Non-Communicable Disease Prevalence in the High-Altitude Zanskar Valley of Ladakh, India

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INTRODUCTION

- The Zanskar valley in Ladakh, India, is one of the most remote, permanently inhabited high altitude regions of the world (altitude 3500-3800m)
- Extreme isolation, limited year-round transportation routes and poor healthcare infrastructure and primary care access makes this one of the most underserved regions of India

OBJECTIVES

To examine the impact of high altitude and geographic isolation on non-communicable disease (NCD) burden in the Zanskar valley

METHODS

- N=220 (N=66 males, N=154 females) permanent high-altitude inhabitants of the Zanskar valley who presented to the ATMA-LIP Zanskar Health Camp in Padum, Ladakh (altitude 3675m) in July 2022.
- Medical histories obtained by a physician fluent in the local language. Anthropometric data, vital signs and laboratory investigations were collected.
- Limited abdominal ultrasonography performed by physicians with advanced training in point-of-care ultrasound.
- Data expressed as mean ± SEM. Data analysis performed using Student's t-tests and Fisher's exact test.

RESULTS

Variable	Males	Females	Overall	P-value
Age (y)	54.97 ± 6.77	49.81 ± 4.01	52.1 ± 3.5	P=0.070
No Education	25 (37.9%)	123 (79.9%)	148 (67.3%)	P<0.0001
Smoker (N/%)	21 (32.3%)	1 (0.65%)	22 (10.1%)	P<0.0001
Alcohol (N/%)	27 (42.2%)	81 (52.9%)	108 (49.8%)	P=0.181
Vegetarian	4 (6.2%)	15 (9.7%)	19 (8.7%)	P=0.446
Height (m)	1.59 ± 0.20	1.49 ± 0.12	1.52 ± 0.10	P<0.001
Weight (kg)	61.21 ± 7.59	52.68 ± 4.24	54.45 ± 3.68	P<0.001
BMI (kg/m^2)	24.08 ± 2.99	23.58 ± 1.90	23.41 ± 1.58	P=0.133
WC (cm)	83.34 ± 10.34	77.02 ± 6.25	78.12 ± 5.30	P<0.001

Table 1: Demographic data 60.5% of the cohort were subsistence farmers. Most had received no formal education and females received significantly less. Males smoked more than females although alcohol use was approximately even.

Variable	Males	Females	Overall	P-value
SpO$_2$ (%)	86.20 ± 10.69	86.84 ± 7.00	86.15 ± 5.82	P=0.927
HR (bpm)	77.40 ± 9.60	78.58 ± 6.33	77.92 ± 5.28	P=0.687
SBP (mmHg)	130.66 ± 16.21	124.96 ± 10.07	127.74 ± 8.63	P=0.207
DBP (mmHg)	83.48 ± 10.35	83.88 ± 6.76	83.55 ± 5.65	P=0.952

Table 2: Vital signs Systolic and diastolic pressures were measured three times in a seated position and averaged. HR and SpO$_2$ recorded at rest via pulse oximetry. No significant differences were noted between sexes.
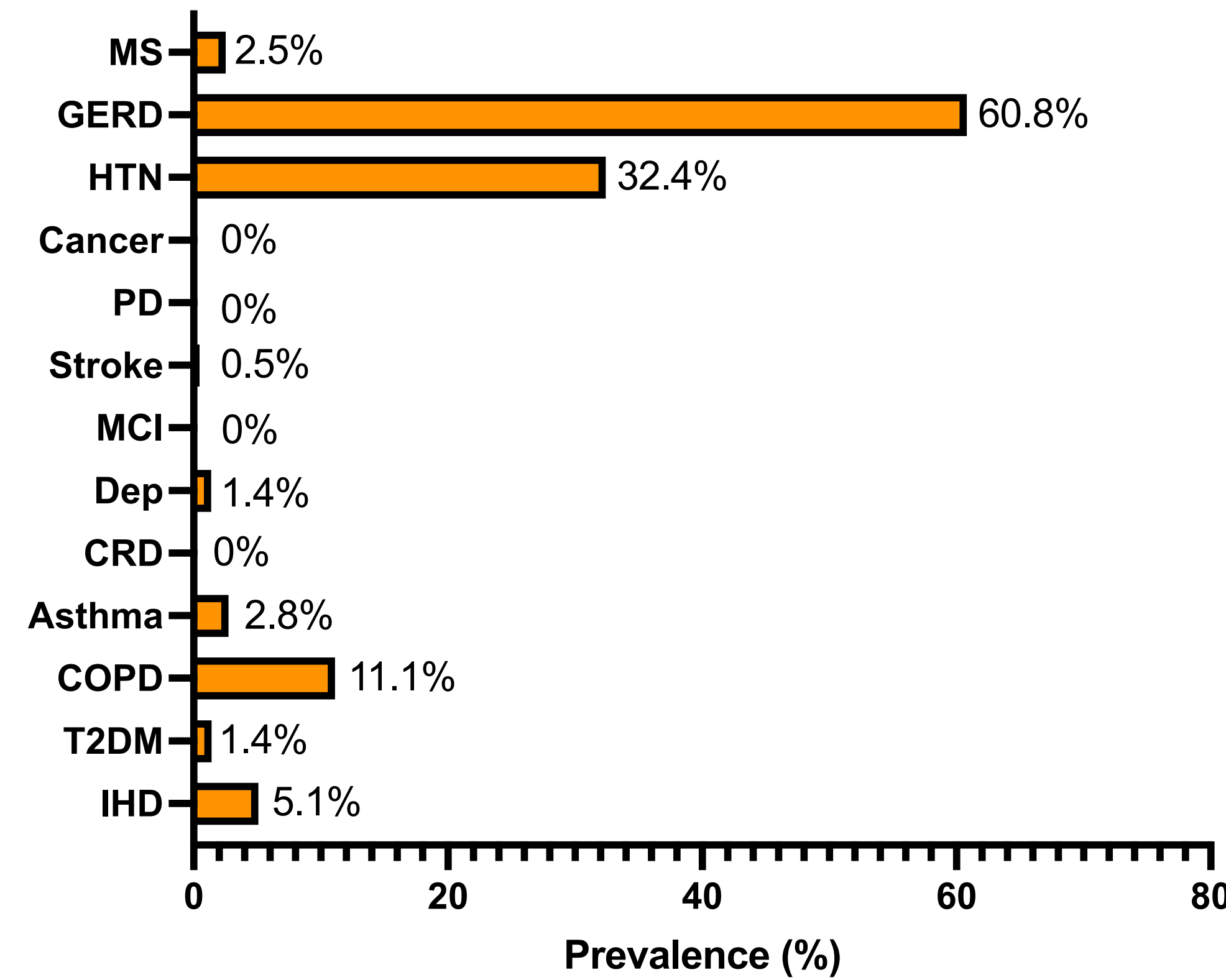

Figure 1: Non-communicable disease prevalence Prevalence of GERD and hypertension were highest in our sample followed by COPD, ischemic heart disease, asthma and metabolic syndrome. There were no cases of dementia or cancer in our study cohort. See legend.

Variable	Males	Females	Overall	P-value
MS	2.1% (1)	2.7% (3)	2.5% (4)	P>0.999
GERD	46.2% (30)	67.1% (102)	60.8% (132)	P<0.01
HTN	33.3% (22)	32.0% (49)	32.4% (71)	P=0.876
Cancer	0	0	0	P>0.999
PD	0	0	0	P>0.999
Stroke	1.5% (1)	0	0.5% (1)	P=0.299
MCI	0	0	0	P>0.999
Depression	1.5% (1)	1.3% (2)	1.4% (3)	P>0.999
CRD	0	0	0	P>0.999
Asthma	4.6% (3)	2.0% (3)	2.8% (6)	P=0.367
COPD	14.1% (9)	9.9% (15)	11.1% (24)	P=0.355
T2DM	1.5% (1)	1.3% (2)	1.4% (3)	P>0.999
IHD	6.3% (4)	4.6% (7)	5.1% (11)	P=0.736

Table 3: Prevalence of NCDs by sex Significant differences were observed in prevalence of GERD between males and females. However, no other between-sex differences were noted. Data shown as % (N). *Legend: MS=metabolic syndrome; GERD=gastroesophageal reflux disease; HTN=hypertension; PD=Parkinson's disease; MCI=mild cognitive impairment; CRD=chronic renal disease; COPD=chronic obstructive pulmonary disease; T2DM=type-2 diabetes mellitus; IHD=ischemic heart disease.*

Variable	Males	Females	Overall	P-value
Hb (g/L)	148.6 ± 18.6	133.2 ± 10.7	134.2 ± 9.1	P<0.001
Fasting BG (mmol/L)	5.2 ± 0.7	5.2 ± 0.4	5.3 ± 0.4	P=0.140
Creatinine (μmol/L)	62.5 ± 8.1	55.5 ± 4.7	61.1 ± 4.4	P=0.324
HBsAg (%pos)	1.6%	5.1%	4%	P=0.439
ALT (IU/L)	15.9 ± 2.1	14.4 ± 1.2	15.1 ± 1.1	P=0.153
Chol (mmol/L)	3.35 ± 0.44	3.21 ± 0.27	3.31 ± 0.24	P=0.603
TG (mmol/L)	1.70 ± 0.22	1.57 ± 0.13	1.65 ± 0.12	P=0.544
HDL (mmol/L)	1.15 ± 0.15	1.09 ± 0.09	1.11 ± 0.08	P<0.01
LDL (mmol/L)	1.87 ± 0.24	1.81 ± 0.16	1.87 ± 0.13	P=0.998
VLDL (mmol/L)	0.33 ± 0.04	0.31 ± 0.03	0.32 ± 0.02	P=0.556
Cho/HDL	3.0 ± 0.4	3.0 ± 0.3	3.0 ± 0.2	P=0.668
LDL/HDL	1.7 ± 0.2	1.7 ± 0.1	1.7 ± 0.1	P=0.576

Table 4: Laboratory values Blood samples were collected during the camp and analyzed post-hoc. Significant differences were observed in both Hb and HDL levels between sexes. Mean HDL levels were below the suggested threshold for females (>1.2mmol/L). 4% of the cohort had a reactive HBsAg. Mean fasting blood glucose was within the upper limit of normal.

75.8%   13.5%   10.7%
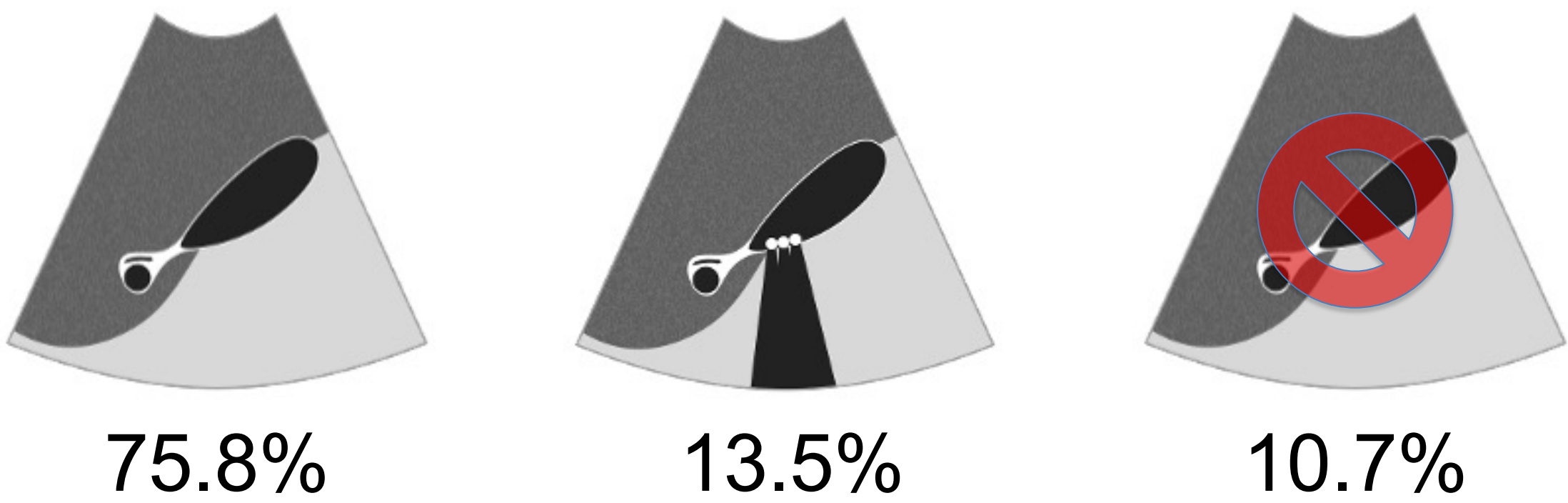
Figure 2: Abdominal ultrasound 10.7% of the cohort had undergone cholecystectomy. Of the remaining cohort, 13.5% had cholelithiasis identified on bedside biliary ultrasound and 75.8% were deemed normal. N=54/217 (24.9%) had evidence of hepatic steatosis on ultrasound.

CONCLUSION

- Inhabitants of the Zanskar have a relatively high prevalence of GERD, hypertension, COPD and biliary disease, with low prevalence of cancer, stroke and dementia.
- Prevalence of GERD was significantly higher in females in the region.
- Females had low mean HDL levels, but otherwise normal lipid profiles.
- Most people in the region work as subsistence farmers and have very limited education, especially true of females.
- Targeting innovative ways to deliver primary care to this isolated high-altitude region may decrease morbidity.

A Thousand Metres Above (ATMA) is a non-profit society that supports healthcare initiatives in the Himalayas (www.athousandmetresabove.org)