

TEN PUBLICATIONS IN ORDER OF SIGNIFICANCE

1. Das K, Das K, Mukherjee PS, Ghosh A, Ghosh S, Mridha AR, Dhibar T, Bhattacharya B, Bhattacharya D, Manna B, Dhali GK, Santra A, **Chowdhury A**. Nonobese population in a developing country has a high prevalence of nonalcoholic fatty liver and significant liver disease. *Hepatology*. 2010; 51: 1593 – 1602.

No. of citations: 529

This paper is considered to be a landmark one in NAFLD research, having had brought to mainstream research and public health focus the entity named 'NAFLD IN lean Individuals' or lean NASH that is of significant interest globally. While the link between obesity, affluence and fatty liver disease is well known, this community based epidemiological work in West Bengal had shown that NAFLD with significant liver disease can occur even in apparently lean (BMI is a poor surrogate of body adiposity) people who are the majority population in the developing countries. Subsequently, many research groups working with Asians as well as Caucasians have upheld the validity of the entity, underscoring the significance of this paper.

This study was a general population based estimate of fatty liver disease in a population of Birbhum, West Bengal. The background prevalence of obesity defined by BMI and waist circumference was low. Despite this nearly 8% of the population had NAFLD, including cirrhosis in a small subset. Insulin resistance, metabolic syndrome, markers of inflammation were all present with fair frequency even amongst those who were considered sub threshold for obesity, thereby evading attention for BMI based metabolic ill health. This work has been highly cited and considered to be the one that garnered international interest in *NAFLD among lean individuals*. The methodology adopted (community screening followed by deep phenotyping in institutions), extensive evaluation of disease and its pathophysiology and the insights coming from analysis of data were robust and innovative. Many downstream mechanistic studies have been undertaken by this group, including genetics of lean NAFLD by this group subsequently. In view of the spiraling burden of NAFLD in India, the core scientific and public health significance of this study has been highly appreciated by peer groups.

2. Das K, Sarkar R, Ahmed I M Sk, Mridha AR, Mukherjee PS, Das K, Dhali GK, Santra A, **Chowdhury A**. Normal liver stiffness measure (LSM) values are higher in both lean and obese individuals: a population-based study from a developing country. *Hepatology* 2012; 55: 584-593.

No. of citations: 111

The development of transient elastography (TE; Fibroscan) is one of the major breakthroughs in the field of noninvasive assessment of liver fibrosis. TE provides quantification of the complex biological phenomenon of liver stiffness and establishment of a set of normative values and setting a cutoff for "normalcy" in different populations is important for its clinical application. Working with healthy, free living population of Birbhum, West Bengal cohort and also with patients having liver disease, this study had

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evaluated the range of liver stiffness measures (LSM) in healthy individuals of a community, in asymptomatic liver disease subjects without fibrosis and in patients with advanced fibrosis and delineated the LSM cutoffs in Indian population. The study demonstrated that lean people do have significant elevation of LSM values as compared to individuals with normal BMI/ waist circumference, implying that anthropometric leanness did not always indicate absence of liver fibrosis. This was a further evidence following up on the 2010 study of Chowdhury's group on NAFLD in lean.

3. Albhaisi S, Chowdhury A, Sanyal A. Non-alcoholic fatty liver disease in lean individuals . J Hep Reports. 2019; 1(4): 329–341.

No of Citations: 109.

This was a review and hypothesis generating paper on Lean NASH based on data that the author generated and comparing that in the context of contemporary global information. It entailed an exhaustive analysis of epidemiology, pathophysiology, clinical features and potential therapy approaches to this entity that was initially considered to be an outlier phenotype and then has come to center of public health discourses. The significance of changes in the gut leading to metabolic stress and inflammation in the liver in NAFLD was discussed to be important in the lean phenotype to be common particularly among Asians. This paper is considered to be one of the most widely read and quoted paper in relevant discourses.

4. Ghosh S , Barik A , Majumdar S , Garain A , Mukherjee S , Majumdar S Chatterjee K , Bhaumik S , Bandopadhyay SK, Satpathi B , Majumdar PP, Chowdhury A . Health & Demographic Surveillance System Profile: The Birbhum population project (Birbhum HDSS). Int J Epidemiol. 2015. 44: 98-107.

No of Citations: 42.

A population laboratory is a treasure island for biomedical research. It brings a socio-demographic interface that is so important in disease causation and human health. It also allows development of cohorts for studies on outcomes in chronic diseases. India does not have many such and building one involves pulling together of resources from many areas, plan it well and implement it. This paper describes the efforts of Dr. Chowdhury and colleagues in development of an useful health and demographic surveillance system in a rural population. The Birbhum population project was an eventful culmination of the initial epidemiological work that Chowdhury has been engaged in since early 2000's in this population. This paper describes the structure, steps in development including population characterization, regulatory principles and potentials of the cohort that has subsequently been the subject of many a remarkable studies by Chowdhury and other scientists.

The Birbhum HDSS was established in 2008 and covers 351 villages in four administrative blocks in rural areas of Birbhum district of West Bengal, India. The project currently follows 54 585 individuals living in 12 557 households. As a population laboratory, the cohort has attracted development of a research ambience and culture for contextually relevant research in epidemiology, implementation of health programs as well as sociology of human health



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and diseases. The importance of this paper is description of its' genesis that has attracted researchers from many different countries working in population health globally .

5. Barik A, Shah RV, Spahillari A, Murthy VL, Ambale-Venkatēsh B, Rai RK, Das K, Santra A, Hembram JR, Bhattacharya D, Freedman JE, Lima J, Das R, Bhattacharyya P, Das S, **Chowdhury A**. Hepatic steatosis is associated with cardiometabolic risk in a rural Indian population: A prospective cohort study. *Int J Cardiol*. 2016; 225: 161-166

No of citations: 12

Cardiovascular disease is the most critical clinical event in NAFLD. While many studies in population cohorts in the west has demonstrated this tight link, data on this in Indian population cohorts studying significance of this was lacking. This study in Birbhum cohort was a large scale, population based, extensive evaluation of fatty liver disease and cardiovascular risk factors in the context of rural population. The study was designed in away to assess metabolic risk, fatty liver diseases and carotid intimal medial thickness as a marker of subclinical cardiovascular disease. In order to compare, a frame was drawn where the data from Birbhum population was compared with a multiethnic population of United states. The authors included scientists from both countries. Rural Indians exhibited a higher visceral adiposity index and pro-atherogenic dyslipidemia at a lower BMI than Americans. These results underscored the emerging relevance of hepatic steatosis and adiposity in the developing world and suggest efforts to target these accessible phenotypes for cardiometabolic risk prevention.

6. **Chowdhury A**, Santra A, Chaudhuri S, Dhali G.K., Chaudhuri S, Maity SG, Naik TK, Bhattacharya SK, Guha Mazumder DN. Hepatitis C virus infection in general population: A rural community based study in West Bengal, India. *Hepatology*. 2003; 37: 802-809.

No. of citations: 264

This was the first community population based epidemiological study on Hepatitis C virus infection in India. Prior studies on this aspect were all hospital based or blood donor based and therefore were not robust to help in formulating preventive measures. The study included 3,579 inhabitants of 9 villages of Birbhum and used a door to door approach and a structured questionnaire for collecting sociodemographic details, present and past health status and blood samples followed by molecular epidemiological analysis along with tests for liver function. The prevalence estimates, genotypes of HCV in infected individuals and also factors promoting viral transmission in the community were determined. This study was a major breakthrough in uncovering the dynamics of HCV transmission in a population beyond the western countries and *helped in planning the national viral hepatitis control program subsequently.*

7. **Chowdhury A**, Santra A, Chakravorty R, Banerji A, Pal S, Dhali GK, Datta S, Banerji S, Manna B, Roy Chowdhury S, Bhattacharya SK, Guha Mazumder DN.

Community based epidemiology of Hepatitis B virus Infection in West Bengal, India: Prevalence of HBeAg negative infection and associated viral variants. *J Gastroenterol Hepatol.* 2005; 20: 1712-1720

No of citations: 101

This was a large scale community-based epidemiological study of Hepatitis B virus (HBV) infection carried out in Birbhum, West Bengal that provided valuable insights into the magnitude and pattern of HBV infection, hepatitis B e antigen (HBeAg)-negative infection and the associated viral mutants in India. The study documented that ~3% of the population tested positive for hepatitis B surface antigen and HBV acquisition had started in early childhood and peaked in adulthood. The indiscriminate and unsterile injection practice prevailing in the rural community along with birth at home were found to be the important causes of viral transmission. Most infections in the community were e-negative and inactive and were associated with wild type HBV sequences and there was very low prevalence of mutations in the precore (PC) stop codon and basal core promoter (BCP) regions of HBV. These findings uphold the need for behavioral changes and at birth or early childhood immunization for the prevention of HBV infection. The nature of the study (community based), the genetic analysis of HBV done here and identification of the risk factors of HBV transmission had made it a landmark study and contributed significantly in the subsequent design of national HBV control program in India.

8. Das J, Chowdhury A, Hussam R, Banerjee AV. The impact of training informal health care providers in India: A randomized controlled trial. *Science.* 2016; 354(6308). pii: aaf7384.

No. of citations: 150

This was an implementation research in the design of a randomized controlled trial seeking effectiveness of an intervention for development of alternate health care human resource in the context of rural health care delivery. It had come out of investigations in health care policy, which revealed that untrained, health workers of the informal sector are the first point of contact in at least 70% occasions by rural people in India. While their quality is a significant concern, the non-availability of trained health care personnel is the primary factor for this need and the supply imbalance resulted in the existence of an almost parallel system in the difficult to access setting. This paper was an impact assessment in RCT design of a training program with around 350 informal sector health care workers to see whether that improves their practice behavior or not. The methodology adopted was very robust with standardized patients ("mystery clients") used as assessors and data collectors. The data did show some improvement in the trained personnel practice while there were no improvements in several areas of their behavior including usage of unnecessary medications and antibiotics. This study designed by Prof. Abhijit Chowdhury along with Prof. Abhijit V Banerjee did invoke significant attention and debate in policy circles. Importantly, this research formed the basis of an up-scaled training program for the informal workers in the state of West Bengal. It has also been widely cited in view of the novelty of the finding, rigor pursued in the research and implications in rural health care delivery.



9. Abutaleb A, Khatun M, Clement J, Baidya A, Singh P, Datta S, Ahammed SM, George K, Mukherjee P, Santra A, Neogi S, Parikh S, Pillai V, Kottilil S, Chowdhury A. A Model of Care Optimized for Marginalized Remote Population Unravels Migration Pattern in India. *Hepatology*. 2021; 73(4): 1261-1274.

No of citation: 2

This was a general population-based study on HBV infection in remote areas of Arunachal Pradesh (state with highest HBV prevalence in India and tremendous constraints in care delivery) and covers aspects of molecular epidemiology, status of liver disease and development of a model of care. Nearly 12000 people were screened, linked to HBV care and prevention and all data were collected on tablet-based tool and transferred to a cloud data base to be analyzed later. The study was remarkable in ways of approaching marginalized community through field teams, step wise incremental complexity in methodology of analysis and magnificent teamwork with teams in four places working together in tandem (field in Arunachal Pradesh, laboratory in Tezpur, Assam, apex laboratory in Kolkata and analytical coherence brought with a team in USA). Beyond the specifics of data that showed unique genotypes of HBV that correlate with the population migration patterns in the area, the study described an unique, simplistic model of care that was able to link a highly resource-limited population to screening, preventive vaccination, follow up therapeutic care and HBV characterization using an electronic platform. This model of care can be applied to other similar settings globally.

10. Mukherjee PS , Ghosh S , Mukhopadhyay P , Das DK, Sarkar P , Majumdar S , Chatterjee K, Chowdhury A, Das K . Stepwise evaluation for the risk of metabolic unhealthiness and significant non-alcoholic fatty liver disease in India. *The Lancet Regional Health - Southeast Asia* 2023;12: 100142 .

No of Citations: 1

NAFLD is part of a wider metabolic ill health and public health strategies for prevention as well as care of NAFLD should preferably be broad based, targeting metabolic ill health. This study is the first large scale population based study in Indian population on development of a care pathway for NAFLD approaching it from a comprehensive metabolic ill health perspective. The study included 80000 population in 19 community development blocks of Birbhum. A stepwise incremental approach to evaluation of potential subjects was done, starting with anthropometry and ALT. Subsequently, appropriately selected "at risk" subjects were tested by incremental investigations – simple though – Blood sugar, Lipids. Based on the initial and subsequent tests appropriate for a stage of work up, population could be assigned to a green (no risk) , yellow (potential risk) and red (definite risk) categories . This approach allowed identification of at risk NAFLD and metabolic ill health with effectiveness. Usage of low cost, simple tests, the approach of staggered incremental testing makes this study results highly relevant and applicable for a care pathway for India and other situations of resource constrains.

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