

## **Title:** Epidemiology of Non-Communicable Disease in Rural Nepal: the NCD Nepal Study

Manoj Bhandari MD, Manoj Bhattarai MD, Bishal Belbase MBBS, Drona Pandeya MS, Sulochana Ghimire BPH, Gorakh Thapa PCL, Madan Raj Bhatt MPH, Lava Timsina PhD, Yashashwi Pokharel MD

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For more information about the NCD Nepal Study, please check website: <http://www.healthfoundationnepal.org/non-communicable-disease-project.html>

### **Background**

Non-communicable diseases (NCD), including cardiovascular disease (CVD) are a leading cause of death from low to middle income country (LMIC), yet there are limited high quality data from remote areas of LMIC, like rural Nepal.

### **Methods**

We designed a prospective epidemiological and implementation study (the NCD Nepal Study) of 40-75 years old individuals from Ghorahi Sub-Metropolitan Wards 3,4,6,7, which is 406 kilometers West of the capital of Nepal, Kathmandu (total target population 7052). We conducted screening for NCDs and provided treatment for common NCDs using mobile monthly health clinic. Persons with NCDs had labs and were invited for continuity of care and treatment using the United States and the World Health Organization based protocols. Individuals without NCDs are followed up every 1-2 years. Here, we report data of first 1119 participants from their initial visit.

### **Results**

The mean age was 54 years, 64% were women. Approximately 50% described having a monthly income of <10,000 Nepalese Rupee and about 50% had < 5<sup>th</sup> grade education (Table). The mean body mass index, waist circumference and blood pressure were 24.0 kg/m<sup>2</sup>, 82.1 cm and 124/77 mmHg, respectively. Mean daily intake of salt, fruits and vegetables were 13.2 gram, 1.1 serving and 1.6 serving, respectively. About 48% performed <30 min/daily vigorous physical activity. In general, women were younger, had lower education, higher body mass index but lower waist circumference, lower daily intake of vegetables and lower vigorous physical activity compared with men (Table). Random glucose was 126 mg/dL (N= 702) and fasting glucose was 124 mg/dL(N= 417) [Figure 1]. Mean total cholesterol (N=401), high-density lipoprotein cholesterol (N=401), triglycerides (N=401), serum creatinine (N=400) and hemoglobin A1C (N=77) are 166 mg/dL, 48 mg/dL, 214 mg/dL, 0.8 mg/dL and 7.1 %, respectively (Figure 1). Approximately 20% used unhealthy level of alcohol, 14% were current smoker and among 245 people selected using predefined protocol, the estimated 10-year risk of having heart attack and stroke was 8.5% (atherosclerotic cardiovascular disease, ASCVD risk, Figure 2). Hypertension and diabetes were prevalent in 30.8% and 30.5% respectively. Prevalent cases were identified using self-reported diagnosis and on-site diagnosis and laboratory test. Undiagnosed hypertension was present in 16.8%, while elevated glucose (fasting  $\geq$ 126 mg/dL or random  $\geq$ 200 mg/dL) was present in 20.6%. Among those who had hemoglobin A1C checked (N=77), diabetes criteria (hemoglobin A1C  $\geq$ 6.5%) was met in 40% of individuals. Overall, the burden of coronary artery disease, stroke, heart failure and peripheral artery disease was low (Figure 2), but this could have been underestimated.

### **Conclusions**

In rural Nepal, modifiable NCD risk factors are highly prevalent and a high proportion of people are unaware of having diabetes and hypertension. Well-designed community-based prospective studies with active surveillance and treatment of NCDs like the NCD Nepal Study are urgently needed in LMIC like Nepal to better understand NCD epidemiology and to assess the effect of inexpensive, locally appropriate interventions before fully manifest complications of NCDs develop. Academic institutions, non-profit and philanthropic organizations, international professional societies, biomedical industry, local government including Nepal government and Nepalese diaspora can contribute in various ways to alleviate NCD burden.

Word count: 467

**Abbreviations:** ASCVD = atherosclerotic cardiovascular disease, CVD = cardiovascular disease, Cr = creatinine, DM = diabetes mellitus, Etoh = alcohol, Glu = glucose, HbA1C = hemoglobin A1C, HDL-C = high-density lipoprotein cholesterol, HTN = LDL-C = low-density lipoprotein cholesterol, LMIC = low to middle income country, NCD = non communicable disease, Tot Chol = total cholesterol, Trigly = triglycerides

Table. Baseline characteristics from community screening in Ghorahi Sub-Metropolitan Area, wards (3,4,6,7), Dang, Nepal

Characteristics	All (N=1119)	Men (N=408)	Women (N=711)	P-value
Age, years	54.18 (11.17)	56.58 (11.24)	52.80 (10.90)	<0.001
Monthly income (in Nepalese Rupee)				0.209
<10,000	534 (48.02%)	179 (43.98%)	355 (50.35%)	
10 to <20,000	328 (29.50%)	131 (32.19%)	197 (27.94%)	
20 to <30,000	129 (11.60%)	52 (12.78%)	77 (10.92%)	
≥30,000	121 (10.88%)	45 (11.06%)	76 (10.78%)	
Education				<0.001
<5 grade	314 (49.22%)	125 (39.68%)	189 (58.51%)	
5-10 grade	259 (40.60%)	138 (43.81%)	121 (37.46%)	
11-12 grade	45 (7.05%)	34 (10.79%)	11 (3.41%)	
>12 grade	20 (3.13%)	18 (5.71%)	2 (0.62%)	
Body mass index (kg/m <sup>2</sup> )	24.05 (3.99)	23.39 (3.73)	24.43 (4.09)	<0.001
Waist circumference (cm)	82.10 (11.99)	83.38 (11.02)	81.36 (12.46)	0.007
Systolic blood pressure (mm Hg)	124.47 (35.83)	125.41 (19.81)	123.93 (42.38)	0.507
Diastolic blood pressure (mm Hg)	77.37 (11.40)	78.16 (11.24)	76.93 (11.47)	0.0821
Daily salt intake (grams)	13.23 (8.28)	12.98 (7.39)	13.35 (8.71)	0.562
Daily fruit intake (servings)	1.15 (0.54)	1.16 (0.58)	1.14 (0.50)	0.750
Daily vegetables intake (servings)	1.63 (0.61)	1.76 (0.68)	1.56 (0.56)	<0.001
≥30 min/daily vigorous physical activity				0.012
Daily	17 (9.44%)	14 (15.91%)	3 (3.26%)	
Several days a week	56 (31.11%)	29 (32.95%)	27 (29.35%)	
Once weekly	21 (11.67%)	11 (12.50%)	10 (10.87%)	
<30 min/daily vigorous physical activity	86 (47.78%)	34 (38.64%)	52 (56.52%)	
Prevalent coronary artery disease	6 (0.55%)	4 (1.00%)	2 (0.29%)	0.126
Prevalent congestive heart failure	2 (0.28%)	1 (0.38%)	1 (0.23%)	0.701
Prevalent stroke	6 (0.54%)	2 (0.49%)	4 (0.57%)	0.868

Categorical variables are expressed as N (%) and continuous variables as mean (standard deviation).  
Categorical variables were examined using Pearson's chi-square or Fisher's exact as appropriate and continuous variables were examined using Student's t-test.

Figure 1. Pertinent NCD-related laboratory values based on initial visit

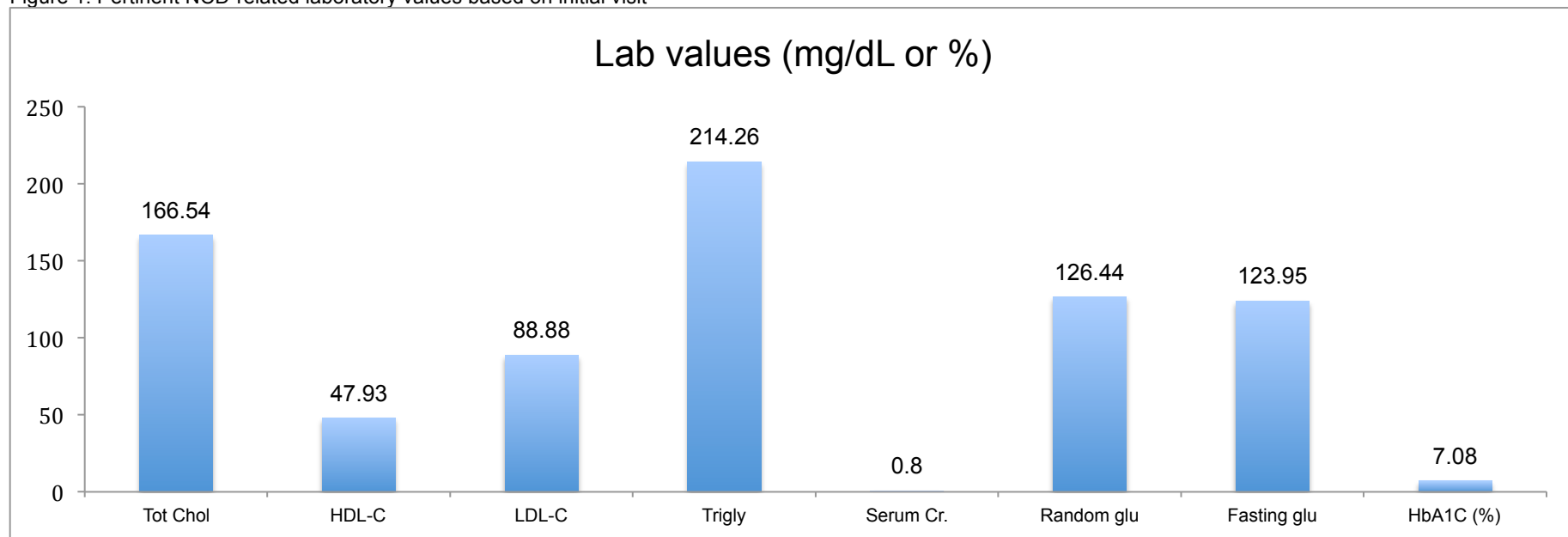


Figure 2. Burden of NCD based on initial visit

