Cardio-metabolic risk factors among patients with tuberculosis attending tuberculosis treatment centers in Nepal

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Indra Prasad Poudyal
Tribhuvan University Institute of Medicine

Pratik Khanal
Tribhuvan University Institute of Medicine

iampratikkhanal@gmail.com Corresponding Author
ORCiD: https://orcid.org/0000-0002-1057-5700

Shiva Raj Mishra
Nepal Development Society

Milan Malla
Department of Health Services, Ministry of Health and Population

Prakash Poudel
Tribhuvan University Institute of Medicine

Raj Kumar Jha
Tribhuvan University Institute of Medicine

Anil Phuyal
Tribhuvan University Institute of Medicine

Abiral Barakoti
Department of Health Services, Ministry of Health and Population

Bipin Adhikari
Center for Tropical Medicine and Global Health, Nuffield Department of Medicine, University of Oxford, Oxford

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SUBJECT AREAS
KEYWORDS

Tuberculosis, cardio-metabolic risk factors, Non-communicable diseases
Abstract
Background The co-morbidity of cardio-metabolic diseases in patients with Tuberculosis adds a significant burden in current health systems in developing countries including Nepal. The main objective of this study was to explore cardio-metabolic risk factors among patients with Tuberculosis.

Methods This was a cross-sectional study conducted in 12 tuberculosis centers from eight districts of Nepal between May and July 2017. A total of 238 patients with tuberculosis who visited Tuberculosis centers for Directly Observed Treatment Short-course therapy participated in this study. Interviews with participants were conducted using a structured questionnaire and were supplemented by anthropometric measurements and on site blood glucose tests. Data were analyzed using descriptive and inferential statistics.

Results Among 221 study participants, 138 (62.4%) had new smear positive pulmonary tuberculosis, 24 (10.9%) had new smear negative pulmonary tuberculosis and 34 (15.4%) had new extra pulmonary tuberculosis. Overall, 43.1% of the patients with tuberculosis had at least one cardio-metabolic risk factor. The prevalence of at least one cardio-metabolic risk factor was more in male than female (47.8% versus 33.8%). Prevalence of tobacco (18.9% versus 4.8%), and alcohol (12.6% versus 6.5%) use was proportionately higher in male compared to female. The prevalence of hypertension (17% vs. 21%) and obesity (11.9% vs. 12.9%) was lower in male compared to females. Female (AOR=0.47; CI: 0.23-0.94), those from Gandaki Province (AOR=0.32; CI: 0.13-0.79) and literate (AOR=0.49; CI: 0.25-0.96) had reduced risk of cardio-metabolic disease risk factors.

Conclusions This study highlights the role of gender and socio-demographic characteristics associated with the risk of cardio-metabolic diseases in patients with Tuberculosis. The findings from this study can guide medical practitioners and policy makers to consider clinical suspicion, diagnosis and treatment. National treatment guideline can benefit by integrating the management of non-communicable diseases in Tuberculosis treatment centers.

Background
Tuberculosis (TB) constitutes a top ten causes of mortality globally and resulted in 1.6 million deaths in 2017 [1]. Low and middle income countries (LMICs) share a disproportionate burden of morbidity
and mortality due to TB despite of the available efficacious treatment [1, 2]. The highest incidence (2/3rd of the global burden) of new TB cases was reported from South East Asia and Western Pacific region followed by African region, which shared a fourth of the global incidence. It is estimated that 95% of all TB cases and 98% of all TB deaths occur in South East Asia and the Africa [2]. Various factors synergize the burden of morbidity and mortality related to TB in developing countries that includes poverty, poor public health system, and co-morbidities [3]. Thus, TB continues to be a persisting challenge in global health [4].

Among an estimated 10.4 million new TB cases worldwide in 2015, 5.9 million (56%) were found in men, 3.5 million (34%) in women and 1 million (10%) in children [5]. In Nepal, almost half of the total population (45%) is infected with TB and affects mostly (60%) productive age group (18-45 years). Annually, 44,000 people develop active TB, and half of which is Pulmonary TB with around 7000 deaths every year [6].

Together with the burden of TB [7], developing countries suffer from an added burden due to rising epidemic of non-communicable diseases (NCDs) such as diabetes and hypertension [8]. World Health Organization (WHO)’s report showed that the diabetes [8] was the direct cause of 1.5 million deaths and high blood glucose was the cause of another 2.2 million deaths worldwide in 2012. It is projected that diabetes will be the seventh leading cause of death in 2030 [9]. Diabetes is a known risk factor for TB and is associated with poor outcome while TB is associated with worsening glycemic control [10–12]. Studies have revealed as low as 6% to a maximum of 54% of prevalence of diabetes among patients with TB [13-20]. Evidence also suggests that people with diabetes are as much as three times more likely to contract TB than non-diabetics [21] thus WHO suggests bi-directional screening in high prevalent regions [22].

Few studies in the past have explored the factors affecting the outcome of TB such as multi-drug resistance (MDR) [23], stigma associated with MDR TB [24] and barriers to treatment [3, 25–27]. One review article in the past has explored the co-morbidity of diabetes and Tuberculosis among ageing population of Nepal. However, no studies in the past have explored cardio-metabolic risk factors among TB patients in Nepal. The consequence of diabetes, hypertension as well as other cardio-
metabolic risk factors among patients with TB is under-appreciated. The dearth of evidence has further affected the coordination between TB and NCD control program in Nepal. The aim of this study was to explore the prevalence of cardio-metabolic risk factors among patients with TB attending Directly Observed Treatment Short Course-(DOTS) centers of Nepal.

Methods

Study design and study setting

This was a facility based cross-sectional study conducted in 12 TB centers (DOTS centers) in eight out of 77 districts of Nepal between May and July 2017. The study districts were Morang in Province 1, Dhading in Province 3, Baglung and Tanahaun in Gandaki province, Rolpa in Province 5 and Kailali, Dadeldhura and Doti in Sudurpaschim province.

A total of 238 patients with TB visiting DOTS centers for anti-tubercular therapy during the study period and meeting the eligibility criteria participated in this study. The participants were selected from DOTS clinics of Primary Health Centers (PHCs) and government hospitals of the country. The inclusion criteria for the participants included: (1) aged 15 years and above; (2) newly diagnosed TB or currently under anti-tubercular medication; and (3) those willing to give written informed consent to participate in the study. Pregnant women and lactating mothers were excluded from the study considering associated gestational diabetes mellitus.

Data collection measures

Patients were interviewed at DOTS clinic through a structured questionnaire by paramedics or medical officers who were trained to fill the questionnaires. Information about socio-demographic and behavioral characteristics was obtained through interviewing study participants while information on TB category was collected from the patient card. Data on anthropometric measurements and blood pressure assessment were collected using standard method as described in WHO STEPS survey [28]. Random blood sugar level was measured in laboratory by Glucose oxidase-Peroxidase method for undiagnosed cases and the value of 200 mg/dl or more for diabetes and 140 mg/dl or more for pre-diabetes as recommended by the American Diabetes Association (ADA) [29]. Current tobacco use was described as those who have used smoked or consumed smokeless tobacco within 30 days while
current alcohol use was described as those who have at least drank once in the past 30 days.

The questionnaire for data collection was developed based on extensive literature review. Questionnaire related to socio-demographic characteristics was adapted from Nepal Demographic Health Survey 2016 [30] while behavioral, clinical and anthropometric characteristics was based on WHO STEPS survey [28].

**Study variables**

Socio-demographic variables included data on age, sex, ethnicity, geographical location, educational status and occupation. Behavioral variables included current alcohol use and current tobacco use. Clinical variables included diabetes status, hypertension status and prevalence of HIV/AIDS. Anthropometric variables included measurement of Body Mass Index (BMI).

For inferential analysis, prevalence of at least one cardio-metabolic risk factor (alcohol use, tobacco use, diabetes, hypertension according to JNC criteria and overweight/obese) was considered as a dependent variable and all other variables were considered as independent variables.

**Data management**

Data were entered in EpiData Version 3.1 and was analyzed using IBM SPSS version 20. Continuous variables were summarized as mean with standard deviation (SD). Categorical variables were expressed as frequencies and percentages and Chi-squared test was performed to compare the proportions. A logistic regression analysis was used to explore the association between socio-demographic variables (independent variables) with the presence of at least one cardio-metabolic risk factor (dependent variable). Both unadjusted and adjusted odds ratio were analyzed. A significant statistical association were considered when p values were <0.05 with 95% Confidence Interval (CI).

**Ethics**

A written informed consent was obtained from individual participants. Confidentiality and anonymity of the participants were ensured by coding the interviews. Study participants were informed clearly about their freedom to opt out of the study at any point of time without providing justification for doing so. The study obtained ethical approval from Ethical Review Board of Nepal Health Research Council (Registration number: 55/2017). In case of patients from 15 to 17 years of age, written
informed consent was taken from their caretakers while assent was obtained from themselves.

Results
A total of 238 patients with TB participated in the study. Among them, 221 participants with complete information were retained in the analysis.

**Treatment category of patients with TB**
Overall, 62.4% (138/221) had new smear positive pulmonary TB, 10.9% (24/221) had new smear negative pulmonary TB and 15.4% (34/221) had new extra pulmonary TB. The proportion of relapse cases, defaulters and those under treatment failure category among the total cases was 9.0% (20/221), 1.8% (4/221) and 0.5% (1/221) respectively (Table 1).

**Socio-demographic characteristics**
The mean age of the participants (±SD) was 45.19±17.33 years and 71.9% of them were male. Major proportion of participants belonged to Janajati ethnic group (41.6%) followed by Brahmin/Chhetri (32.1%). Three out of ten participants were illiterate while nearly half of them were engaged in agriculture as their primary occupation. (Table 2).

**Behavioral and clinical characteristics**
The proportion of current tobacco and alcohol use among the study participants was 14.9% (33/221) and 10.9% (24/221) respectively. The mean BMI of the participants (±SD) was 19.88 ±4.13 kg/ m² with 43.0% underweight, 9.9% overweight and 2.3% obese (Table 3). The patient report showed that 3.6% (8/221) of the patients with tuberculosis had HIV. The proportion of pre-diabetics was 15.8% (35/221) and diabetics were 6.3% (14/221) (Table 3). The mean blood glucose of the participants (±SD) was 114± 46.13 mg/dl.

The mean systolic and diastolic blood pressure (±SD) was 112.5±18.1 mm Hg and 72.2±11.8 mm Hg respectively. The prevalence of hypertension according to the American Heart Association (AHA) classification was 37.1% (82/221) and according to the Joint National Committee for hypertension (JNC) classification was 18.2% (40/221). Among the study participants, 5% (11/221) were under anti-hypertensive medication and 5% (11/221) had positive first-degree family history for hypertension (Table 3).
Among those who were under anti-hypertensive medications, 72.7% (8/11) had uncontrolled blood pressure according to AHA classification while 63.6% (7/11) had uncontrolled blood pressure according to JNC classification (Data not shown).

**Cardio-metabolic risk factors among patients with TB**

Overall, 43.1% (97/221) of the patients with TB had at least one cardio-metabolic risk factor. The prevalence of at least one cardio-metabolic risk factor was more in male than female (47.8% versus 33.8%) (Table 4). The proportion of patients with TB currently using tobacco, alcohol and having diabetes was higher in males than females while the proportion was higher in females as compared to males for hypertension and being overweight or obese. While examining the factors associated with prevalence of at least one cardio-metabolic risk factor, those from Gandaki province (AOR=0.32; CI: 0.13-0.79) had lower odds as compared to province one (Table 5). Female (AOR=0.47; CI: 0.23-0.94) and literate (AOR=0.49; CI: 0.25-0.96) study participants had lower chance of having cardio-metabolic risk factor as compared to male and illiterate study participants.

**Discussion**

**Overall Findings**

This study identified significant factors affecting the risk of cardio-metabolic diseases in patients with TB. More than two out of five patients had at least one cardio-metabolic risk factor and males were more at risk than females including the behaviors related to consumption of tobacco, and alcohol. Nevertheless, the proportion of developing hypertension and obesity was higher in females compared to males. Sex, geographic location and patients’ education level were significantly associated with the risk of cardio-metabolic diseases.

**Males and cardio-metabolic risk**

The preponderance of males in bearing cardio-metabolic risk factors highlights their higher proportion of developing TB and thus cardio-metabolic risk factors. The predominance of males in developing TB echoes with the global and national reports [5, 6] which may partially explain the risk of cardio-metabolic diseases among these patients. Nonetheless, the socio-cultural role of males in Nepalese society where their increased exposure to work and occupation, food and life-style related behavior
compared to females who may not have similar exposure, further explains the higher risk of cardio-metabolic risk factors [31]. One associated factor within this study that sheds light on male’s increased risk of cardio-metabolic diseases is the higher consumption of tobacco and alcohol more than females [31, 32]. Socio-culturally in Nepal, males are at the forefront of earning money and managing the household expenditure. Availability of cash money, together with the cultural benefits due to patriarchy in Nepalese society can further explain the increased leeway for males that conduces the affordability for consumption of alcohol and tobacco [32]. These high-risk behaviors are further predicated on other factors such as level of education, occupation and the individual motivation towards healthy life style. The significantly higher odds of having at least one risk to cardio-metabolic diseases in male patients with tuberculosis further support our argument.

Females, obesity and hypertension

The proportion of female patients with TB in this study who had higher risk of developing hypertension and diabetes resonates with the nationally representative survey where females were found to be the vulnerable population in developing cardio-metabolic diseases [33], and can be explained by the socio-cultural entanglements of female’s role in Nepalese society. Similar to other South Asian nations, females are often housebound, particularly those who are unemployed or are in poor-socio-economic status, and are found to have higher rates of obesity and cardio-metabolic risks than male counterparts [34-36]. Females are culturally repressed in their outdoor activities often because of threats of sexual harassments and violence. Such cultural restrictions are further aggravated by lack of urban green spaces, parks and exercise places conducive for physical exercise in South Asia [37]. Embedded in the patriarchal culture of Nepal [38], females are not only burdened by household chores such as cooking, they are also vulnerable to delayed and irregular eating. Delayed and irregular eating generally stems from cultural and traditional niceties of serving the male members of the family first. In addition, wasting of cooked food in traditional Nepali family (usually devoid of refrigerator) is considered ‘ominous’ which can add pressure to the female members to finish the remaining portion of food. The latter can aggravate irregular and over eating. Women in Nepal are also vulnerable to fasting based on religious and cultural practices. The ramifications of
delayed, irregular (over and under) eating and fasting are established to increase the risk of developing obesity, diabetes and hypertension [39]. These socio-culturally shaped behaviors contribute to higher prevalence of cardio-metabolic risks in females in Nepal. Though female had significantly lower odds of having at least one cardio-metabolic risk factor in this study as compared to males, the greater risk of hypertension and overweight/obesity cannot be neglected.

**Socio-demographic factors and cardio-metabolic risk**

Other socio-demographic factors that affect higher risk to cardio-metabolic diseases are equally important. Although the population from Gandaki province had lower risk of developing cardio-metabolic risk, causal explanations are hard to draw from the geographic location alone. Nevertheless, this may have been due to the socio-demographic characteristics of the population in Gandaki province, such as higher education level, relatively higher affluence, organized urban planning with adequate space for exercise, increased awareness in regards to food and behavior and other socio-ecological factors.

In this study, literate patients with TB showed reduced risk of cardio-metabolic diseases and echoes with previous studies from Nepal [36]. Our findings are also consistent with South African study where the risk of cardio-metabolic disorders were higher among men, and was lower in those with higher education and socio-economic status [40]. The fact that higher education in general might have led to increased awareness regarding the NCDs such as diabetes and hypertension and thus the personal modification in food and life style related behavior could be one of the mechanisms to explain the finding.

**Limitations and further area of research**

This cross-sectional study relied on questionnaire-based survey at 12 DOTS center across Nepal and the results are largely representative for eight districts in Nepal. Nevertheless, by virtue of the study being cross-sectional and dependent on quantitative assessment, causal explanations of the association for cardio-metabolic risks among TB patients could not be adequately explained. In future, qualitative studies using in-depth interviews and focus group discussions with the patients with TB can yield a rich set of data to explain the associated factors with cardio-metabolic diseases in this
Also, further studies can build to explore how the current DOTS centers can increasingly collaborate in management of co-morbid cardio-metabolic conditions with evidence suggesting that risk factors of death among patients with TB die are non-infectious co-morbidities as well as alcohol and substance abuse [41]. As TB and HIV prevalence continue to decline in Nepal, operational and health system research may provide useful insights on how to integrate a major infectious disease, TB with rising trend of NCDs.

Conclusion
Gender, education and geographical location were significantly associated with risk of cardio-metabolic diseases among patients with TB in Nepal. The factors identified in this study can guide medical practitioners and policy makers to consider clinical suspicion, diagnosis and treatment.

Revised TB treatment guideline can benefit by integrating the management of NCDs in Tuberculosis treatment centers. The socio-cultural entanglements of these factors and the increasing co-morbidity of cardiovascular diseases urge the need for a broader approach of management of life-style related behavior.

Abbreviations
AHA: American Heart Association; ADA: American Diabetes Association; AOR: Adjusted Odds Ratio; BMI: Body Mass Index; CI: 95% Confidence Interval; DOTS: Directly Observed Treatment Short Course; JNC: Joint National Committee for Hypertension; LMICs: Low income and middle income countries; PTB: MDR: Multi-Drug Resistant; Pulmonary Tuberculosis; NCDs: Non-Communicable Diseases; PHCs: Primary Health Care Centres; SD: Standard Deviation; TB: Tuberculosis; WHO: World Health Organization

Declarations

Consent for publication
A written informed consent was obtained from individual participants. For those under 18 years of age, assent was obtained from the study participants and written consent was taken from their caretakers. Confidentiality and anonymity of the participants were ensured by coding the interviews. Study participants were informed clearly about their freedom to opt out of the study at any point of time without providing justification for doing so.
Availability of data and materials
All data related to this study are included in the manuscript.

Ethics approval and consent to participate
Ethical approval for this study was provided by the Nepal Health Research Council, Kathmandu, Nepal (Registration number: 55/2017).

Competing interests
Authors have no competing interest associated with this paper. Bipin Adhikari is on the editorial board of BMC Public Health.

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Contributors
IPP, PK and SRM conceived the concept and design of the study. MM, PP, RKJ, AP and AB provided inputs to the study protocol and conducted the survey. IPP, PK, SRM and BA wrote the first draft and underwent substantial revision based on the inputs from all other authors.

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Tables

Table 1 Tuberculosis category of the study participants (n=221)

| TB status                        | Frequency | Percentage |
|----------------------------------|-----------|------------|
| New smear Positive Pulmonary TB  | 138       | 62.4       |
| New smear Negative Pulmonary TB  | 24        | 10.9       |
| New Extra Pulmonary TB           | 34        | 15.4       |
| Relapse                          | 20        | 9.0        |
| Treatment failure                | 1         | 0.5        |
| Defaulter                        | 4         | 1.8        |

Table 2 Socio-demographic and behavioral characteristics and comorbidities among patients with TB (n=221)
| Variables                        | Frequency | Percentage (%) |
|---------------------------------|-----------|----------------|
| **Socio-demographic variables**  |           |                |
| **Age**                         |           |                |
| Less than 20                    | 12        | 5.4            |
| 20-39                           | 74        | 33.5           |
| 40-59                           | 81        | 36.7           |
| 60 and above                    | 54        | 24.4           |
| **Sex**                         |           |                |
| Male                            | 159       | 71.9           |
| Female                          | 62        | 28.1           |
| **Ethnicity**                   |           |                |
| Janajati                        | 92        | 41.6           |
| Brahmin/Chhetri                 | 71        | 32.1           |
| Dalit                           | 40        | 18.1           |
| Others (Madheshi, Muslim, Thakuri, Sanyasi) | 18 | 8.2 |
| **Education level**             |           |                |
| Illiterate                      | 68        | 30.8           |
| Informal                        | 39        | 17.6           |
| Primary                         | 32        | 14.5           |
| Secondary                       | 55        | 24.9           |
| Higher secondary and above      | 27        | 12.2           |
| **Occupation**                  |           |                |
| Agriculture                     | 108       | 48.9           |
| Unskilled manual                | 54        | 24.4           |
| Skilled manual (Professional, technical, clerical) | 40 | 18.1 |
| Sales and services              | 19        | 8.6            |
| **Province**                    |           |                |
| One                             | 45        | 20.4           |
| Three and Five                  | 35        | 15.8           |
| Gandaki                         | 54        | 24.4           |
| Sudurpaschim                    | 87        | 39.4           |

Table 3 Behavioral and clinical characteristics among patients with TB (n=221)
| Variables                          | Frequency | Percentage (%) |
|-----------------------------------|-----------|----------------|
| **Anthropometric and Behavioral characteristics** |           |                |
| **BMI (kg/m\(^2\))**              |           |                |
| Too thin for height (<18.5)       | 95        | 43.0           |
| Normal (18.5-24.9)                | 99        | 44.8           |
| Overweight (24.9-29.9)            | 22        | 9.9            |
| Obese (>30)                       | 5         | 2.3            |
| **Tobacco use**                   |           |                |
| Current                           | 33        | 14.9           |
| Past                              | 119       | 53.8           |
| Never                             | 69        | 31.2           |
| **Alcohol use**                   |           |                |
| Current                           | 24        | 10.9           |
| Past                              | 123       | 55.7           |
| Never                             | 74        | 33.5           |
| **Clinical characteristics**      |           |                |
| **HIV**                           |           |                |
| Positive                          | 8         | 3.6            |
| Negative                          | 213       | 96.4           |
| **Diabetic mellitus\(^\pm\) (\(\geq 140\) mg/dl)** |           |                |
| Yes                               | 35        | 15.8           |
| No                                | 186       | 84.2           |
| **Diabetes mellitus (\(\geq 200\) mg/dl and above)** |           |                |
| Yes                               | 14        | 6.3            |
| No                                | 207       | 93.7           |
| **Hypertension (JNC\(^a\))**     |           |                |
| Normal                            | 123       | 55.7           |
| Pre-hypertension                  | 58        | 26.2           |
| Stage I Hypertension              | 26        | 11.8           |
| Stage II Hypertension             | 3         | 1.4            |
| Hypertensive under medication     | 11        | 5.0            |
| **Hypertension (AHA\(^b\))**     |           |                |
| Normal                            | 123       | 55.7           |
| Elevated BP                       | 16        | 7.2            |
| Stage I Hypertension              | 42        | 19.0           |
| Stage II Hypertension             | 29        | 13.1           |
| Hypertensive under medication     | 11        | 5.0            |
| **Family history of Hypertension**|           |                |
| Yes                               | 11        | 5.0            |
| No                                | 96        | 43.4           |
| Unknown                           | 114       | 51.6           |

\(^\pm\) including prediabetes, \(^a\): JNC classification, \(^b\): AHA classification

Table 4 Clustering of cardio-metabolic risk factors and their socio-demographic correlates among patients with TB (n=221)
| Variables          | Overweight/obesity | Tobacco | Alcohol |
|-------------------|-------------------|---------|---------|
|                   | n(%)              | n(%)   | n(%)   |
| Total*            | 27 (12.2)         | 33 (14.9) | 24 (10.9) |
| **Male**          |                   |         |         |
| **Age**           |                   |         |         |
| Less than 20      | 0 (0)             | 0 (0)   | 0 (0)   |
| 20-39             | 6 (31.6)          | 7 (23.3) | 7 (25.0) |
| 40-59             | 12 (63.1)         | 14 (46.7) | 5 (25.0) |
| 60 and above      | 1 (5.3)           | 9 (30.0) | 8 (40.0) |
| **Ethnicity**     |                   |         |         |
| Janajati          | 8 (42.1)          | 8 (26.7) | 6 (30.0) |
| Brahmin/Chhetri   | 6 (31.6)          | 12 (40.0) | 6 (30.0) |
| Dalit             | 3 (15.8)          | 6 (20.0) | 6 (30.0) |
| Others            | 2 (10.5)          | 3 (13.3) | 2 (10.0) |
| **Education level** |                 |         |         |
| Illiterate        | 2 (10.5)          | 15 (50.0) | 13 (65.0) |
| Informal          | 6 (31.6)          | 6 (20.0) | 1 (5.0)  |
| Primary           | 3 (15.7)          | 4 (13.3) | 1 (5.0)  |
| Secondary         | 4 (21.1)          | 4 (13.3) | 5 (25.0) |
| Higher secondary and above | 4 (21.1) | 1 (3.4)  | 0 (0)    |
| **Occupation**    |                   |         |         |
| Agriculture       | 7 (36.8)          | 17 (56.7) | 13 (65.0) |
| Unskilled manual  | 5 (26.3)          | 5 (16.7) | 4 (20.0) |
| Skilled manual    | 4 (21.1)          | 4 (13.3) | 1 (5.0)  |
| Sales and services | 3 (15.8)   | 4 (13.3) | 2 (10.0) |
| **Province**      |                   |         |         |
| One               | 5 (26.3)          | 7 (23.3) | 4 (20.0) |
| Three and Five    | 1 (5.3)           | 7 (23.3) | 7 (35.0) |
| Gandaki           | 8 (42.1)          | 4 (13.3) | 1 (5.0)  |
| Sudurpaschim      | 5 (26.3)          | 12 (40.1) | 8 (40.0) |
| **Male total***   | **19 (11.9)**     | **30 (18.9)** | **20 (12.6)** |
| **Female**        |                   |         |         |
| **Age**           |                   |         |         |
| Less than 20      | 0 (0)             | 0 (0)   | 0 (0)   |
| 20-39             | 5 (62.5)          | 0 (0)   | 1 (25.0) |
| 40-59             | 2 (25.0)          | 3 (100.0) | 2 (50.0) |
| 60 and above      | 1 (12.5)          | 0 (0)   | 1 (25.0) |
| **Ethnicity**     |                   |         |         |
| Janajati          | 5 (62.5)          | 1 (33.3) | 2 (50.0) |
| Brahmin/Chhetri   | 2 (25.0)          | 0 (0)   | 0 (0)   |
| Dalit             | 1 (12.5)          | 2 (66.7) | 2 (50.0) |
| Others            | 0 (0)             | 0 (0)   | 0 (0)   |
| **Education level** |                 |         |         |
| Illiterate        | 2 (25.0)          | 3 (100)  | 4 (100.0) |
| Informal          | 2 (25.0)          | 0 (0)   | 0 (0)   |
| Primary           | 0 (0)             | 0 (0)   | 0 (0)   |
| Secondary         | 3 (37.5)          | 0 (0)   | 0 (0)   |
| Higher secondary and above | 1 (12.5) | 0 (0)   | 0 (0)   |
| **Occupation**    |                   |         |         |
| Agriculture       | 4 (50.0)          | 2 (66.7) | 3 (75.0) |
| Unskilled manual  | 3 (37.5)          | 1 (33.3) | 1 (25.0) |
| Skilled manual    | 1 (12.5)          | 0 (0)   | 0 (0)   |
| Sales and services | 0 (0)             | 0 (0)   | 0 (0)   |
| **Province**      |                   |         |         |
| One               | 4 (50.0)          | 2 (66.7) | 3 (75.0) |
| Three and Five    | 2 (25.0)          | 0 (0)   | 0 (0)   |
| Gandaki           | 1 (12.5)          | 0 (0)   | 0 (0)   |
| Sudurpaschim      | 1 (12.5)          | 1 (33.3) | 1 (25.0) |
| **Female total*** | **8 (12.9)**      | **3 (4.8)** | **4 (6.5)** |

*total n(%) of having individual with ≥1 risk factors with and without disaggregation by sex

Table 5 Factors associated with at least one cardio-metabolic risk factor (n=221)
| Variables          | ³1 risk factors | Unadjusted OR (95% CI) | Adjusted OR (95% CI) |
|--------------------|-----------------|------------------------|----------------------|
| **Age**            |                 |                        |                      |
| Less than 40       | 29 (29.9)       | Ref                    | Ref                  |
| 40 and above       | 68 (70.1)       | 2.00 (1.14-3.49)       | 1.49 (0.77-2.90)     |
| **Sex**            |                 |                        |                      |
| Male               | 76 (78.4)       | Ref                    | Ref                  |
| Female             | 21 (21.6)       | 0.56 (0.34-1.03)       | 0.47 (0.23-0.94)     |
| **Ethnicity**      |                 |                        |                      |
| Dalit              | 21 (21.6)       | Ref                    | Ref                  |
| Janajati           | 37 (38.1)       | 0.61 (0.29-1.29)       | 0.56 (0.25-1.27)     |
| Brahmin/Chhetri    | 32 (33.0)       | 0.74 (0.34-1.62)       | 0.72 (0.31-1.68)     |
| Others             | 7 (7.3)         | 0.58 (0.19-1.79)       | 0.37 (0.11-1.26)     |
| **Education level**|                 |                        |                      |
| Illiterate         | 40 (41.2)       | Ref                    | Ref                  |
| Literate           | 57 (58.8)       | 0.42 (0.23-0.75)       | 0.49 (0.25-0.96)     |
| **Occupation**     |                 |                        |                      |
| Agriculture        | 54 (55.7)       | Ref                    | Ref                  |
| Skilled manual     | 12 (12.4)       | 0.43 (0.20-0.93)       | 0.71 (0.29-1.71)     |
| Sales and Service  | 10 (10.3)       | 1.11 (0.42-2.95)       | 1.30 (0.46-3.70)     |
| Unskilled manual   | 21 (21.6)       | 0.64 (0.33-1.24)       | 0.79 (0.38-1.64)     |
| **Province**       |                 |                        |                      |
| One                | 25 (25.8)       | Ref                    | Ref                  |
| Three and Five     | 16 (16.5)       | 0.67 (0.28-1.64)       | 0.52 (0.20-1.37)     |
| Gandaki            | 16 (16.5)       | 0.34 (0.15-0.77)       | 0.32 (0.13-0.79)     |
| Sudurpaschim       | 40 (41.2)       | 0.68 (0.33-1.40)       | 0.62 (0.28-1.36)     |

*Significant at p<0.05