervention and without net control villages of the Sonapur Primary Health Centre of Kamrup district of Assam during the follow up study period March 2007–January 2010.

There was consistent decline in malaria incidence in LLIN intervention villages, and overall impact on malaria transmission reduction was significant compared to untreated net and no-net control villages for the corresponding study period. Results have been promising and communities across India preferred LLINs over residual spraying operations[22–25]. Similar experiences have been recorded in other malaria endemic countries.[27–29] Based on these research findings, LLIN based intervention has been accepted by the Technical Advisory Committee, and the National Vector Borne Disease Control Programme has embarked upon large scale distribution of LLINs prioritizing high-risk population in malaria endemic states/districts (http://www.nvbdcp.gov.in/).

Social acceptability and durability of field distributed LLINs

Social acceptability, durability and community compliance of distributed LLINs are critical and vital issues for success of the control programme. A questionnaire based cross-sectional community surveys were conducted for LLIN usage practices in the beneficiary villages during different seasons. It was observed that householders were fully aware of benefit of using LLIN as personal protection method and compliance of net usage was 100% of the individuals surveyed (Table 2). In initial surveys conducted in December 2005 for Olyset LLIN users, 3.3% (9/270) respondents reported mild skin itch lasting for first few days. However, in subsequent surveys conducted during November 2008 and May 2009, none of beneficiaries reported any adverse event. All surveys combined, 89–94 per cent of users reported reduction in mosquito bites, and most householders (80–100 %) recommended the use of long-lasting insecticidal net as personal guard against malaria and other pest insects, e.g., bedbugs, head lice. These LLINs were also subject to examination for physical condition of net in use by the householder initially distributed in August 2005. In November 2008 (after three years of distribution), it was observed that 402/435 (92.4%) were still in good condition, 17/435 (3.9%) were partially damaged characterized by stitching of holes, and 16/435 (3.7%) were categorized unusable with multiple large holes that remained unstitched. In May 2009 (after nearly four years of distribution), nets were subject to yet another physical inspection at random for the extent of damage due to use, and it was observed that there was apparent increase in number of nets that were partially damaged (31.2%) and those rendered unusable (8.8%), but inhabitants were still in possession and using. Thus, Olyset LLIN besides retaining protective bio-efficacy for >3 years, were observed to be durable in field conditions for nearly 4 years. Similar experiences were recorded in Interceptor LLIN (polyester net) beneficiary population groups except for relatively higher proportions of respondents (81/225) reporting transient tingling skin reaction for first few months of usage, but all nets inspected (125/125) were observed with one or two holes after 3 years of usage.

Table 2: Cross-sectional community response surveys among Olyset® net users in experimental villages of the Sonapur Primary Health Centre, Kamrup District, Assam

S.No.	Question	% Users* (N = 217)	% Users** (N = 197)
1.	**Are you familiar of the benefit of using mosquito nets**	100	100
2.	**Are you using any other indigenous method for Mosquito control**	No	No
3.	**Do you sleep inside the Olyset® net**	100	100
4.	***Did you suffer any of the following***		
	Skin irritation	0	0
	Nausea	0	0
	Vomiting	0	0
	Itching	0	0
	Headache	0	0
	Drowsiness	0	0
	Eye irritation	0	0
	Difficulty in breathing	0	0
	Any other	0	0
5.	***Observations/ perceptions using LLINs***		
	Reduction in mosquito bites	89	94
	Reduction in nuisance due to bedbugs	0	0
	Reduction in nuisance due to head lice	1	0
	Reduction in nuisance due to body lice	0	0
6.	***Do you recommend use of LLIN in future***	100	80
7.	***Physical condition of net***		
	Good	92.4 (402/435)	60(198/330)
	Partially damaged	3.9(17/435)	31.2(103/ 330)
	Unusable	3.7(16/435)	8.8(29/330)
8.	***Washing frequency***		
	Monthly	No data	8.18(27/330)
	Quarterly	No data	77.88(257/330)
	Half yearly	No data	13.03(43/330)
	Annually	No data	0.91(3/330)

First survey conducted in November 2008; ** second survey in May 2009; N = number of respondents

Up-scaling of LLINs distribution & future challenges

India has about a billion population at risk of malaria and accounts for the highest disease burden in the Southeast Asia for estimated loss of disability adjusted life years.[1,2] Malaria transmission is complex due to multi-species co-existence and variable species dominance and bionomical characteristics. [30] For results based in India and other malaria endemic countries, it has been is clearly demonstrated that LLINs is an effective intervention against disease vectors and is assessed to be community-based, feasible and sustainable strategy. Long-lasting insecticidal net has been identified as key intervention world over and strongly endorsed by WHO for universal

coverage at no costs to end users. Accordingly, the National Vector Borne Disease Control Programme (NVBDCP) of Government of India aims at scaling up use of LLINs to achieve maximal utilization by populations living in high-risk areas of malaria receptivity.[31] It is projected that LLIN would replace residual spray operations and conventionally treated net, and would be common household commodity for personal protection in years ahead. It has been held the most appropriate technology in outreach marginalized population groups living in remote inaccessible/ forest fringe pockets reporting most cases and deaths.

In LLIN beneficiary population groups, disease transmission trends are declining (formerly intractable high-risk areas); hence it is the right time to sieze the opportunity for up scaling LLIN based intervention coupled with appropriate drug policy in place to combat the malaria illness and preventing spread of drug-resistant malaria.[32] The national vector borne disease control programme is, however, faced with emerging challenges including (i) multiple insecticide resistance against target disease vector mosquito species, (ii) emerging multi-drug resistance and steadily rising proportions of *P. falciparum* to nearly 50% of reported cases, (iii) short supply of antimalarial drugs and insecticides resulting in continued transmission in many areas. It is worrisome that *An. culicifacies*, the major mosquito vector species transmitting >60% of malaria cases in India, is reportedly multi-resistant in certain pockets and fast invading new territories making a malaria control a complex enterprise.[33.34] The advent of mosaic nets, e.g., PermaNet® 3.0, Olyset® Plus combining mix of different technologies incorporating synergists viz., piperonyl butoxide (PBO) is one such new innovation which offers to overcome insecticide resistance menace.[15,16] However, there is scope for research in new insecticides which are more potent and longer lasting to meet the emerging pyrethroid resistance.[35]

LLINs are increasingly popular and widely accepted by the communities for personal protection against mosquito bites/ insect pests. Up-scaling of LLIN distribution is the need of hour by innovative strategies including indigenous production, social marketing, promoting partnership between government, NGOs, donors and the corporate sector to make LLIN an affordable commodity by reducing taxes and tariffs.[36] The success of this intervention would rest on political commitment for increased allocation of resources for sustained supply of LLINs, making provision for monitoring residual efficacy and replacing those worn out ensuing equitable access to quality healthcare in poorest of the poor and vulnerable population groups including pregnant mothers and children. In moving forward for achieving ambitious goal of malaria pre-elimination in feasible districts/states, the future priority area must include developing malaria-risk maps for focused interventions, monitoring insecticide resistance, cross-border initiative with neighboring countries for data sharing and coordinated control efforts, strengthening health systems for improved surveillance and monitoring, and universal access to malaria treatment and prevention which would help meeting the Millennium Development Goal in reducing malaria morbidity and mortality by 2015.[37]

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USE OF MID UPPER-ARM CIRCUMFERENCE-OF-AGE AS A SCREENING MEASURE OF WASTING: A CASE OF UNDERNUTRITION AMONG KARBI TRIBAL CHILDREN (1-5 YEARS) OF ASSAM, NORTHEAST INDIA

Nitish Mondal* and Lota Engtipi[*]

Abstract: *The prevalence of childhood undernutrition is considered a significant determinant of adverse health effect in children who survive to adulthood. The objectives of the present study were to assess the prevalence of undernutrition based on MUAC and to compare the prevalence of undernutrition trends among tribal Karbi children of Northeast India. The present community based cross-sectional study was carried out among Karbi children aged 1-5 years of Karbi Anglong district of Assam. A total of 809 children (425 boys; 384 girls) were selected using a multistage stratified random sampling method. Anthropometric measurement of MUAC was obtained following standard procedure. The prevalence of undernutritionl status was assessed by computing age-and sex-specific z-scores by comparing with the WHO reference population of the same age and sex, using WHO Anthro (version 3.2.2.). Children with a z-score value <–3SD and <–2 SD from the reference were considered to be severely and moderately undernourished respectively. The overall prevalence of wasting was found to be 33.18% and 32.29% among boys and girls respectively (p>0.01). The sex-specific overall moderate prevalence of wasting was found insignificantly (p>0.05) greater among girls (19.27%) than boys (18.82%), but severe wasting was greater among boys (15.35%) than girls (13.02%). The severity of the undernutrition related to the public health using conventional anthropometric index of MUAC showed very high wasting >15.00% among Indian children. There is urgent need for nutritional intervention to addressed the public health problem especially undernutrition among children.*

Key Words: Undernutrition, wasting, Karbi, MUAC, Tribe, Assam,

Disclaimers: Authors have not any conflict of interest

INTRODUCTION

Nutritional status of individuals or population is now recognized to be a prime indicator of the health status, where assessment plays significant role by identifying vulnerable segments of the population. The prevalence of childhood undernutrition is considered to be a significant determinant of adverse health effect in children who survive to adulthood.[1] It is one of the principal causes of ill-health condition and premature mortality and morbidity among children.[2] Ironically, despite of economic development, India continues to have greater prevalence of undernutrition in infants and children.[2-11]

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The anthropometry is still remains single most universally applicable, non-invasive and inexpensive technique to assess nutritional status particularly in epidemiological and clinical investigations.[1] Several conventional anthropometric measures and indices {e.g., low-body mass index-for-age, mid-upper arm circumference (MUAC)-for-age, height-for-age, weight-for-height, weight-for-age} have been extensively utilised to assess the child undernutrition.[1-2] Moreover, these conventional anthropometric measurements are generally overlapping in nature and markedly underestimate the actual magnitude of undernutrition[2,10], but reflecting distinct biological processes of human life and their usages are very important for determining appropriate nutritional intervention programme.[1,2,9,10]

The MUAC is considered as an inexpensive, non-invasive and quick tool for assessment of undernutrition suitable for community and clinical investigations. The main advantage of MUAC is its simplicity, particularly for screening children in emergency situations. Recently, the World Health Organization (WHO) has developed age-and sex-specific MUAC cut-offs to determine the prevalence of undernutrition.[1,12,13] Several community investigations have already reported the prevalence of undernutrition in children (0-5 years) using MUAC among non-Indian[14-18] and Indian populations.[11,19-27] It is also noted that the comparison with standard anth-ropometric measures (e.g., height-for-age and weight- for-age), the MUAC is a more reliable and low-cost indicator to determine undernutrition and also associate with morbidities in the community and clinical trials. [1,3,12,16, 28, 29] Given its large population size and widespread poverty, a majority of the individuals are undernourished in India.[2,6,8,9] The assessment of their nutritional status thus assumes an immediate priority and is a daunting task for any researcher focusing in epidemiological or clinical investigations. The objectives of the present study wee to assess the prevalence of undernutrition based on MUAC and also to compare the prevalence of undernutrition trends among tribal Karbi children (aged 1-5 years) of Northeast India.

MATERIAL AND METHOD

The present community based cross-sectional study was carried out among Karbi children aged 1-5 years of Karbi Anglong district ($25^0$33' N to $26^0$35' N latitude and $92^0$10' E to $93^0$50' E longitude) of Assam, Northeast India. The district is the largest district amongst the 27 districts of Assam and covers an area of 10,434 km^2. According to the National Census of 2011, the district had a population of 9,65,280 individuals (4,93,482 males; 4,71,798 females) with an average literary rate of 49.52% (56.82% males; 43.18% females). A total of 5 Karbi dominated villages situated ~ 120 km from district town Diphu of Karbi Anglong, were included in the present study. Ethnically, the Karbis are belongs to the Mongoloid group and linguistically belonging to the Tibeto-Burman speaking population.[30] A total of 809 children (425 boys; 384 girls) were selected using a

multistage stratified random sampling method. The data was collected during the period from October 2011 to September 2012. Special care was taken so that each category (sex/age) had a minimum of 60 children. The necessary permissions were taken from the local village authorities' prior to collect the data. The data was collected visiting the households of the children employing structured schedules. The study objectives were explained and a verbal consent was taken from the parents prior to obtain the anthropometric data and the study was conducted in accordance with the ethical guidelines for human experiments as laid down in the Helsinki Declaration.[31]

Anthropometric measurements recorded

Anthropometric measurement of MUAC was obtained following the standard procedure.[32] The MUAC was taken at the point midway between the acromion and the radiale of the upper-arm using a plastic coated non-stretchable measuring tape on the left side of each subject to the nearest 0.10 cm. All the selected children were free from any physical deformities and not suffering from any diseases at the time of data collection. The intra-observer and inter-observer technical error measurement {TEM=v (? D^2/2N), D = difference between the measurements, N= number of individuals measured}differences were calculated for testing the co-efficient of reliability [R= {1-(TEM)^2/SD^2}, the SD= standard deviation of all measurements] of the obtained anthropometric measurements using standard procedures.[33] To determine the accuracy of the measurements using TEM, the MUAC were recorded from 50 children. Very high values of R (>0.975) were obtained for both inter-and intra-observer TEM analysis and thus, these values were found within the suggested cut-off level (TEM >0.95) as suggested by Ulijaszek and Kerr.[33]

Assessment of nutritional status

The assessment of undernutrition was done in terms of wasting using MUAC-for-age. The WHO recommended the use of z-score or standard deviation to classification for assessing the undernutrition was used.[1,34] The prevalence of undernutrition status was assessed by computing age- and sex-specific z-scores by comparing with the WHO reference population of the same age and sex, using WHO Anthro (version 3.2.2).[34] The severity of undernutrition was subsequently assessed in the present study by utilizing the z-score to the classification.[35] A child with a z-score value below –3SD and –2 SD from the reference were considered to be severely and moderately undernourished respectively. The interpretation of the index involves a comparison with international reference population to determine the undernutrition status as recommended by the WHO.[1] The proposed classification was used to identify the severity of public health problem of undernutrition (e.g., wasting) based on the percentages among the children as follows: Low: <5.00%; Medium: 5.00-9.00%; High: 10.00-14.00%; Very High: =15.00%.

Statistical analysis

The statistical analysis was carried out using the Statistical Package for Social Sciences (SPSS) (version 16.0). Descriptive statistics (mean and standard deviation) of MUAC and age specific z-score of MUAC were obtained for both sexes. Age and sex specific difference in mean MUAC and age specific mean z-score of MUAC were assessed using One-way analysis of variance (ANOVA). The Chi-square (χ^2) analysis was utilized to assess the differences in the nutritional indices between sexes in the undernourished groups. A p-value of <0.05 was considered to be statistically significant.

RESULTS

Age- and sex-specific subject distribution, descriptive statistics of MUAC, z-score of MUAC-for-age and prevalence of severe and moderate wasting (low MUAC-for-age) among Karbi children is depicted in Table 1. The overall and age specific mean MUAC was found to be greater among boys than girls, except those in age group of 4 years (p<0.05). The overall mean z-score of MUAC-for age was found to be -1.59 z-score and -1.51 z-score among boys and girls respectively (p>0.05). The sex specific mean z-score of MUAC-for-age was found greater among boys than girls, but only exception was observed in 5 years. Using ANOVA, no significant difference was observed in the sex difference (p>0.05) in mean MUAC (F=1.17; d.f., 1, 808) and z-score of MUAC-for-age (F=0.80; d.f., 1, 808). Age specific mean differences were found statistically significant (p<0.01) in mean MUAC (F=57.94; d.f., 4, 425 and F=65.07; d.f., 4, 383) and z-score of MUAC-for-age (F=5.50; d.f., 4, 425 and F=4.51; d.f., 4, 483) among boys and girls using ANOVA.

Assessment of Wasting using low MUAC-for-age

The overall prevalence of wasting was found to be 33.18% and 32.29% among Karbi boys and girls respectively (p>0.01) (Figure 1). The age specific overall prevalence of wasting was found to be greater in early age (e.g., 1 year). The sex-specific overall moderate prevalence

Table 1: Age and sex specific subject distribution, mean of MUAC, z-score MUAC-for-age and prevalence of moderate and severe wasting using MUAC-for-age among Karbi tribal children

Age (year)	Sample (N)		Mean MUAC (cm)		Mean z-score (MUAC-for-age)		Severe wasting (<-3SD z-score MUAC-for-age)		Moderate wasting (<-2SD z-score MUAC-for-age)	
	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls
1	62	67	11.85 ±1.82	11.52 ±1.96	-2.13 ±1.92	-2.02 ±2.06	23 (37.10)	27 (40.30)	14 (22.58)	11 (16.42)
2	97	70	13.38 ±1.34	13.36 ±1.40	-1.24 ±1.68	-1.09 ±1.32	12 (12.37)	8 (11.43)	9 (9.28)	6 (8.57)
3	81	89	13.74 ±1.03	13.70 ±1.23	-1.75 ±0.87	-1.47 ±0.98	9 (11.11)	5 (5.62)	25 (30.86)	23 (25.84)
4	106	91	14.25 ±1.08	14.32 ±0.97	-1.71 ±1.13	-1.51 ±0.84	11 (10.38)	4 (4.40)	24 (22.64)	20 (21.98)
5	79	67	14.92 ±1.08	14.86 ±0.85	-1.29 ±1.10	-1.46 ±1.11	6 (7.59)	6 (8.96)	8 (10.13)	14 (20.90)
Total	425	384	13.73 ±1.57	13.61 ±1.70	-1.59 ±1.40	-1.51 ±1.32	61(14.35)	50 (13.02)	80 (18.82)	74 (19.27)

Values are parenthesis indicates percentage

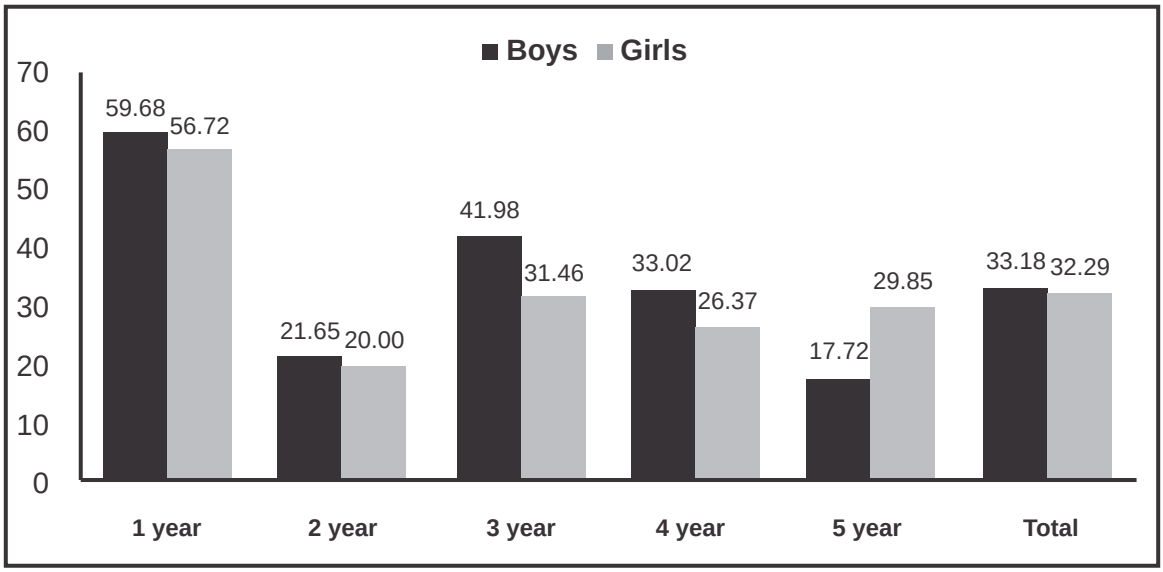

Figure 1: Age and sex specific overall prevalence of wasting (<-2SD) among Karbi children using MUAC-for-age

of wasting was found to be insignificant (p>0.05) and greater among girls (19.27%) than boys (18.82%), but severe wasting was greater among boys (15.35%) than girls (13.02%). The age-specific wasting showed no trend but prevalence showed that 1 year old children were found to be more affected in both moderate (boys 37.10%; 40.30%; p>0.05) and severe (boys 22.58; girls 16.42%; p>0.05) grades of low MUAC-for-age (Table 1). The lower prevalence of wasting was obtained in 5 year and 2 year old children in severe and moderate categories. The no significant sex-and age-specific difference were found in moderate and severe wasting categories using χ^2 analysis (p>0.05).

DISCUSSION

Assessments of the undernutrition among children bears great significance in the developing countries such as India, where the vast majority of the populations are undernourished and under-privileged.[2,9,10] Needless to say, the first and foremost aim of nutritional assessment studies is to determine the design and timing of different nutritional programmes launched to combat child undernutrition. [1,36] Such assessments are important for the improvement of their health and overall development of community concerned. A large proportion of children in the developing countries are found to be deprived of proper nutrition due to their poor socio-economic status, ignorance and lack of health facilities.[9,10,24] The present study made efforts to determine nutritional status utilizing conventional anthropometric measure of MUAC-for-age among children belonging to Karbi tribal population of Northeast India. The MUAC has been considered as a valid and simple proxy screening measure for wasting or protein-energy malnutrition in children (aged 0-5 years). Furthermore, the application of MUAC

Table 2: Comparison of the prevalence of low-MUAC-for-age (wasting) with tribal and non-tribal population of India

Ethnic group/ population	District/State	Sample (N)	Age group	Reference/ cut-offs	Prevalence of Wasting	χ2-value†	Reference
Bauri	Purulia, West Bengal	499	2-6 years	WHO,1995	32.46	0.006	Das et al.[27]
Santal	Purulia, West Bengal	514	2-6 years	WHO,1995	33.27	0.019	Das et al. [27]
Affluent urban	Midnapore, West Bengal	1060	1-3 years	WHO,1995	18.96	27.70**	Maiti et al. [26]
Munda and Oraon	Paschim Midnapore, West Bengal	65	1-5 years	WHO, 2006	56.90	14.46**	Bisai et al.[11]
Munda and Oraon	Paschim Midnapore, West Bengal	65	1-5 years	MUAC<13.5 cm	52.30	9.34**	Bisai et al.[11]
Urban poor	North 24 Parganas, West Bengal	899	1-5 years	WHO, 1995	77.80	349.57**	Bisai[25]
Urban poor	North 24 Parganas, West Bengal	899	1-5 years	WHO, 2007	69.80	232.18**	Bisai[25]
Bengalee Muslims	Nadia District, West Bengal	2016	3-5 years	WHO, 1995	35.11	0.701	Biswas et al.[24]
Rural-Urban	Cuttack, Orissa	292	1-5 years	MUAC<13.5 cm	30.32	0.351	Mishra and Mishra[21]
Shabar	Khurda and Cuttack, Orissa	101	1-5 years	WHO,1995	35.60	0.167	Chakrabarty et al.[20]
Urban affluent	Kolkata, West Bengal	21	1-5 years	MUAC<13.5 cm	28.67	0.085	Chatterjee and Saha [22]
Bengalee	Hooghly, West Bengal	894	2-5 years	WHO,1995	64.54	59.37**	Mandal and Bose [23]
Punjabi	Different parts of Punjab	6531	1-5 years	WHO,1983	38.52	4.74*	Kaur et al.[19]
Karbi	Karbi Anglong, Assam	809	1-5 years	WHO, 2007	32.76	---	Present study

Level of significance *p<0.05; **p<0.01; † Difference with present study

appears to be a better predictor for assessment of childhood undernutrition than many other anthropometric indicators in clinical and community based studies especially focusing in emergency settings.[1,16,25,28,37] Therefore, concerned authorities need to take initiatives to utilize low-cost methods like MUAC for identifying children at risk for acute malnutrition at an early age in clinical and epidemiological investigations. These studies will help policymakers to formulate appropriate measures intervention and surveillance to combat child undernutrition at the regional and national level as well.

A comparison of undernutrition (e.g., wasting) status among different Indian tribal and non-tribal population based on MUAC-for-age is depicted in Table 2. The overall prevalence of undernutrition was 32.76% among Karbi children. Similar prevalence of low MUAC-for-age was already reported by several researcher in Bauri children (p>0.05) and Santals (p>0.05)[27], urban affluent (p>0.05)[22], and Bengalee Muslim (p>0.05)[24] of West Bengal, Shabar tribals (p>0.05)[20] and rural-urban children of Orissa (p>0.05)[21]. The prevalence of undernutrition among Karbi children of the present study was found to be significantly (p<0.05) lower than those reported MUAC based studies among children belonging to urban population of North 24 Parganas[25], Bengalee (64.54%)[23] of West Bengal, Punjabi children (38.52%)[19] and Munda and Oraon tribal children of Paschim Medinipur, West Bengal (56.90% and 52.30%)[11]. A significantly lower prevalence of low MUAC-for-age was reported among affluent urban (18.96%) of Midnapur, West Bengal[26] (p<0.05). It is well established fact that in India, children belonging to the economically lower segments of tribal populations suffer in nutritional status as compared to the

general caste children.[7,9] The WHO[1] has proposed classification for assessing the severity of undernutrition related to the public health using conventional anthropometric index of MUAC showed very high wasting >15.00% existed in among Indian children[11,19-27] including these Karbi tribal children.

CONCLUSION

The results of this study indicates that prevalence undernutrition (e.g., wasting) is still a major problem among tribal and non-tribal children residing in rural than urban areas including Karbi children. There is an urgent need for nutritional intervention programme to address the public health problem especially early aged undernutrition. The intervention should be introduced to ensure the proper balance diets, protective nutrients and general nutritional awareness to ameliorate the nutritional status.

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FOREST BIODIVERSITY, NUTRITION AND TRIBAL HEALTH

Swapan Kumar Kolay[1]

Abstract**:** *Forest ecosystem contributes to the diets and subsistence of forest dwellers and in increasingly market oriented economies they provide a significant portion of food and medicines consumed by the rural and urban population. Recognizing that the sustainable use of forest resources is essential for local livelihoods and the well being of Sahariya–a primitive tribal group of Sheopur forest division of Madhya Pradesh, provides a foundation for investment in conservation of biodiversity and its integration with objectives of poverty reduction, food security and disease reduction in development policies. However, it is necessary to demonstrate that biodiversity is indispensable for combating malnutrition and diseases of vulnerable Sahariya population in Sheopur district of Madhya Pradesh of unprecedented population growth and resource demand. This article outlines key components of the link between forest biodiversity and the viability of contemporary food system.*

Key Words: Biodiversity, Livelihood, Primitive Tribal Group, Malnutrition

INTRODUCTION

The World Health Organization (WHO) estimates that 3.5 billion people in developing countries rely on plant-based medicine for their primary health care. Identification and conservation of medicinal plants is crucial to the health of peoples in developing nations.[1] As a global community, we are now in the midst of a crisis in loss of biological and cultural diversity. The current ongoing loss of biodiversity is the greatest contraction of life since the end of the Mesozoic Era sixty-five million years ago-a wave of extinctions that extinguished the dinosaurs.[2] Although prehistoric extinction spasms tend to claim mostly animals, plants too are now threatened with extinction on a large scale. The current rate of species extinction is now thought to be 100 to 1,000 times higher than "background" levels.[3] But most societies recognize that food, medicine and health are interrelated. Food is typically associated with cultural identity and social well being. This paper deals with the link between forest biodiversity, nutrition and health among the Sahariyas of Sheopur forest division, Madhya Pradesh. Traditional food systems typically draw on local biodiversity and are based on local production and management of forest and specific environments.[4]

It has been found that ethno-biological literature documents the historical and current importance of an array of resources consumed by Sahariya communities living in and around the forests. It also demonstrates the richness

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of the traditional knowledge of indigenous and local Sahariya communities related to gathering and hunting of plant and animal foods and the medicinal value of forest species. From a wide range of ecosystems, some 7000 of the earths plant species have been documented as gathered or grown for food [5] and thousands more have medicinal properties.[6] In the Sheopur forest division out of total 100 species 40 species have been documented as gathered for food and medicine.

METHODOLOGY

A survey of 166 rural Sahariya residents in the surrounding villages around Karhal block of Sheopur district of Madhya Pradesh was undertaken. The study used a standard questionnaire, which was developed in English and translated into Hindi. Altogether 5 villages were visited during the course of the study. Data analysis was undertaken utilizing a statistical software package.

The data has been collected by interview of individuals residing in the villages, regardless of whether they were farming or NTFPs collection from the forest. This was done in order to capture the overall economic activity occurring in these villages, including both on-farm and Non-timber Forest Product (NTFP) activities. In numerous cases, families had land but were not farming it due to a variety of obstacles such as irrigation, inputs, or other issues. Thus this survey captures both farmers and non-farmers i.e. NTFPs residing in Sheopur areas. Total 166 respondents were selected randomly for the study (15 from Upri Khori, 12 from Nichli Khori, 82 from Goras, 32 from Ameth, and 25 from Dob.)

Table 1: Study Villages with Surveyed Household

State	District	Block	Villages	Surveyed Household
Madhya Pradesh	Sheopur	Karhal	Upri Khori	15
			Nichli Khori	12
			Goras	82
			Ameth	32
			Dob	25
Total				**166**

In addition the data was collected from 12 Government Officials as well as Forest Dept. involved to implementation of conservation of biodiversity in these villages.

Description of Sample

The majority of respondents interviewed were male (85%) and married (80%). Most respondents were literate (55%), although a smaller number (45%) were illiterate and had no formal education. Formal education varies widely with 25% of the sample only completing primary school, 20% completing middle school and 10% completing secondary school. No college graduate was encountered. The mean age of the respondents was 46 years. The majority of households (74%) indicated that the husband was the head of the household while 24% indicated that the parents were the head of the households. In only 2 cases was a female the head of the household. Rural areas in the Sheopur are known for the traditional gender roles and these results support this generalization. In most cases, women refused to speak to the interviewer if the husband was not present. Given these traditional gender

roles, reaching women directly through finance will be challenging, particularly if on-farm activities and NTFPs collection are the main priority. The size of the households ranged from 2 to 8 members, with a mean of 4 members. Surprisingly, the vast majority (98%) of the sample indicated that they obtained their main source of news and information from the radio. A negligible number indicated other sources such as television and newspapers or family members.

Biodiversity, diets and health of Sahariya

From a nutritional perspective, forest environments offer ample sources of animal (vertebrate and invertebrate) protein and fat, complemented by plant derived carbohydrates from fruits and tubers and diverse options for obtaining a balance of essential vitamins and minerals from leafy vegetables, fruits and other plant parts. Similarly traditional cultivation systems drawing on agro-biodiversity can make adequate food available in spite of potential intermittent and seasonal shortages of many forest foods. Thus forest food resources can provide a valuable safety net in case of shortage of food crops. Undoubtedly, then, forest biodiversity is the basis for Sahariya in Sheopur district of Madhya Pradesh. Some of the forest fruits, as the guava *(Psidium guajava)*, black berry (*Rubus spp)*, jackfruits *(Artocarpus heterophyllus* Lam.), lemon *(Citrus limon* (L.) Burm. F.), papia *(Carica papaya Linn.)*, mango *(Mangifera indica* L), ber (*Ziziphus jujube),* tendu (*Diospyros melanoxylon* Roxb), tamarind *(Tamarindus indica),* bael (*Aegle marmelos* (L.) Correa), aonla (*Emblica officinalis Gaertn),* mauha (*Madhuca longifolia* (Koen.) Mac. Br.), baheda *(Terminalia bellirica* Roxb.), harra (*Terminalia Chebula),* neem *(Azadirachta indica)* are rich in vitamins are recognized as exceptional nutrients source (see Table 2). However, the nutrient composition of most wild species and minor crops has been poorly studied.[7] One major concern is the technique adopted for the collection of gums and resins from trees like*, Boswellia serrata* Roxb. (Salai), *Sterculia urens* Linn (Kullu) and *Anogeissus latifolia* (Roxb. ex DC.) Wall. (Dhawda) that are found in large patch of forest in dry deciduous forest of the region. Due to faulty tapping technique employed, there are large numbers of deaths of such trees in the natural forest due to permanent damage to tree trunks. Since regeneration of such species in forests takes a long time in natural forest, there is an alarming reduction in the tree cover of these groups of species.[8] In the caseof another NTFP, *Asparagus racemosus*, Wild. (Satawar), the whole plant is uprooted to obtain its roots.

Table 2: Major NTFPs, Fruits & Vegetable available in Sheopur, Parts used and their Collection Season

S. No.	Scientific Name	Local Name	Collection Season	Part (s) & Purpose of used
1	*Aegle marmelos* (L.) Correa	Bael	October-November	***(a)*** ***Fruit pulp****:* Diabetes, diarrhea, troubles during pregnancy, healthy mind and brain, cure of anaemia, fractures, swollen joints, bael squash. ***(b)*** ***Leaves****:* Treatment of asthma, jaundice, typhoid, high blood pressure. ***(C)*** ***Root + fruit pulp + leave:*** Healing of wound.
2	*Anogeissus latifolia* (Roxb. Ex DC.) Wall	Dhawda	December - February	***(a)*** ***Gum:*** Stomach, skin diseases, cold-resistant stress (CRS), pylorus ligated (PL) and ethanol-induced ulcers.
3	*Asparagus racemosus,* Wild	Satawar	August-September	***(a)*** ***Root/ tube :*** Low in calories, only 20 per 5.3 oz. serving, less than 4 calories per spear, contains no fat or cholesterol, very low in sodium, a good source of potassium, a source of fiber (3 grams per 5.3 oz. serving), an excellent source of folacin, a significant source of thiamin, a significant source of vitamin B6, one of the richest sources of rutin, an antioxidant which strengthens capillary walls, contains glutathione (GSH), glutathione (GSH) is one of the most potent anti carcinogens and antioxidants found within the body. Treatment of infertility, loss of libido, threatened miscarriage, menopausal problems, hyperacidity, stomach ulcers, bronchial infections and externally it is used to treat stiffness in the joints. The root is used fresh in the treatment of dysentery. ***(b)*** ***Whole plants:*** Diarrhea, rheumatism, diabetes and brain complaints.
4	*Boswellia serrata* Roxb.	Salai	December - May	***(a)*** ***Oleo- resin:*** Inflammatory bowel disease, rheumatoid arthritis, osteoarthritis, asthma, lowering cholesterol and triglyceride levels in the blood and liver and colitis.
5	*Cassia obtusifolia* Linn.	Powar	March-April	***(a)*** ***Seeds:*** Ascites from cirrhosis, Infantile mal-absorption, acute conjunctivitis, glaucoma, corneal ulcer, night-blindness, dizziness due to hypertension and habitual constipation.
6	*Celastrus peniculata* Wild	Malkangni	October-November	***(a)*** ***Seeds:*** As a powerful brain tonic to stimulate intellect, increase cognitive recognition (helps with dreams), sharpen memory, to promote intelligence (it is known as Mags-zudi or "brain clearer"), seeds oils for epilepsy, abdominal disorders, ben-ben and sorus, head ache, joint pains, leucoderma, liver disorders, paralysis and ulcers etc

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7	*Dioscorea bulbifera* (Linn.)	Kasalu	March-April	***(a) Tuber:*** The roots are large, tuberous, and very rich in nutritious starch. The flowers and roots are eaten by the poorer classes: the latter are very bitter, but after undergoing the process of being covered over with ashes and steeped in cold water, they become eatable.-(J. -Graham.) Several species yielding yams are eatable. Among the principal may be mentioned the D. aculeata (Linn.) The tubers are about 2 lb. or more in weight. They are dug up in the forests in the cold season, and sold in the bazaars. They are known as the (Goa potato. The D. globosa (Roxb.) is much cultivated as yielding the best kind of yam, much esteemed both by Europeans and natives. The D. triphylla (Linn.), not eatable, for the tubers are dreadfully nauseous and intensely bitter even after being boiled. They are put into toddy to render it more potent, as they have intoxicating properties. A few slices are sufficient for the purpose.-J. Graham.
8	*Diospyros melanoxylon* Roxb.	Tendu	May	***(a) Leaves:*** The leaves are reported to contain 7.12% crude protein, and 25.28% crude fiber. Use Country Cigaret (bidi). ***(b) Fruits:*** The fruits have a cooling and an astringent effect. ***(c) Seeds:*** The seeds can be intoxicating; as a cure for mental disorders, nervous breakdowns and palpitations of the heart. ***(d) Flower:*** Dried flowers are reportedly useful in urinary, skin and blood diseases. ***(e) Bark:*** The bark is astringent; its decoction is used in diarrhea.
9	*Emblica officinalis Gaertn.*	Aonla	October - December	***(a) Fruit pulp:*** Amla is an important dietary source of Vitamin C, minerals and amino acids. The edible fruit tissue contains protein concentration 3-fold and ascorbic acid concentration 160-fold. Glutamic acid, proline, aspartic acid, alanine, and lysine are 29.6%, 14.6%, 8.1%, 5.4% and 5.3% respectively of the total amino acids. The pulpy portion of fruit, dried and freed from the nuts contains: gallic acid 1.32%, tannin, sugar 36.10%; gum 13.75%; albumin 13.08%; crude cellulose 17.08%; mineral matter 4.12% and moisture 3.83%. Amla fruit ash contains chromium, 2.5 ppm; zinc 4 ppm; and copper, 3 ppm. Anemia, biliousness, bleeding, internal colitis, constipation, diabetes, eye, lung inflammations, improve eyesight, fever,

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				gastritis, G.I. disorders, gout, gum bleeding (to stop), hair (premature gray/balding), heart complaints, hepatitishemorrhoids, ophthalmopathy, dyspepsia, colic, flatulence, hyperacidity, peptic ulcer,erysipelas, skin diseaes, leprosy, haematemesis, inflammations, anaemia, emaciation, hepatopathy, jaundice, strangury, diarrhoea, dysentery, haemorrhages, leucorrhoea, menorrhagia, cardiac disorders, intermittent fevers and greyness of hair. ***(b)*** ***Flowers:*** Flowers are cooling and aperient. ***(c)*** ***Leaves:*** Leaves Useful in treatment of conjunctivitis, inflammation, dyspepsia, diarrhea and dysentery. Useful in treatment of diabetes, cough, asthma, bronchitis, cephalalgia, ***(d)*** ***Bark:*** Useful in ulcerative stomatitis and gastrohelcosis. The bark is useful in gonorrhoea, jaundice, diarrhea and myalgia. Bark is astringent. The herb is also aphrodisiac, hemostatic, nutritive tonic, rejuvenative (for Pitta). ***(e)*** ***Root:*** In traditional medicine the root juice is claimed to be useful in cough, asthma, stomach affections, intestinal infections, diabetes and a cure for scabies.
10	*Helicteres isora* Linn.	Morarphali	October to February	***(a)*** ***Fruit:*** Fruits are demulcent, mildly astringent and useful in griping and flatulence.
11	*Madhuca longifolia* (Koen.) Mac. Br.	Mauha	May (Flower), July (Fruits)	***(a)*** ***Flower:*** The flowers are used to produce an alcoholic drink in tropical India. Mauha flower is edible and is a food item of tribals. Flowers are used to make syrup for medicinal purposes. The flowers of Mauha tree are fomented to produce an alcoholic drink called Mauha, country liquor. Flowers are regarded as cooling, tonic and demulcent. They are used for coughs, colds and bronchitis. The honey from flowers is edible and used in eye diseases. ***(b)*** ***Fruits:*** This oil (solid at ambient temperature) is used for the care of the skin, to manufacture soap or detergents, and as a vegetable butter. A low quality of oil is extracted form the seeds which is eaten and used in soap making. The wood is very hard and is used for furniture. ***(c)*** ***Bark:*** The bark is used medicinally in leprosy.
12	*Nyctanthes arbor-tristis* Linn.	Syari	December - March	***(a)*** ***Leaves:*** Widely used in Ayurvedic system of medicine for the treatment of sciatica, arthritis, fevers, various painful conditions and

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				diuretics, liver disorders and as laxative. Leaves of Nyctanthes arbor-tristis protect the liver from toxic effects of carbontetrachloride by reducing the elevated levels of Serum glutamate pyruvate transaminase, serum glutamate oxaloacetate transaminase and serum bilirubin (total and direct). ***(b)*** ***Stem:*** Prepared for Tukri/basket.
13	*Steculia urens* Roxb.	Kullu	December - February	***(a)*** ***Gum or resin:*** Trees exude gum karaya used in foodstuffs as emulsifiers, stabilizers and thickeners. The tree yields gum karaya from the pith and cortex. The main constituent of the resin is a phlobatannin, containing 3 phenolic OH groups. A large part of the Karaya is used in the pharmaceutical Industry as a bulk laxative and as a denture adhesive in which the finely powdered gum is dusted on the dental plate and swells when it touches the moist surface of the gums. This gives a comfortable and tight fit of the plate. ***(b)*** ***Seeds:*** Seeds are eaten after roasting. Seeds and young tender roots are eaten in times of famine.
14	*Terminalia bellirica* Roxb.	Baheda	November-January	***(a)*** ***Fruit:*** Asthma, bronchitis, cholera, cold, constipation, cough, gastric complaints, liver complaints and stomachache.
15	*Adansonia digitata*	Baobab	October	***(a)*** ***Leaves:*** Fresh baobab leaves provide an edible vegetable similar to spinach which is also used medicinally to treat kidney and bladder disease, asthma, insect bites, and several other maladies.
16	*Terminalia arjuna*	Arjun	April-May	***(a)*** ***Bark:*** Cardiac disorders, reduction in blood pressure, maintaining the cholesterol level at the normal rate, good for obesity , indigestion, fever, urinary tract infections, renal or urinary bladder stones, bleeding piles, diarrhea with blood, general tonic effect in Cirrhosis of Liver, anti-mutagenic or anti-cancer potential and antioxidant properties similar to the Vitamin E.
17	*Terminalia Chebula*	Harra	January	***(a)*** ***Fruit:*** Increase the appetite, as digestive aid, liver stimulant, as stomachic, as gastrointestinal prokinetic agent, mild laxative helps in digestion, chronic diarrhea, excessive gas in intestine, nervous weakness, nervous irritability, edema and various inflammations, chronic cough, coryza, sorethroat and asthma, urethral discharges like spermatorrhea, vaginal

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				discharges like leucorrhea, renal calculi, dysurea, retention of urine, skin disorders with discharges like allergies, urticaria and other erythematous disorders, chronic fever, reduces the ill effects of fat rich, creamy and oily food. T. chebula is the definite aid for persons who habitually overeat. Further it can supplement the cholesterol normalizing drugs, modern clinical research shows- anti-bacterial and antioxidant properties, Some anti-tumor activity and effect in inhibiting the HIV virus, ability to evacuate the bowel, Wide antibacterial and antifungal activity, esp. against E. coli.
18	*Convolvulus pluricaulis*	Sankhpushpi		***(a)*** ***Leaves:*** Asthma, bronchitis, dysentery, fever, spermatogenesis, ulcer and stomachache.
19	*Commiphora weightii*	Guggul	December-February	***(a)*** ***Gum:*** treatment of gout, arthritis, rheumatism, obesity and inflamation etc in traditional system of medicine. Simultaneously, lipid lowering effect of different extracts and fractions of gum-guggul was evaluated. The active lipid lowering agent, a standardized fraction from ethyl acetate extract of guggul gum containing guggulesterone mixed with some other steroids, diterpenes, esters and higher alcohols named as ' guggulipid' was developed in our institute CIPLA INDIA has now been marketing guggulipid as hypolipidemic agent under the trade name Guglip.
20	*Azadirachta indica*	Neem	January - March	***(a)*** ***Fruits/ Leaves:*** anti-tubercular, anti-protozoal, anti-allergic and dermatological and dental diseases. It is now widely used as organic insecticide, antifeedant, oviposition deterrent, synergistic and growth regulating activity. Neem decoction is used as the insecticide at Tapovan Ashram where organic farming practices are adopted.
21	*Adhatoda vasica*	Adusa / Vasaka	January - March	***(a)*** ***Shurb+ leaves+ roots+ fruits:*** It is an every green shrub, the leaves, roots and fruits of which are extensively used in curing cold, cough, bronchitis, asthma and also in removal of intestinal parasites. It's juice is also useful in treating tuberculosis.
22	*Chlorophytum borivillianum*	Safed Musli	September - October	***(a)*** ***Roots:*** rich source of over 25 alkaloids, vitamins, minerals, proteins, carbohydrates, steroid saponins and polysaccharides. A number of health tonics for general and sexual weakness are prepared from it. It's decoction is used in the case

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				of impotency as it is quite rich in glycocides and has spermotogic properties. Traditionally, it is an essential part of the diet of lactating mothers (after delivering) in the form of laddoos.
23	*Aloe barbadensis*	Aloe vera, Gwar Patha, Ghrit Kumari	April- July	***(a)*** ***Leaves:*** A wild perennial herb of great medicinal value. It is stomachic tonic in small doses and acts as purgative and indirectly emmanagogue and anthelmintic in large dose. It has been a favourite remedy for intestinal worms in children. In the form of a lotion, it is recommended in catarrhal and purulent opthalmia. Dissolved in spirit, it is used as a hair dye to stimulate hair growth. A sweet confection prepared from the pulp of the leaves is given in piles. Pulp mixed with honey and turmeric is recommended in coughs and cols. The juice of the leaves is useful in painful inflammations and chronic ulcers. Eczematous skin is quickly cicatrized and healed on application of small piece of leaf of aloe. The healing of abrasions of human skin show definite improvement. A five week treatment of aloe vera in patients of severe x-ray dermatitis shows complete regeneration of the skin on the scalp and forehead. Its use in cosmetics is gaining much popularity.
24	*Ocimum sanctum*	Tulsi		***(a)*** ***Leaves:*** The plant is of great medicinal value. The leaves are nerve tonic and sharpen memory. They promote the removal of catarrhal matter and phlegm from bronchial tubes. The tender leaves when eaten raw are preventive of many fevers, sore throat, respiratory disorders, kidney stone, heart disorders, children's ailments, mouth infections, etc. That is why a few leaves are recommended to be chewed raw daily by Hindus as God's Prasad.
25	*Tricholoma ponderosa*	Mushroom	August-October	***(a)*** ***Whole Parts:*** Mushrooms are an ideal food - they contain almost no fat, sugar and salt but are a valuable source of dietary fiber and a good source of the B vitamins - niacin, riboflavin, thiamin, folate, vitamin B6, biotin and pantothenic acid. These vitamins are lost when vegetables are cooked in boiling water. Niacin helps to control the release of energy from protein, fat and carbohydrate. Riboflavin is also essential for the breakdown of carbohydrate, fat and protein into energy. It is also needed for healthy skin and mucous membranes, especially those in the cornea. Thiamin controls the release of energy from carbohydrate, needed for the normal functioning of the brain and nervous system. Folate is essential for the formation of red

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				and white blood cells in bone marrow. B6 is essential for breaking down protein for use in building new body tissue. Biotin is necessary for the release of energy from fat. Collectively, these B vitamins in mushrooms may help to relieve stress, depression and fatigue. It is also one of the few dietary sources of Vitamin D - for strong healthy hair, skin and nails. Mushrooms are a good source of the minerals potassium, selenium, copper and phosphorus. Mushrooms contain more potassium than most other vegetables and fruits. This mineral can have a positive effect in lowering blood pressure.
26	*Psidium guajava*	Guava	August-February	***(a)*** ***Fruits:*** Guava is low in saturated fat, and very low in cholesterol and sodium. It's also a good source of vitamin A, potassium, copper, folate and manganese, and a very good source of dietary fiber and vitamin C. Nutrient Value per 100 grams of edible portion- Water 86.10gm, Energy 51 kcal, Protein 0.82 gm, Total lipid (fat) 0.60 gm, Carbohydrate, by difference 11.88 gm, Fiber, total dietary 5.4gm, Ash 0.60 gm, Calcium 20 mg, Iron 0.31mg, Magnesium 10 mg, Phosphorus 25 mg, Potassium 284 mg, Sodium 3 mg, Zinc 0.23 mg, Copper 0.103 mg, Selenium 0.6 mcg, Vitamin C 183 mg, Thiamin 0.050 mg, Riboflavin 0.050 mg, Niacin 1.200 mg, Pantothenic acid 0.150 mg, Vitamin B-6 0.143 mg, Folate, total 14 mcg, Folic acid 14 mcg, Folate, DFE 14 mcg_DFE, Vitamin A, IU 792 IU, Vitamin A, RE 79 mcg_RE, Vitamin E 1.120 mg_ATE, Fatty acids, total saturated 0.172 gm, Fatty acids, total monounsaturated 0.055 gm, Fatty acids, total polyunsaturated 0.253 gm, Cholesterol 0 gm, Amino acids 0.509 gm. ***(b)*** ***Leaves:*** Guava, particularly its leaves, has been a subject for diverse research in chemical identity of its constituents, pharmacological properties and history in folk medicine. For example, from preliminary medical research in laboratory models, extracts from guava leaves or bark are implicated in therapeutic mechanisms against cancer, bacterial infections, inflammation and pain. Essential oils from guava leaves have shown strong anti-cancer

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				activity in vitro. Guava leaves are used as a remedy for diarrhea and for their supposed antimicrobial properties. Guava leaves or bark have been used traditionally to treat diabetes.
27	*Rubus spp.*	Blackberry (Jamun)	June - August	***(a)*** ***Fruits:*** Blackberries are notable for their high nutritional contents of dietary fiber, vitamin C, vitamin K, folic acid - B vitamin, and the essential mineral, manganese. The amount of nutrients in 100 gm of blackberry: energy- 52 kcal, water - 86 gm, protein - 0.720 gm, fats - 0.390 gm, carbohydrate - 12.76 gm, total dietary Fiber - 5.3 gm, calcium - 32 mg, iron - 0.57 mg, magnesium - 20 mg, phosphorus - 21 mg, potassium - 196 mg, zinc - 0.27 mg, copper - 0.14 mg, manganese - 1.3 mg, selenium - 0.6 mcg, vitamin C - 21 mg, folate - 34 mcg, vitamin A - 165 IU, vitamin A - 16 mcg, vitamin E - 0.710 mg. Being rich in antioxidants, blackberries help the body in fighting free radicals and thus, avoid various types of cancer, The high tannin content, and the resultant antiseptic properties, of blackberries makes them good for tightening tissues as well as treating minor bleeding, Consumption of blackberry has been found to be beneficial for those suffering from diarrhea and intestinal inflammation, Mild infections, like sore throats and mouth irritations, can be treated with the help of blackberries, Blackberries have been used to alleviate hemorrhoids also, Blackberries have been found to have anti-bacterial properties and can even help cleanse blood, Regular consumption of blackberries has been seen to delay the process of ageing. ***(b)*** ***Seeds:*** Blackberries are exceptional among other Rubus berries for their numerous, large seeds not always preferred by consumers. They contain rich amounts of omega-3 (alpha-linolenic acid) and -6 fats (linoleic acid), protein, dietary fiber, carotenoids, ellagitannins and ellagic acid.
28	*Artocarpus heterophyllus* Lam.	Jackfruit (Kathal)	March - June	***(a)*** ***Fruits:*** The amount of nutrients in 100 gm of jackfruit: calories – 94 Kcal, sodium - 3 mg, total carbohydrates - 24 gm, dietary Fiber - 2 gm, protein - 1 gm, vitamin A - 297 IU, vitamin C - 6.7 mg, thiamin - 0.03 mg, riboflavin - 0.11 mg, niacin - 0.4 mg, vitamin B6 - 0.108 mg, folate - 14 mcg, calcium - 34 mg, iron - 0.6 mg, magnesium - 37 mg, phosphorus - 36 mg,

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				potassium - 303 mg, sodium - 3 mg, zinc - 0.42 mg, copper - 0.187 mg, manganese - 0.197 mg, selenium - 0.6 mcg, total fat - 0.3 mg, saturated fat - 0.063 mg, monounsaturated fat - 0.044 mg, polyunsaturated fat - 0.086 mg, cholesterol- 0 gm. Being rich in potassium, jackfruit helps in the lowering of the blood pressure, Jackfruit contains phytonutrients, with health benefits ranging from anti-cancer to antihypertensive, Jackfruit has been found to have anti-ageing, antioxidant and anti-ulcer properties. ***(b)*** ***Roots:*** Jackfruit root has been found to be beneficial for those suffering from asthma, The root of jackfruit is said to be good for the treatment of a number of skin problems, The extract of Jackfruit root is believed to help cure fever as well as diarrhea, The seeds can be boiled and roasted (eaten as a nut) and have a chestnut flavor.
29	*Ziziphus jujuba*	Ber	November-January	***(a)*** ***Fruits:*** Medicinal properties immunostimulant sedative antiallergenic Medicinal parts Fruit Has medicinal uses The fruit is round or oblong and from 1/2 to 1 inch long. It is spongy, sweet, date-like and dark brown in color when ripe, pleasantly acid when fresh becoming sweeter with ripening. Ziziphus jujuba is most often used in candy. Chinese jujube (sometimes called Chinese date) is most often used pickled, dried or fresh. Ziziphus jujuba is called da zao in Chinese. This plant is used as a traditional herbal remedy. It's used as an immunostimulant, a sedative and an antiallergenic. Only the fruit is used in herbal preparations. Traditional uses Parts used Traditional uses Contemporary uses Fragrance Fragrance parts Fragrance intensity Fragrance category Dye parts Dye color Nutrition Is edible yes Culinary uses Fresh Dried Pickled Candy Nutritional value Edible parts Fruit Description of edible parts round or oblong and from 1/2 to 1 inch long Flavor / texture spongy, sweet, date-like and dark brown in color when ripe, pleasantly acid when fresh becoming sweeter with ripening.
30	*Citrus limon* (L.) Burm. F.	Lemon (limbu)	December-January	***(a)*** ***Fruits:*** The lemon's sourness comes from its high citric acid level, which, in addition to its wonderful flavor and aroma, can slow the oxidation in cut fruit, ward off scurvy, change milk into buttermilk, remove stains and odors from your hands, "cook" fish without heat, and discolor aluminum pans!

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				Lemons are high in vitamin C and potassium, and also contain limonene, a compound shown to have anticancer properties in laboratory animals. Limonene also appears to raise the levels of beneficial enzymes in the liver. Vitamin C also can lower histamines in the body, histamines are naturally occurring chemicals that can cause red, itchy eyes and runny noses. Recent research at the University of Arizona found that people who use citrus peel in cooking, baking or in their tea have less risk of skin squamous cell carcinoma (skin cancer). Other research published in the Journal of the American Medical Association found that people who eat more grapefruit, lemons and oranges, and other fruits and vegetables high in potassium, have reduced risk of stroke. And the membranes between citrus segments provide pectin, a soluble dietary fiber that helps control blood cholesterol levels. Also lemons can be used as a home remedy for blemishes - apply a little lemon juice mixed with water several times a day. This can help healing plus remove the red. All citrus are high in flavonoids (the most common antioxidant found in fruits and vegetables, thought to reduce formation of substances that cause cancer and heart disease.) They also contain terpenes, phenols, and isothiocyanates—plant chemicals that are thought to help to prevent cancer.
31	*Carica papaya* **Linn.**	Papaya	February-April	***(a) Fruits:*** Some cultures call the papaya tree "the medicinal tree" because it's seeds and leaves have been used to make medicine. Papaya leaves and unripe papaya have an enzyme called Papain that breaks down protein in meat to make it tender. That's why papaya can be used as a meat tenderizer. Papain is also a powerful enzyme that digests proteins breaking down the amino acids making them readily available."It is well recognized that the Papaya contains peculiar and valuable digestive properties, which

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				make it of great value in the diet." -report of U.S. Dept. of Agriculture. Papaya is rated as one of the most nutritious fruits. Papaya is high in vitamin C and a good source of fiber and folate.
32	*Tamarindus indica*	Tamarind	April - June	***(a) Ripe Pulp:*** Food Value Per 100 g of Edible Portion- Moisture 28.2-52 g, Protein 3.10 g, Fat 0.1 g, Fiber 5.6 g, Carbohydrates 67.4 g, Invert Sugars 70% glucose; 30% fructose) 30-41 g, Ash 2.9 g, Calcium 35-170 mg, Phosphorus 54-110 mg, Iron 1.3-10.9 mg, Sodium 24 mg, Potassium 375 mg, Vitamin A 15 I.U., Thiamine 0.16 mg, Riboflavin 0.07 mg, Niacin 0.6-0.7 mg, Ascorbic Acid 0.7-3.0 mg and Tartaric Acid 8-23.8 mg. Analyses of the pulp are many and varied. Roughly, they show the pulp to be rich in calcium, phosphorus, iron, thiamine and riboflavin and a good source of niacin. Ascorbic acid content is low except in the peel of young green fruits. Tamarind preparations are universally recognized as refrigerants in fevers and as laxatives and carminatives. Alone, or in combination with lime juice, honey, milk, dates, spices or camphor, the pulp is considered effective as a digestive, even for elephants, and as a remedy for biliousness and bile disorders, and as an antiscorbutic. In native practice, the pulp is applied on inflammations, is used in a gargle for sore throat and, mixed with salt, as a liniment for rheumatism. It is, further, administered to alleviate sunstroke, Datura poisoning, and alcoholic intoxication. In Southeast Asia, the fruit is prescribed to counteract the ill effects of overdoses of false chaulmoogra, Hydnocarpus anthelmintica Pierre, given in leprosy. The pulp is said to aid the restoration of sensation in cases of paralysis. ***(b) Leaves & Flowers:*** Tamarind leaves and flowers, dried or boiled, are used as poultices for swollen joints, sprains and boils. Lotions and extracts made from them are used in

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				treating conjunctivitis, as antiseptics, as vermifuges, treatments for dysentery, jaundice, erysipelas and hemorrhoids and various other ailments. The fruit shells are burned and reduced to an alkaline ash which enters into medicinal formulas. The bark of the tree is regarded as an effective astringent, tonic and febrifuge. Fried with salt and pulverized to an ash, it is given as a remedy for indigestion and colic. A decoction is used in cases of gingivitis and asthma and eye inflammations; and lotions and poultices made from the bark are applied on open sores and caterpillar rashes. The powdered seeds are made into a paste for drawing boils and, with or without cumin seeds and palm sugar, are prescribed for chronic diarrhea and dysentery. The seedcoat, too, is astringent, and it, also, is specified for the latter disorders. An infusion of the roots is believed to have curative value in chest complaints and is an ingredient in prescriptions for leprosy. The leaves and roots contain the glycosides: vitexin, isovitexin, orientin and isoorientin. The bark yields the alkaloid, hordenine. ***(c)*** ***Seeds:*** contain approximately 63% starch, 14-18% albuminoids, and 4.5-6.5% of semi-drying oil.
33	*Mangifera indica* L	Mango	April - May	**(a)** **Fruits:** Mangoes are high in many carotenoids, especially Beta-carotene. Beta-Carotene has a protective affect against the harmful rays of the sun. Research indicates that even in older people, sun tolerance is increased when Beta-Carotene intake is increased. (Professor Mathews-Roth, Harvard University 1969-75). Mangoes contain Vitamin A (of which Beta-Carotene is a precursor and more usable), Vitamins C & E and Selenium. It also contains B-complex (anti-stress) vitamins, magnesium, potassium, phosphorus, selenium, Folic acid (folate), and zinc. Mangoes are very low in Saturated Fat, Cholesterol and Sodium and are a good source of dietary fiber. It also contains some protein and amino acids, about 2% of your daily recommended amount.

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34	*Triticum aestivum*	Wheat		***(a)*** ***Grains:*** (i) Nutrition facts: Wheat grains are used to make flour, which is a staple food in every country and culture. It has wide culinary uses, from the making of breads, pasta and cakes to fermentation of alcoholic beverages. It contains Manganese, Phosphorus, Magnesium and Selenium in very large quantities. Rich in Zinc, Copper, Iron and Potassium. However, Calcium is also present in small amounts. (ii) Vitamin contents: It is rich in Vitamin B6, Niacin, Thiamin, Folate, Riboflavin and Pantothenic Acid. Vitamin E and Vitamin K are also present in small but considerable amounts. (iii) Calorie Content: Wheat has a calorific value of 339.0 per 100 gm. Being a grain, it is very appropriate in calories and hence, filling as a food. (iv) Health Benefits: Consumption of whole wheat is necessary for a healthy metabolism, as it prevents Breast Cancer, Gallstones, childhood Asthma and heart risks. Definitely an essential food to intake for women for gastro-intestinal health also reduces risk of high blood pressure, Diabetes and high cholesterol. To add up to it all, it has phytonutrients which promotes better health through maintaining high blood levels.
35	*Cruciferae Brassica* spp	Mustard		***(a)*** ***Grains:*** Protein is high in lysine, methionine, threonine and tryptophan. Being to some degree deficient in valine it was most satisfactory when blended with proteins containing adequate amounts of this amino acid. Use of the herb is contraindicated in those with gastrointestinal ulcers or inflammatory kidney diseases. Mustard plasters to treat chest congestion, a practice still used today. Its medicinal properties gave rise to the first successful anticancer drug, which is still used to treat leukemia. Antirheumatic, cardiopulmonary stimulant, hyperemic (increases blood flow) glycosides (mainly myrosin and sinigrin) , volatile oil, fatty oil (30-35%) , proteins (40%), phenyl propane derivatives mustard plasters are used in many parts of the world to treat chest congestion from colds, flu, and bronchitis, as well as bronchial pneumonia, sinusitis, pleurisy, lumbago, and sciatica. Good

S. No.	Scientific Name	Local Name	Collection Season	Part (s) & Purpose of used
				for headaches or to stimulate the cardiopulmonary system to relieve frostbite and vascular disease. To improve the digestive system and to promote a healthy appetite. As an irritant, Mustard stimulates the gastric mucous membrane and increases the flow of gastric juices (also having some effect on pancreatic secretions), Mustard Seed is a stimulant that warms and invigorates the circulatory system, encourages blood flow, and is also said to aid in the metabolism of fat in the body. Useful for colds and flu. Mustard plasters are a tried-and-true remedy to relieve the pain of arthritic joints, rheumatism, sciatica, neuralgia, neck pain, backache and muscle pain.
36	*Cicer arietinum*	Gram/ Chhana	February - March	***(a)*** ***Grains:*** Nutritional value of Green Gram (Per 100 grams) Energy: 30 calories, Protein: 3 grams Carbohydrate: 6 grams, Dietary Fiber: 2 grams green gram is free of flatulence-causing agents. The protein is especially rich in the amino acid, lysine, but it is somewhat deficient in sulphur-containing amino acids. The seeds are rich in calcium, phosphorous, magnesium, potassium, folate and other B Vitamins. They also contain appreciable amounts of Vitamin C. It is eaither used whole or split into dal. green gram is a common soup base, and gram flour is a common ingredient in many fried snacks. Chinese medicine uses green gram as a remedy for oedema, fever, headache and generalised anxiety, and as a diuretic. It is also a folk remedy for arsenic poisoning and other mineral toxins.
37	*Pennisetum americanum* (L.) Leek	Bajra	October-December	***(a)*** ***Grains:*** Nutritive value of Bajra per 100 grams-protein 11.6gm, fat 5 gm, CHO 67.5 gm, Minerals 2.3 gm, Calcium 42mg, Fiber 1.2 gm, total Energy 361 K Cal. The whole grain form of Bajra is more nutritious than milled one as it contains greater levels of B-complex vitamins, dietary fiber and essential fatty acids. Bajra like millets also supplies minerals like iron and calcium. The milled Bajra with less nutritional value may lead to obesity if eaten in excess. Various Bajra bran's add bulk to the diet as it contains high levels of dietary fiber and helps in reducing the risk of heart diseases by lowering the levels of cholesterol. Fiber also helps to prevent constipation and may reduce the risk of developing various bowel disorders including bowel colon.

S. No.	Scientific Name	Local Name	Collection Season	Part (s) & Purpose of used
38	*Capsicum annuum*	Chili	December-January	***(a)*** ***Fruits:*** Actually, evidence has shown as an anticoagulant, thus possibly helping prevent heart attacks or strokes caused by blood clot. Skin and have a anti-inflammatory effect. Moreover, Chili are high in vitamin A and C, which, in turn, may be effective in protecting against cancer. Vitamin C is an antioxidant, a chemical substance capable of removing the threat from free radicals, which can cause cells to mutate.Red Chili are quite a good source of beta carotene.
39	*Solanum lycopersicum* var. cerasiforme	Tomato		***(a)*** ***Fruits:*** Tomatoes are lipophilic, which means their nutritional value is increased by being cooked in some fat, Cooked tomatoes may be more beneficial for health than raw tomatoes, Tomatoes are rich in vitamins (A, C, Calcium) and fiber, Tomatoes are rich the antioxidant Lycopene. There may also be an association between heart health and tomatoes. In a study conducted by University of North Carolina scientists, the fat samples drawn from both heart attack sufferers and healthy controls were analyzed for lycopene and other carotenoids.They found significantly more lycopene in the fat of the controls than the heart patients. Not surprisingly, the diet of the control group was also higher in tomato products.
40	*Pisum sativum*	Pea	December-January	***(a)*** ***Grains:*** Peas are a high protein food and a good source of potassium and the B-vitamins. Complex carbohydrates, which peas provide, release energy slowly to the body. This helps to maintain a consistent energy level. Peas are an excellent source of minerals phosphorus, potassium, magnesium and calcium. One-half cup of cooked peas provides more than 10 grams of dietary fiber. A high fiber diet may help prevent heart disease and some cancers. Peas are also a good source of Vitamin C, A, and folate. Vitamin C is an essential nutrient for healthy skin and gums. Peas also contain the important antioxidants Zinc and Selenium.

Link between food and health are increasingly understood in terms of the functional benefits provided by photochemical, including numerous carotinoids and phenolics, apart from their value as essential nutrients.[9] Stimulants of immunity and antioxidant, glycaemic and lipidaemic agents can moderate communicable and non communicable diseases such as diabetes, cancer and cardiovascular disease. Guava, for example, is rich in the antioxidant lycopene, which has reorganized anti-cancer properties. Many locally available fruits have a high content of omega- 3 fatty acids and mono unsaturated fatty acids which reduce the risk of cardiovascular and other diseases. But many forest species with commercial potential have not been characterized for their specific fatty acid composition.[10] Leaves of many forest species are rich sources of xanthophylls which contribute to optimal eye function.

While these kind of functional properties of foods are seldom recognized by local Sahariya communities without the benefit the scientific analyses, Sahariyas often attribute to particular foods value in treating or preventing disease. Indeed the distinction between food and medicine which characterizes scientific perspectives stands in contrast which traditional concepts of health which recognized the therapeutic and sustaining value of food more holistically.

The widespread use of roots, barks and other forest plant parts as medicine appears to offer public health benefits, but these are difficult to validate scientifically. Ethno-botanical studies in dry deciduous forest areas are typically document knowledge of 40 species within local Sahariya communities and widespread use of plans in primary health care. Much of the recorded data on the use of medicinal plants is anecdotal and idiosyncratic and their specific contribution to the health of individuals can not be effectively evaluated without controlled investigation. Ethno-pharmacological research, including clinical studies, demonstrates the efficacy of many traditional remedies, phytoremedies or foods to the health of populations. Even these remain inadequate to measure the efficacy and contributions of traditional healing practices to physical and mental health.

Nevertheless, for forest based societies that draw on traditional knowledge for most of their subsistence needs, the use of a diversity of resources can be expected to contribute to health. Although many traditional subsistence systems depend on one or more staples such as wheat, bajra or maize such diets are kept diverse and balance through small but contemporary amounts of animal- source foods including birds, fish, insects and molluscs as well as sauces, condiments, snacks and beverages obtain from plants.

Forest Biodiversity and Food

In developing country food systems affect both human health and the health of ecosystems. When rural populations lose access to important natural resources because of environmental degradation, economic changes (including changes in land use),cultural erosion or poverty, their reduced diet results in food insecurity,

malnutrition and disease. Similarly, when people move to cities they lose ready access to the beneficial products of local biodiversity because these are either unavailable or unaffordable.

Considerable changes in patterns of consumption and resource use in urbanization because of consumption with the commercialization of the food supply and other subsistence items. With the global population expected to grow to 8.3 billion by 2030, this elevated urbanization rate represents a tremendous increase in the number of humans who depends on foods that are purchased and produced by others outside cities. Simply meeting present and future food security needs necessitates intensification of production systems of cereals, sugar, oilseeds, other staple crops and animal source foods. Production increases will draw heavily on technology and greater exploitation of land and natural ecosystems.

Three crops alone – rice, wheat and maize already provide over 50 percent of the global human food supply.[5] In Sheopur district of Madhya Pradesh bajra and wheat, a couple of other products of high inputs, high yield agriculture, sugar and edible oil (Soya and mustard), are important in global trade. Together these staples form the bulk of the diet of urban dwellers. Large scale commercial agriculture responds to the demand for these crops for export and local markets. On the other hand, the food supply of urban dwellers in many developing countries increasingly depends on food imports.

The availability of calorie- rich food at affordable prices contributes to food security and has reduced the number of undernourished Sahariya people. However for poor Sahariya people whose food choices are determined foremost by economic means, dietary options are limited. At the same time local producers, particularly small scale farmers, have difficulty competing with inexpensive (often subsidized) imports. Deficiencies in infrastructure and support for small scale production contribute to keeping local forest products, unavailable or expensive in local markets. As supermarkets take a larger market share in developing countries, opportunities for local producers to sell diverse products, particularly wild foods from forests, may be reduces.[11] However, although it is difficult to compete, local producers need not be excluded, especially if they can highlight the unique nature of their products and fill specially niches.

The major NTFP sources considered for the study were Dharwa gum, Mouha, Anola, Satawar, Belguda, Salai/ Chird gum, Kher gum, Ganger, Chironji and Tendu leaves sold in a year. The value of each items was estimated according to the current market rates at the time of study in 2009 situation of Sheopur district, Madhya Pradesh. Table 3 indicates that among the Sahariyas in five villages of Sheopur district the average income of family from NTFPs which is up to Rs. 13947/ year.

Table 3: Village Wise Average Income of Family from NTFP (rupees/ year)

Items	Upri Khori		Nichli Khori		Goras		Ameth		Dob		Total	
	CAF (Kg.)	*IAF (Rs.)*	*CAF (Kg.)*	*IAF (Rs.)*	*CAF (Kg.)*	*IAF (Rs.)*	*CAF (Kg.)*	*IAF (Rs.)*	*CAF (Kg.)*	*IAF (Rs.)*	*CAF (Kg.)*	*IAF (Rs.)*
Dhawra Gum (@160/- per Kg.)	27	4299	41	6533	25	4031	37	5868	24	3795	31	4905
Mouha (@ 15/- per Kg.)	168	2525	142	2125	46	695	80	1203	0	0	87	1310
Anola (@ 20/- per Kg.)	39	764	21	415	29	585	56	1113	20	378	33	651
Satawar (@ 20/- per Kg.)	0	0	0	0	27	545	0	0	13	258	8	161
Belguda (@ 10/- per Kg.)	68	685	25	256	0	0	148	1499	0	0	48	488
Salai/ Chird Gum (@ 40/- per Kg.)	0	0	0	0	91	3634	0	0	152	6069	49	1940
Kher Gum (@ 70/- per Kg.)	6	448	5	315	8	586	7	503	10	675	7	505
Ganger (@ 5/- per Kg.)	76	378	81	405	0	0	65	327	0	0	44	222
Chironji (@ 16/- Kg.)	27	425	9	136	0	0	23	374	0	0	12	187
Tendu Leaves (@ 450/- per Bag)	3	1230	2	900	3	12845	4	1889	2	1026	3	3578
Total	**414**	**10753**	**324**	**11085**	**230**	**22921**	**421**	**12775**	**220**	**12201**	**322**	**13947**

CAF= Collection Average/ Family, IAF= Income Average/ Family
Source: Primary Field Data

Table 4: Village Wise Average Total Income of Family (rupees/ year) from Different Sources

Source of Income	Average In come Per Family (Rs.)					
	Upri Khori	Nichli Khori	Goras	Ameth	Dob	Total
Agricultural Product	2120	3000	0	3094	1024	1848
Domestic Animals	0	667	1902	1203	980	950
Eggs/ Cocks / Hens	67	0	516	250	280	223
NTFP Gathering	10753	11085	11360	12475	12203	11575
Artisans	0	3790	0	0	0	758
Wage earned	6133	6700	3423	4125	3000	4676
Total	**19073**	**25242**	**17202**	**21147**	**17487**	**20030**

Source: Primary Field Data

It refers to the total annual income of each family earned from various sources like agriculture, domestic animal, egg/ cocks/ hens, NTFP gathering, artisan and wage labourer etc.

It can be seen from table 4 notably that, there is great difference in average income of family from artisan work sources particularly from *nicktenthus tukri* and stood as major contributor of total income i.e. Rs.758/- year. Moreover it can be said that in all the same 5 villages NTFP sector has been shifted from a subsidiary occupation to a commercial enterprise contributing equally or more towards total income of the respondents.

In all the 5 villages the average total income per family which raised up to Rs. 20030/- year in 2008-2009. Similarly, in Nichli Khori and Ameth village it was high i.e. Rs.25242/- and Rs. 21147/- year respectively. It can be noticed that in Ameth and Dob villages, which can be attributed to large landholding size (2.75 acre and 1.88 acre respectively) as compare to Upri Khori village (1.31 acre). But due to frequent drought as well as low rainfall over the year the growth of total income was found marginal. Therefore it is evident that for sustenance of rural economy natural resource management; particularly water management by the village community is essential component.

In many areas, as use of local biodiversity decreases, a diet lack in

variation but high in calories contributes to increasing problems of obesity and non communicable disease.[12] The globalization of culture and commerce forests a westernization of developing of country food systems and diets. Where high rates of infectious illness persist and under nutrition and over nutrition co-exist, communicable and non- communicable diseases creates a double burden. Chronic diseases pose a staggering cost, particularly for Sheopur district and economies in transition. A recent report by the World Health Organization[1] estimated that the loss in national income as a result of heart disease, stroke and diabetes over the next 10 years for populous countries. The challenge is to address a problem whose causes and consequences span health, agriculture, culture, markets and environment.

While the impact of rapid socio-cultural changes can be seen throughout the Sheopur forest division of Madhya Pradesh, those areas that retain strong traditional food systems in which diet has recognized health, cultural and ecological roles are better able to avoid the concomitant increases in disease. Asian and Mediterranean diets provide the clearest examples.[13,14]

Markets, Health and Human Behaviour

Most Sahariya poorest households are in Sheopur forest division harbouring the largest amounts of biodiversity, much of it in and associated with dry deciduous forests. As a consequence, conservation and poverty cannot be addressed independently. Since most of the world population today depends at least in part on purchase foods, improving accessibility to a range of unprocessed and processed forest product offers nutritional benefits to the rural and urban poor. This can be best achieved within a model linking local producers and consumers in which biodiversity contributes to poverty reduction and viable economies within a supportive socio-cultural contest. The model draws on recognized and potential synergies among biodiversity conservation, income improvement, socio-cultural values and health outcomes. For example, while direct use of plant and animal resources coupled with income generation and integrity of socio-cultural traditions contributes to better nutrition and health, a healthy population is conversely more likely to have the incentive and resources to better manage its natural environment. Local communities can manage and use gathered and cultivated species to improve their livelihoods by developing products that can be marketed to meet demands of local food cultures and offer nutritional and cultural benefits to (increasingly urban) consumers. Thus, linking biodiversity and health is both a response to the consequences of economic growth and a way to direct growth in a positive manner.

Forest biodiversity at the local, national and regional levels is a priority and can include the transfer and sharing

of information and successful experiences in defending and enhancing the dietary use of plan and animal diversity.

Policies and regulations related to trade and to human rights, including cultural and food rights, must ensure the viability of food systems that guarantee the sustainability of local ecosystems and respect cultural traditions. The international voluntary guidelines on the right to food [15] for example, explicitly recognize the importance of customs and traditions on matters related to food. The rationale for the cross- cutting initiative on biodiversity for food and nutrition of the Conservation on Biological Diversity (CBD, 2006)[16] acknowledge that "traditional food systems provide positive synergies between human and ecosystem health and culture offers an essential context for mediating positive dietary choices".

Suggestion

The importances of biodiversity for providing nutrients and medicinal agents that can improve health, a strategy involving research, improve marketing, consumer education, policy and the strengthening of partnerships will reinforce the usefulness of biodiversity. The contributions of traditional foods and medicines to health as well being are sufficiently understood to warrant a new prioritization of the marketing of forest foods within the context of strategies to support forest based livelihoods and food based approaches to health. Basic research that can support these activities should include:

(i) Laboratory analysis and compilation of data on the nutrient and phytochemical composition of underused forest products, including consideration of seasonal variability;

(ii) Documentation of links between forest biodiversity and dietary diversity within traditional food systems;

(iii) Survey of the state of traditional knowledge of food diversity and its uses among population subgroups;

(iv) Study of factors, including seasonality that contribute the food choices of local Sahariya, rural and urban dwellers, specifically those involving foods coming from forests;

(v) Testing of hypotheses on the relationship of forest and agricultural biodiversity to dietary diversity and health, including the use of epidemiological methods to demonstrate contributions of biodiversity to the health of Sahariya populations.

(vi) Development and testing of methods for measuring the dietary diversity of rural producers and urban consumers and its association with nutritional and health status;

(vii) Analysis of production, marketing and other factors that contribute to the availability of a diverse diet.

In the study area knowledge of local resources, customs and cultural values should have a fundamental role in identifying sustainable approaches to improving diets and health. A growing body of reliable data collected among the Sahariyas in Sheopur forest division, Madhya Pradesh addresses the health properties of indigenous foods and medicines.

CONCLUSION

Forest biodiversity for health objectives are likely to be multisectoral, multidisciplinary and problem focused. They recognize dietary diversity as a fundamental, cost effective and sustainable way of resolving health problems related to malnutrition, but also that diversity based approaches to improving nutrition and health depend on the conservation and sustainable use of forest and other wild species and biodiversity.

Formulation and implementation of effective strategies involves the participation and integration of the expertise of multiple stakeholders from the scientific, health government and private sectors. At the national level, ministers responsible for environment, health and nutrition, agriculture, forestry, economic development, culture and education could promote forest products within collaborative initiatives for human and ecosystem health, in conjunction with infrastructure and programme support for producers and marketers of priority foods. While international policy instruments such as CBD can offer direction to national initiatives, they also underline the need for coherent policies that unite environmental, health, agriculture and economic development priorities within the framework of the Millennium Development Goals.

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RARE TRIAD OF INJURIES IN LOWER LIMB - A REPORT OF TWO CASES

Rajesh Thembhunikar*

Abstract: *Multiple injuries of the lower limb are common in high energy trauma and are commonly seen in road traffic accidents and in industrial accidents. Their incidence has increased over time, as a result of increase in vehicular traffic and industrialization. Often patients encounter multisystem injury and require an individualized approach that is prioritized, coordinated and comprehensive.*

We present here 2 cases with rare triad of ipsilateral lower limb injury as result of high energy trauma. First patient was case of 35 yrs tribal male presented with a right sided intertrochanteric fracture, supracondylar fracture of femur with proximal tibial fracture with old operated fracture tibia lower 1/3 with plating , which was then managed by dynamic hip screw, cobra plating for supracondylar fracture femur and hybrid fixation for proximal tibial fractures. Second tribal patient had an intracaspular neck femur fracture, M/3 shaft femur fracture and fracture of lateral condyle Tibia in the Right lower limb, which was managed by closed Proximal Femoral Nail and Hybrid External fixator.

Two years post surgery and treatment both patients have returned to their previous occupations and have no restriction in movement at hip and knee. Floating knee injuries are routinely encountered,; however, such combination is rarely seen.

INTRODUCTION

Combined injuries to the lower limb are always indicative of high energy injury and may be associated with life threatening condition.[1,2] Various patterns of combined skeletal injuries have been reported.[3,4] Ipsilateral diaphyseal fractures of femur & tibia have been called floating knee injuries [5] but may include combination of diaphyseal, metaphyseal & intraarticular fractures. Early fixation and mobilization of the patient results in excellent recovery. Stable fixation and early mobilization of hip & knee is the key to successful treatment. The surgical management of this constellation of injuries combining with Floating Knee (Figure 1) is discussed in the light of the current principles of management of a multiple injured patient.

PATIENT ONE

A 35 yr. old tribal male following a Road Traffic Accident (RTA) sustained ipsilateral injuries to right tibia and femur that includes Intertrochanteric, supracondylar fracture femur with proximal tibial fracture [6,7] (all closed fractures) without distal neurovascular deficit.

On admission his right lower limb was shortened and exhibited abduction & external rotation. He had marked swelling and pain around right Knee with

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haemarthrosis, which was aspirated. Plain radiograph revealed right intertrochanteic fracture, right supracondylar fracture femur (Type III B Muller) (Figure 2) with right proximal tibial fracture with intraarticular extension (Schatzkar type III) (Figure 3) with an old operated fracture Right tibia lower 1/3rd with plating done two years earlier.

Three days after trauma, the patient was taken up for fixation, under Epidural anaesthesia, the patient was laid in supine position in a simple operating table for first fixation of supra condylar fracture of femur with cobra plating through lateral approach, then intercondylar fracture of tibia was stabilized with hybrid fixation (percutaneous intercondylar screw with external fixation under image control). This was followed by fracture table attachment for fixation of intertrochanteric fracture with Dynamic hip screw. Patient with stood all the surgeries well and only a single unit of blood transfusion was required intraoperatively. Later in postoperative ward one more unit of blood was transfused. Duration of surgery was about 4 hrs. No peri or post operative complication were encountered.[8] Post operatively after 48 hrs of wound drainage active quadriceps and knee mobilization was encouraged. At the time of discharge, after removal of stitches and primary healing of the wound, patient attained approximately 60 degree of flexion at right Knee. Follow up of the patient was recorded at 1st, 3rd, 6th, 9th month, 1 year and at 2 years. ROM at knee and hip were recorded and status of fracture union was evaluated radiologically. Partial weight bearing was allowed at 10 weeks after radiological signs of union were confirmed, at the same time, the external fixator at right tibia was removed leaving only the cancellous screw in situ. At 6 months Range Of Motion (ROM) at knee was 80° with full range at hip, the patient was able to squat and sit cross legged. Radiologically union (Figure 4) progressed satisfactorily and hence full weight bearing was started and the patient was advised to continue his regimen of strengthening and mobilizing exercises. At one year he was fully independent with returned to his previous duties with complete radiological union (Figure 5). At two year follow up the patient complained of no problems and was fully independent. During this time his lower tibia plate was removed elsewhere.

PATIENT TWO

A 31 year old tribal male suffered road traffic accident and sustained an intracaspular neck femur fracture, M/3 shaft femur fracture and fracture of lateral condyle Tibia in the Right lower limb. He also sustained a fracture of the 5th & 6th ribs on the right side. Patient was hemodynamically stable and strapping for broken ribs was done immediately. After stabilization and anesthetic fitness the patient was moved for operation and a closed Proximal femoral Nailing was done (Figure 6). To stabilize the neck and shaft fracture and hybrid external fixator was applied over the proximal tibia.[9.10] Total time taken was 2 hrs with no intraop blood transfusion was required.

Static quadriceps drill and knee mobilization was started from 1st post op day and were limited by the patients comfort. Non weight bearing walker frame mobilization was started from 3rd post op day and the patient was discharged after stitch removal and primary wound healing on the 10th post op day. At 3 months the patient had 90° ROM of knee with near normal hip ROM. Radiological picture was suggestive of delayed union at the femoral shaft and decision to follow-up was made before intervention was also subsequently delayed by a week. The external fixator frame was removed (Figure 7) and patient allowed partial weight bearing.

At 6 months, radiological union was delayed at the distal femoral fracture hence percutaneous autologus bone marrow infiltration was done at the fracture site under IITV control, the procedure was repeated again after a gap of 3 weeks. At 9 months ROM of knee was >100° and the distal femoral site showed signs of union, visible callus at the fracture site. There was a limb length discrepancy of around 1.5cm for which shoe raise was advised. At the end of 1year the patient was walking without support and has ROM at knee > 100° with full squatting and sitting cross legged. At 2 year follow up the patient was fully independent with no restriction of movement at hip or knee (Figure 8&9). The X-ray revealed that the implant (PFN) had failed at the first distal locking side but with solid union at the fracture site. This was in all probably caused by the delayed union at the femoral diaphyseal fracture site.

DISCUSSION

Ipsilateral fracture of femur & tibia are serious injuriesthat are often associated with major injuries to head, chest, viscera and musculoskeletal system.[11] Various studies have revealed that fracture of the ipsilateral limb requires immediate stabilization of tibia by external / internal means within 2 weeks and results in excellent outcome.[12]

A study of ipsilateral fractures of femur & tibia concluded that at least one fracture, preferably femur, can be stabilized by internal fixation & in another study suggested that rigid internal fixation seems to be more appropriate in fractures other than type III compound fractures. Ipsilateral fractures of femur & tibia 13 are commonly seen with road traffic accident especially in unprotected two wheeler riders.

Internal fixation of both fractures is ideal for early mobilization of both patient and the joint, as the subcutaneous bone hybrid fixation using a subchondral cancellous screw supported by an external fixation of tibia is an acceptable treatment for proximal tibial fractures. Combined treatment with internal & external fixation can produce good results with early mobilization of knee & hip being one of the key factors for successful outcome.

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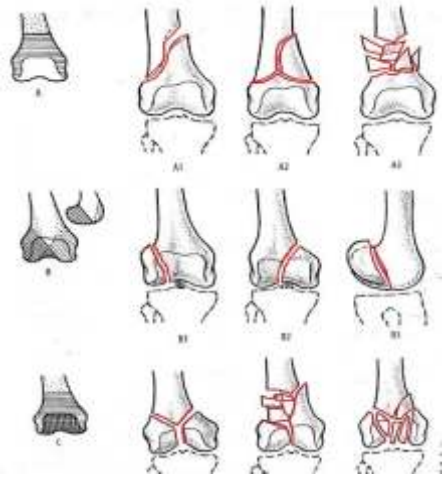

Figure 1: Muller's classification for # distal femur.

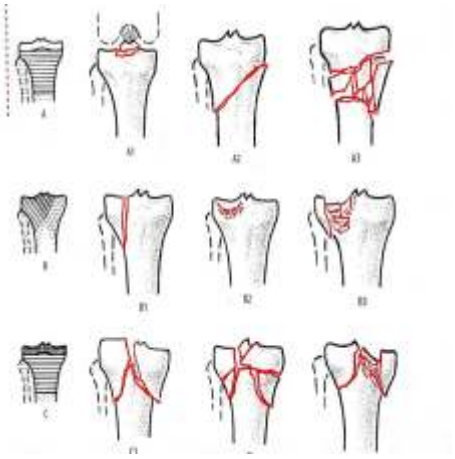

Figure 2: AO Classification for # proximal tibia.

Figure 3: Preoperative X-ray patient 1 showing floating knee

Figure 4: Postoperative scanogram showing four surgeries in ipsilateral lower limb.

Figure 5: Patient 1 postoperative clinical photograph.

Figure 6. Patient2 X-ray pelvis with Proximal Femoral Nail (postoperative).

Figure 7: Patient2 postoperative X-ray after removal of fixator tibia.

Figure 8: Patient 2 with full weight bearing (follow-up).

Figure 9: Patient 2 with squatting position (follow-up).

ANTENATAL AND POSTNATAL PRACTICES AMONG THE BAIGA OF MANDLA DISTRICT MADHYA PRADESH

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Abstract: *Pregnancy among Baiga is considered as a natural phenomenon and survival of the child is considered as the will of the God. Often the death of a woman during childbirth is taken more seriously. For present investigation data was collected from 300 Baiga households of 14 villages of District Mandla of Madhya Pradesh. Different Anthropological techniques were used in data collection. The finding of the study indicates that large proportion of women face different health ailments after delivery and need specialized care. The problems reported by them were fever, persistent back pain, swelling etc. In case of post natal issue 25 % women seek treatment from Government institutions (PHC/CHC/Hospital), 19.4 % responded that in case of post natal complication, they approach private practitioner. Still large proportion of women (36.1 %) practice home remedies and a meager proportion of women went to traditional healers (5.6 %). The study revealed that Baiga women still prefer Home delivery. This may be due to poor network of health infrastructure, corruption in the system and neglecting attitude of staff towards the tribal people*.

INTRODUCTION

Worldwide, about 500,000 women die every year from pregnancy and childbirth related causes. The majority of deaths due to maternal causes are avoidable if pregnant women receive adequate antenatal care during pregnancies, having deliveries in hygienic conditions and with the assistance of trained medical practitioners and receive appropriate and timely postpartum care.[1] The infant mortality is largely affected by antenatal care. Children of mothers who had received antenatal care showed lower mortality than other children who did not receive any antenatal care.[2,3]

As Baiga is a primitive tribe, they live in far-flung, remote and inaccessible area of the hilly Mandla district of Madhya Pradesh. According to census of India (1991) the population of this particularly vulnerable tribe was 317549 whereas they were estimated 18,000 in 1869 closely approximated to the census statistics. One special survey was conducted by Tribal Research Institute (TRI), Bhopal (M.P.) to enumerate the Baigas in 1992-93 and counted 134357 individuals. They were spread in 1215 villages of Mandla, Shahdol, Balaghat, Bilaspur and Rajnadgaon.[4] According to Shrivastva (1999) approximate 43% of Baiga live in Shahdol district (MP), 18.5% in Mandla district (MP), 17.5% in Sidhi (MP) and rest are in Bilashpur (CG), Balaghat (MP), Rajnadgaon (CG) and Surguja districts (MP).[5] Several of national socio-demographic goals for 2010 pertain to safe motherhood. For 2010, the goals were that 80% of all deliveries should occur in institutions, 100% of deliveries need to be attended by trained personnel, and the mortality ratio

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should be lowered to a level below 100 per 100,000 live births. Since 1996, safe motherhood and child health services were incorporated into the reproductive and child health programme (RCH). The National Population Policy adopted by the Government of India in 2000 reiterates the government's commitment to safe motherhood programmes within the wider context of reproductive health.[6]

Baiga are widely studied by many scholars viz. Elvin (1939),[7] Awadh (1950),[8] Nag (1955),[9] Patta (1958),[10] Lohari (1984),[11] Reddy and Modell (1996),[12] Tiwari (1997),[13] Dwivedi (2003),[14] Gautam and Jyoti (2005),[15] Nema and Gautam (2006),[16] Chaudhary and Gautam (2006),[17] Gautam et al. (2007),[18] Gautam (2008)[19] Gautam et al (2007),[20] Gautam (2011),[21] Jhariya et al(2013a),[22] Jhariya et al. (2013b),[23] Verma (2002)[24] but the aspect of child health is rarely explored. Therefore the present study is focused on delivery health care practices among the Baiga.

MATERIAL AND METHOD

Mandla is one of the tribal dominated districts of Madhya Pradesh State. This study is based on the information collected from 300 Baiga families, selected randomly from 14 villages of district Mandla. Firstly, the villages having Baiga population were listed. These villages were arranged in descending order on the basis of their population. The villages having greater concentration were selected on the basis of proportion to population size (PPS). The information was collected in a semi-structured schedule. Simultaneously interview methods of data collection were also adopted for collection of relevant data. Information on Ante Natal Care or ANC Practices like Ante Natal Care (ANC) Registration, ANC check-up, source of ANC check-up, Tetanus Toxoid (TT) Immunization, Supplementary Nutrition (Iron/Folic acid), Delivery Practices, Place of Delivery, Birth attendant, Position of delivery, Post Natal Care or PNC Practices, Post Natal care (PNC) care, Post Natal Problems, Post Natal treatment, Premature delivery etc. were collected.

RESULTS

The study findings are presented category wise as follows:

Antenatal Care or ANC Practices

To improve the status of the maternal and child health, and to reduced the maternal and child mortality; the National and State Government are running different programmes one of them is RCH. In these programs the women of reproductive age and eligible couples are encouraged for recommended ante-natal practices, these include at least 3 ante-natal check-up, 2 TT Immunization and supplementation of Iron and folic acid tablets. During present study the information gathered regarding antenatal Practices of Baiga women are:

Antenatal Care (ANC) Registration

It was found that out of 300 women only 43 were actively engaged in reproduction during last one year and out of these 88.4 % were registered for Ante Natal care (ANC). (Table 1). The Baiga being a Primitive tribe coming forward for Ante Natal care (ANC) is appreciable but the grass root workers like Aganwadi worker (AWW), Accredited Social Health Activists (ASHA), female health worker, and even doctor at respective PHCs need to provide special attention and motivation to improve the Ante Natal care (ANC) registration of Baiga women.

Table 1: Ante Natal care (ANC) among Baiga women

S.N.	Pregnancy and delivery related practices	N	%
1	**Registered for ANC**	38	88.4
2	**ANC check –up**		
	1.Once or twice	22	57.8
	2.Thrice or more	16	42.1
3	**ANC check–up source**		
	1.Govt CHC/PHC	16	42.1
	2.ANM/AWW	22	57.8
4	**TT Immunization**		
	1.Single dose	7	18.4
	2.Two or more dosage	31	81.5
5	**Place of delivery**		
	1.Home	37	86.0
	2.Institution	6	14.0

ANC check–up

As evident from Table 1, only 42.1 % women received Ante Natal care (ANC) check-up at least thrice, remaining 57.8 % women did not received Ante Natal care (ANC) as per recommendation of RCH program and standard norms. They received ANC care 1 or 2 times only.

ANC check–up source

It was found that 42.1 % women received Ante Natal care (ANC) check–up from government CHC/PHC whereas 57.8 % women were provided check–up by grass root worker, like Aganwadi worker and Female health worker (Table 1).

Tetanus Toxoid (TT) Immunization

For safe motherhood two doses of tetanus toxoid (TT) is essential during the first or second trimester of pregnancy but among rural and tribal groups the coverage of TT immunization was reported unsatisfactory hence in the present study the information were collected and it was found that 81% received 2 dose of TT immunization whereas rest 18.4 women received only a single dose (Table 1).

Place of Delivery

In the present investigation it was found that 86 % of deliveries among Baiga were conducted at home during last one year and during the same period only 14 % deliveries were conducted at institution like PHC/SC/CHC/Govt. Hospital (Table 1). This finding clearly indicates that there is need of special attention to improve the institutional delivery practices among the Baiga.

Birth attendant

The information collected about birth attendant is presented in the (Table 2), which clearly indicates that only 14 % of the deliveries were attended by Female health worker and only one delivery was attended by Doctor whereas rest 84 % of the deliveries were not attended by any properly trained personnel.

Table 2: Birth attendant among Baiga women

Birth attendant	N	%
Self	6	14.0
Mother- in- law	19	44.0
Elderly ladies of house	5	11.6
Trained birth attendant	6	14.0
LHV/ANM	6	14.0
Doctor	1	2.32
Total	**43**	**100**

Position of delivery

Through the case-studies and focus group discussion (FGD) information were gathered about position of delivery. It was found that in most of the cases the delivery is conducted in supine position whereas in some of the cases the delivery was conducted in sitting position.

Postnatal Care or PNC Practices

Similar to proper antenatal care of prospective mother, standard postnatal care (PNC) of mother and child is essential for good health of both. Standard postnatal care (PNC) practices also reduces maternal and child mortality. Among Baiga the postnatal care practices were also examined.

Postnatal care (PNC) care

After delivery care by experienced and trained person is essential for few days until the recovery of mother. In the present study it was found that in 83.7 % cases the PNC care was provide by mother-in-law similarly in 9.3 % cases the PNC care was provide by female health workers and in 7 % cases the PNC care was provide by Dai (Table 3).

Table 3: Postnatal care (PNC) care among Baiga women of Mandla district

PNC care	N	%
Mother in law	36	83.7
ANM/LHV	4	9.3
Dai	3	7.0
Total	**43**	**100.0**

Postnatal Problems

As evident from Table 4 it can be stated that 22 % women experienced health issues post delivery. This indicates that large proportion of women face different health issues after delivery and needs specialized care. The problems reported were fever, persistent backpain and swelling of pelvis etc.

Table 4 : Distribution of women as per post-natal problem faced by them

PNC problem	N	%
Problem faced	9	20.9
No problem	34	79.1
Total	**43**	**100**

Postnatal treatment

Out of 43 women who were actively engaged in reproduction during past one year 36 of them experienced PNC problem 25% women sought treatment from Govt. institution (PHC/CHC/Hospital) 19.4% women approached private practitioner. Yet large proportion of women (36.1%) took home remedy and a meager proportion woman went to traditional healers (5.6%) for PNC (Table 5).

Table 5 : Postnatal treatment received by Baiga women.

Postnatal treatment	N	%
Govt. Hospital/CHC/PHC/SC/Dispensary	9	23.6
Private Practitioner	7	18.4
Trained Dai	3	7.8
Home remedy	13	34.2
Traditional Healer	3	7.8
Any other	3	7.8
Total	38	100

Premature delivery

A premature birth is defined as one that occurs less than 37 weeks after conception. There are many reasons of premature birth viz. maternal toxemia, hypertension, abnormal attachment of the placenta, congenital malformation of the infant, poor maternal health, hygiene, poor nutrition, accidents and acute illness etc. In the present study it was found that a total of 1 % women reported premature delivery.

Table 6: Occurrence of premature delivery among Baiga mothers

Premature delivery	N	%
No Premature delivery	297	99
Premature delivery	3	1.0
Total	300	100

CONCLUSION

It was found that out of 300 women only 43 were actively engaged in reproduction during past one year preceding the study and among them 88.4 % were registered for ante-natal-checkup (ANC). This finding indicates that still around 12 % women are not even being registered for ante-natal care (ANC). Forty two per cent women received ante-natal care (ANC) check-up at least three times; remaining 58 % women did not receive ante-natal care (ANC) check-up as per recommendation of RCH and standard norms. However, they registered for ante-natal care (ANC) check-up and received either one or two services. Baiga and neighboring tribe have only one option for ante-natal care (ANC) checkup i.e. government institutions and government employed health personnel like female health worker/Aganwadi worker etc. Regarding tetanus toxoid (TT) immunization of Baiga women, it was found that out of 38 women only 81.5 % received 2 dose of tetanus toxoid (TT) immunization. In the present investigation it was found that in spite of best efforts by Government 86 % of deliveries among Baiga were conducted at home during last one year and during the same period only 14% deliveries were conducted at institution like PHC/SC/CHC/Govt. The information collected about birth attendant who clearly indicates that only 14% of the deliveries were attended by Female health worker and only one delivery was attended by Doctor whereas rest 84% of the deliveries were not attended by any properly trained personal. It was found that in 83.7 % cases the post natal care (PNC) care was provided by mother-in-law similarly in 9.3 % cases the post natal care (PNC) care was provided by female health workers and in 7% cases the post natal care (PNC) care was provided by Dai. Out of 40 women 22% responded that they faced health problem after delivery. This indicates that large proportion of women

face different health problem after delivery and need specialized care. The problems reported by them were fever, persistent back pain, swelling etc. In case of post natal care (PNC) only, 25 % women seek treatment from Govt. institution (PHC/CHC/Hospital) and (36.1%) take home remedy and a meager proportion woman approach to traditional healer (5.6 %) for post natal care (PNC).

It can be inferred that the Home delivery is still preferred by Baiga. The reason behind that is poor network of health infrastructure, corruption in the system and neglected attitude of staff towards the tribes. The existing program needs proper awareness, motivation and monitoring.

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