



Prevalence of Chronic Mountain Sickness in India

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INTRODUCTION

Chronic mountain sickness (CMS) is a maladaptation condition that can affect people who reside permanently at high altitude (HA). It is characterized by polycythemia, hypoxemia and dyspnea and is a significant cause of morbidity in HA populations. Over 140 million people worldwide live permanently at HA, however, research into CMS is lacking and accurate prevalence data for HA regions around the world do not exist.

OBJECTIVES

The purpose of this project was to determine prevalence rates of CMS in the Indian Himalayas, focusing on the northern state of Himachal Pradesh.

METHODS

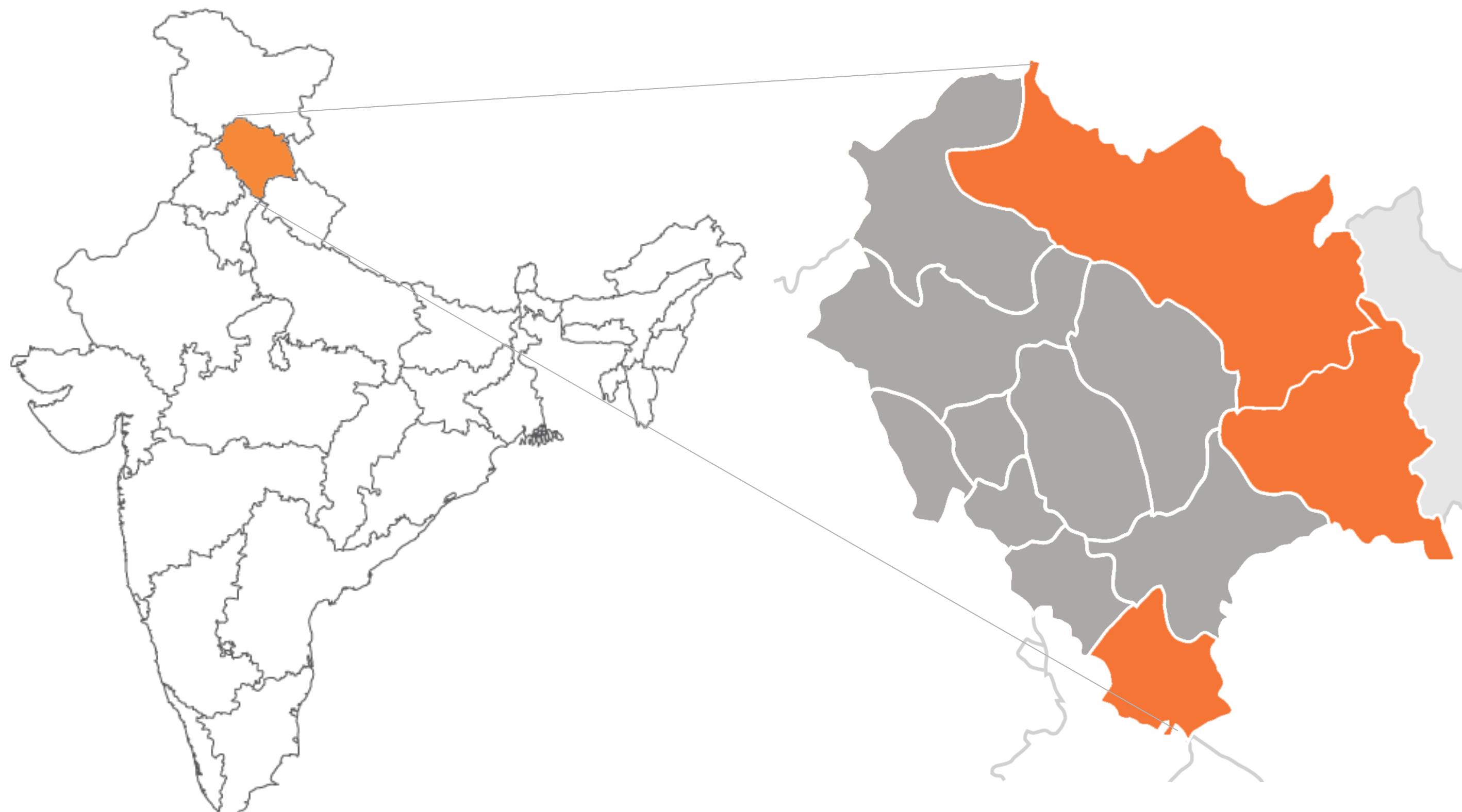


Figure 1: HA Districts in Himachal Pradesh, India

- We surveyed 83 individuals (69 males) in eight towns across the HA districts of Sirmaur, Kinnaur and Lahaul & Spiti in Himachal Pradesh, India. We used an adapted Qinghai CMS scoring system to diagnose CMS.
- Additional data including subject demographics and medical history were also collected.
- Physiologic recordings of oxygen saturation (SpO_2) and pulse rate (PR) were collected via pulse oximetry. Data are presented as mean \pm SEM.

RESULTS

Town	Alt (m)	N	Gender	Age (y)	CMS Score	CMS Prev (%)
Rekong Peo	2,350	11	11M 0F	34.2 \pm 2.0	0.64 \pm 0.23	0.00
Kalpa	2,760	11	12M 0F	32.9 \pm 2.1	1.00 \pm 0.34	0.00
Pooh	2,800	9	5M 4F	38.7 \pm 4.7	1.11 \pm 0.29	0.00
Tabo	3,285	7	3M 4F	30.6 \pm 4.6	1.86 \pm 0.55	28.57
Churdhar	3,500	7	6M 1F	34.4 \pm 5.2	2.14 \pm 0.84	28.57
Nako	3,630	18	17M 1F	39.3 \pm 3.4	1.94 \pm 0.30	5.56
Kye	3,900	4	4M 0F	41.0 \pm 4.9	2.50 \pm 0.90	25.00
Kibber	4,150	14	11M 4F	34.1 \pm 2.3	1.50 \pm 0.51	7.14
Overall	3281 \pm 58	81	69M 14F	35.6 \pm 1.3	1.51 \pm 0.17	6.17

Table 1: CMS Prevalence In our study 6.17% of the population had mild CMS. Alcohol or tobacco consumption were not risk factors for CMS. We observed no relationship between CMS and SpO_2 or PR. The CMS group had significantly lower monthly incomes than the non-CMS group ($2,875 \pm 844$ INR vs. $8,566 \pm 877$ INR, respectively, $p<0.01$). There were no significant differences in age across towns although there was a significant difference in gender ($p=0.0035$).

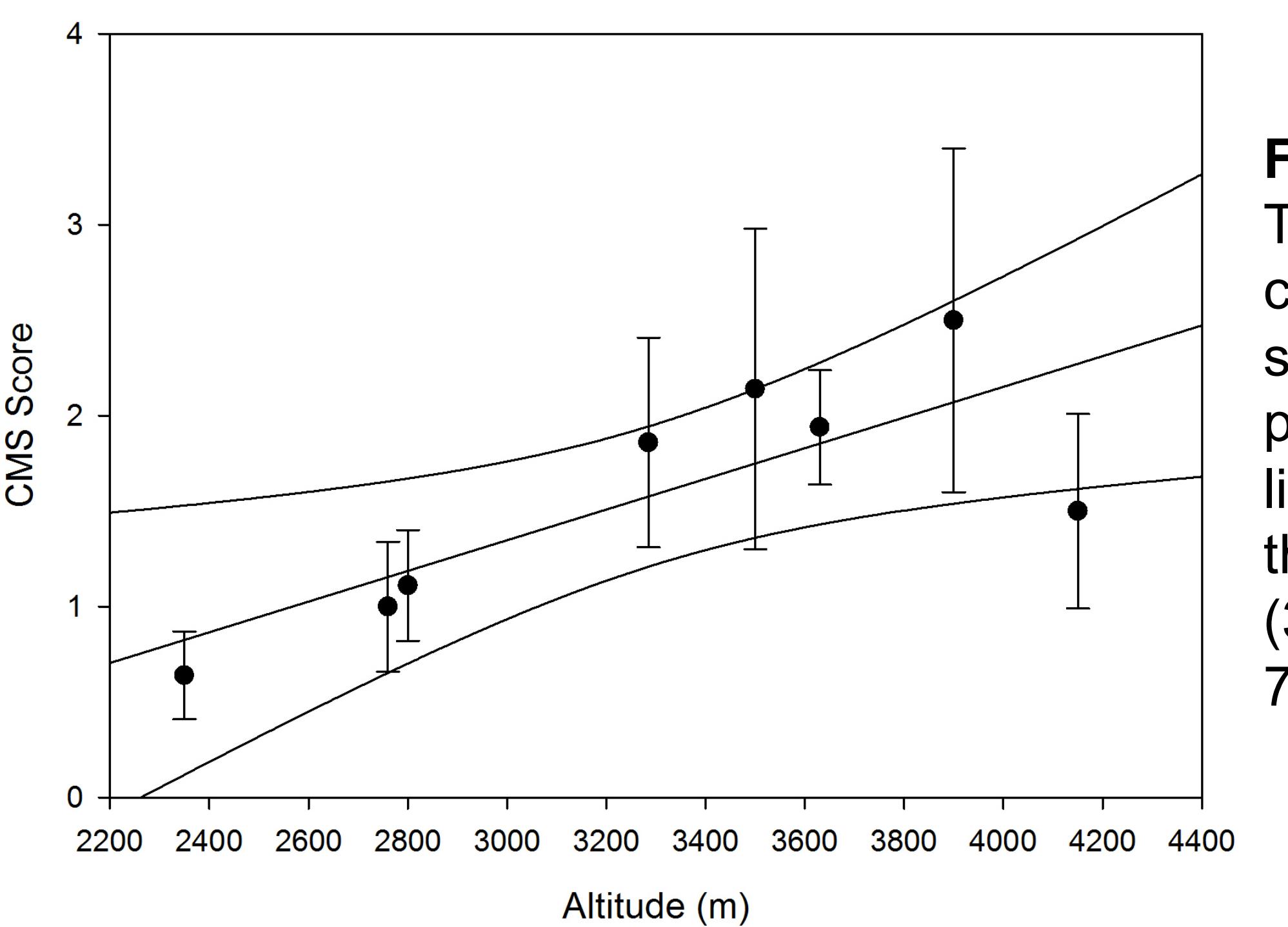


Figure 2: CMS and Altitude
There was a significant correlation between CMS score and altitude ($R=0.784$, $p<0.05$). Patients with CMS lived at higher altitudes than their non-CMS counterparts ($3,763 \pm 113$ m vs. $3,279 \pm 70$ m, respectively, $p<0.05$).

Town	Alt (m)	SpO_2 (%)	PR (bpm)
Rekong Peo	2,350	94.27 \pm 0.53 ^{a,b}	76.18 \pm 3.91
Kalpa	2,760	92.42 \pm 0.76 ^c	84.42 \pm 1.44
Pooh	2,800	92.44 \pm 1.08 ^d	78.67 \pm 5.03
Tabo	3,285	89.86 \pm 0.71	86.43 \pm 2.30
Churdhar	3,500	91.43 \pm 0.70	77.57 \pm 3.31
Nako	3,630	88.72 \pm 1.04 ^a	82.22 \pm 3.13
Kye	3,900	88.25 \pm 1.67	82.00 \pm 9.23
Kibber	4,150	88.43 \pm 0.60 ^{b,c,d}	76.36 \pm 2.52
Overall	3281 \pm 58	90.67 \pm 0.41	80.29 \pm 1.32

Table 2: Physiologic Measurements There were significant differences in SpO_2 , but not PR, across towns. Overall SpO_2 values for this region were similar to values from other HA regions of the world. ^aRekong Peo vs. Nako ($p<0.01$), ^bRekong Peo vs. Kibber ($p<0.001$), ^cKalpa vs. Kibber ($p<0.05$), ^dPooh vs. Kibber ($p<0.05$).

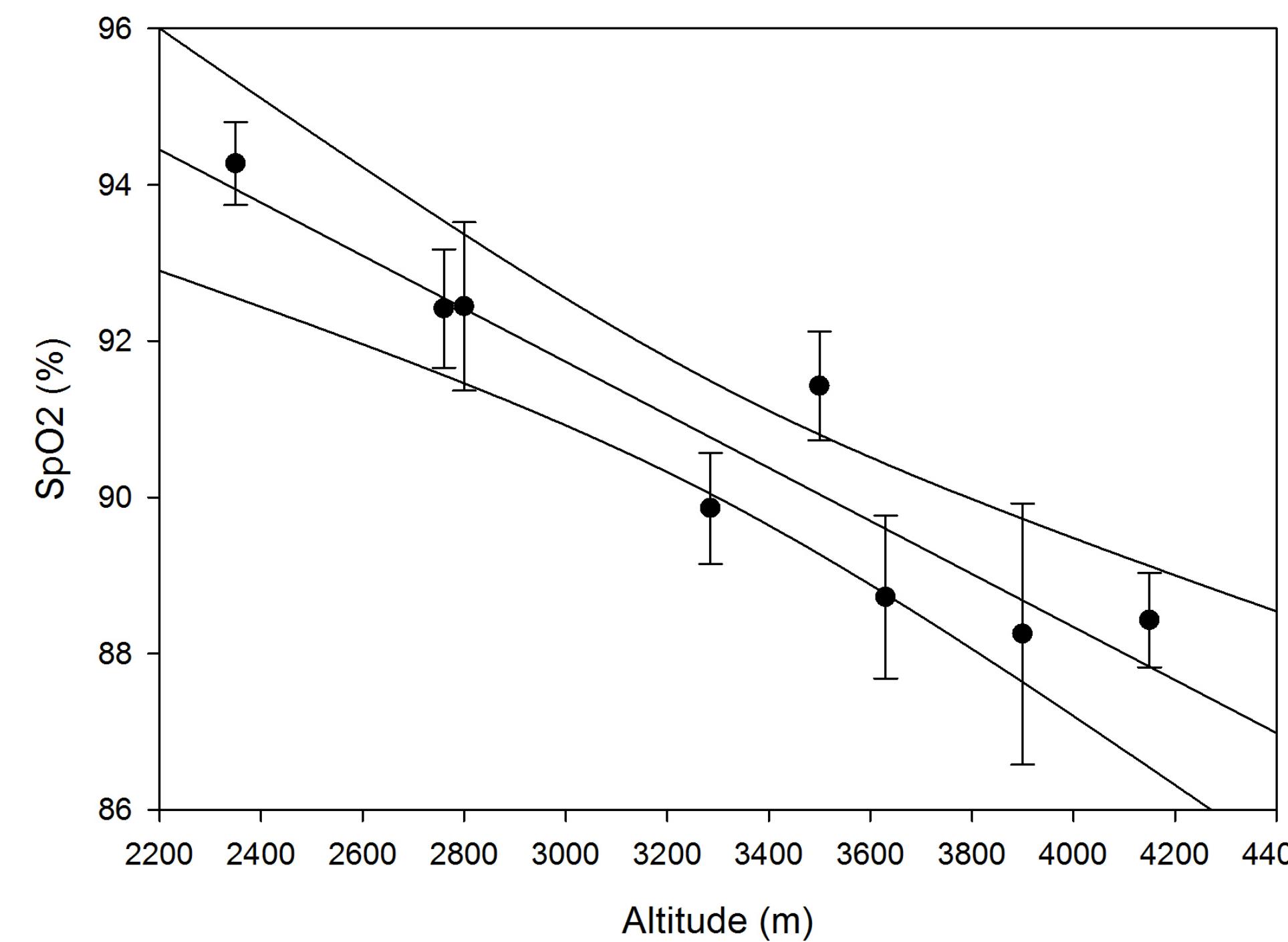


Figure 3: SpO_2 and Altitude There was a significant negative correlation between SpO_2 and altitude ($R=-0.929$, $p<0.00001$) such that at higher altitudes mean SpO_2 values were lower.

Alt Group	N	CMS Score	CMS Prev (%)
< 3,000m	31	1.03 \pm 0.20	0.00
\geq 3,000m	50	1.85 \pm 0.25	13.73

Table 3: CMS Prevalence by threshold At altitudes equal to or greater than 3,000m the prevalence of CMS in our population rose to 13.73%.

CONCLUSION

- CMS prevalence rates in the Indian Himalayas are 6.17%, and 13.73% for towns greater than or equal to 3,000m
- CMS was significantly associated with altitude and income
- CMS was not associated with SpO_2 , PR, tobacco use, alcohol consumption
- Our study has, for the first time, documented an accurate prevalence of CMS in the Indian Himalayas

Figure 4: Worldwide CMS Prevalence Rates

