Abstract of Dissertation submitted by Sweta Koirala

Title: Current health status and its risk factors of the Tsarang villagers living at high altitude in the Mustang district of Nepal

Japanese title: ネパール国・ムスタン地方の高地に位置するTsarang村住民の健康状態の把握と健康リスク因子に関する研究

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Introduction: Low- and middle-income countries are facing double burden of diseases, communicable and noncommunicable diseases (NCDs). NCDs like cardiovascular diseases, cancers, and diabetes (DM) are growing rapidly and are expected to further expand throughout the world. Each year, NCDs account for 40 million deaths globally, and 80% of the premature deaths due to NCDs occur in low- and middle-income countries. The proportion of deaths related to NCDs in Nepal has risen from 51% in 2010 to 66% in 2018. Almost 2 million people live permanently in mountainous area of Nepal. Living at high altitudes involves long-term adaptation to harsh environment and altitude induced hypoxia. Unfortunately, Nepalese population-based studies on incidence and prevalence of NCDs and their risk factors are limited. This study aims to investigate the prevalence of NCDs and determine their risk factors among the adults residing in an isolated village situated at a rural highland of Nepal.

Materials and Methods: A cross-sectional epidemiological study was carried out on residents 18 years old and older in Tsarang village, Mustang district, Province number 4, of Western Nepal. Tsarang villagers were notified in advance of the small medical clinic we had set up for the survey. We recruited 188 participants (M:F = 85:103) between the age of 18 and 80 years. Each participant took a full physical exam that included biomedical measurements of glycosylated hemoglobin (HbA1c) and answered a modified version of WHO Stepwise approach to surveillance (STEPS) questionnaire to investigate on the lifestyle, socioeconomic status and demographic data.
**Results:** A total of 188 participants, 85 (45.2%) were males and 103 (54.8%) were females between 18 and 80 years old. Most of the participants (68.1%) had no formal education or did not finish primary school. Higher proportions of males than females were employed (43.5% vs 12.6%) and had smoking and alcohol drinking habits (34.1% and 50.0% vs 10.7% and 17.5%). 21.1% for males versus 15.5% for females were hypertensive. The prevalence of intermediate hyperglycemia (IHG) and DM was 31.6% and 4.6% respectively, and the prevalence of hypoxemia (SpO₂ < 90%) was 27.1%. A multiple logistic regression analysis for factors for the prevalence of glucose intolerance (HbA1c ≥ 6%) revealed older age (odds ratio [OR] 1.11, 95% confidence interval [CI] 1.06–1.16, for every 1 year increase) and SpO₂ (OR for hypoxemia 3.58, 95% CI 1.20–10.68, vs SpO₂ ≥ 90%).

**Discussion:**
The present epidemiological study done at a rural village of Nepal include information on demography, socioeconomic and current health condition. Our study showed the prevalence of overweight and obese participants to be 29.3% (95% CI = 23.0-36.4%). A study conducted in urban setting of the same district reported the prevalence of overweight to 47.7% and 56.6% respectively. Such differences could be due to economic variations in rural and urban settings.

The prevalence of pre-DM or IHG in our study was 31.6% (95% CI = 24.9-39.2%). This result is similar to a study done among the same ethnic group, Tibetans, in different villages of the same district, which revealed the prevalence of IHG 22.1 to 39.3%. On the other hand, a meta-analysis of data examined the prevalence of DM and IHG in Nepal found pre-DM population to be 10.3%. The study population for the meta-analysis included various ethnic groups and multiple sites. These observations indicate that ethnicity, lifestyle and socio-economic status may attribute to the prevalence of IHG/DM.

In our study, participants with hypoxemia had increased prevalence of IHG/DM compared to participants with normoxia. A previous study has shown that hypoxemia plays a role in the high prevalence of glucose intolerance in Tibetans of China and India. Though the mechanism of hypoxemia causing glucose intolerance is not yet clearly known, we speculate that hypoxic environment such as on high altitudes generates both hypoxemia and oxidative stress, causing induction of expression of many genes related to inflammatory pathways, resulting in hyperglycemia. In addition, both elevation of HbA1c and the prevalence of hypoxemia are accelerated by aging process. The study showed the prevalence of IHG was remarkably high (31.6%), particularly among the participants above the age of 40 years. This suggests that there will be an increased burden of DM at the study site as the population ages. The challenge for future research efforts should focus on prevention and control measures for NCDs in rural highlands areas with limited access to health facilities.

We conclude that along with the lifestyle and genetic predispositions of Tibetan highlanders, additive effects of hypoxemia is one of the common factors for the high prevalence of IHG/DM.