

Socio-demographic correlates and clustering of non-communicable diseases risk factors among reproductive aged women of Nepal: Results from Nepal Demographic Health Survey 2016

7 Bihungum Bista^{1*}, Raja Ram Dhungana², Binaya Chalise³, Achyut Raj Pandey³

9 ¹ Nepal Health Research Council

10 ² Institute of Health & Sports, Victoria University, Australia

11 ³ DFID/NHSP3/MEOR, Abt Associates

12

13 *Correspondence

14 Email: bistabihungum@gmail.com

15

16

17

18

19 Abstract

20 Globally, Non Communicable Diseases (NCDs) are the major killer diseases, majority of which
21 are attributable to common risk factors like smoking, alcohol intake, physical inactivity and low
22 fruits/vegetable consumption. Clustering of these risk factors increases the risk of developing
23 NCDs. The occurrence of NCDs among women is alarmingly high, and this invites impact on
24 upcoming generation too. So, this study aimed to assess the prevalence and clustering of selected
25 risk factors and their socio-demographic determinants in Nepalese women using Nepal
26 Demographic and Health Survey (NDHS) 2016 data.

27 NDHS applied stratified multi-stage cluster sampling to reach to the individual respondent for
28 representing the whole nation .This study included analysis of data of 6,396 women of age 15 to
29 49 years. Chi-square test for bivariate analysis and multiple poisson regression to calculate
30 adjusted prevalence ratio was applied.

31 A total of 8.91% participants were current smoker. Similarly, 22.19% and 11.45% of participants
32 were overweight and hypertensive respectively. Around 6.02% of participants had a co-
33 occurrence of two NCDs risk factors. Smoking, overweight and hypertension were significantly
34 associated with age, education, province, wealth index and ethnicity. Risk factors were more
35 likely to cluster in women aged 40-49 years (APR=2.95, CI: 2.58-3.38), widow/separated
36 (APR=3.09, CI: 2.24-4.28) and Dalit (APR=1.34, CI: 1.17-1.55).

37 This study found that NCD risk factors were disproportionately distributed by age, education,
38 socio-economic status and ethnicity and clustered in more vulnerable groups such as
39 widow/separated, Dalit and Janajati. .

40 **Keywords**

41 Women, smoking, overweight, hypertension, risk factors, clustering

43 **Introduction**

44 Globally, non-communicable disease (NCDs) are the number one causes of death and disability.

45 NCDs account for 41 million deaths each year and 85% of these deaths occur in low- and
46 middle-income countries while nearly half of NCDs deaths (15 million out of 41 million) occur
47 between the age of 30 and 69 years.[1] Cardiovascular diseases, cancers, diabetes, and
48 respiratory diseases, also called the ‘Group of Four’ are responsible for 80% of all NCDs deaths.

49 [1]

50 NCDs share the common risk factors such as low intake of fruit and vegetables, low level of
51 physical activity, tobacco use, harmful use of alcohol, obesity, raised blood pressure, raised
52 blood cholesterol and glucose. The co-occurrence of these risk factors in individual is known as
53 clustering of risk factors. Clustering of risk factors is related with an increased risk of developing
54 NCDs.[2,3] In context of Nepal, STEPS survey 2013, reported that 15.5% of general population
55 and 11.4% of women had three or more risk factors of NCD in them.[4] Evidence show that
56 women are more likely to experience the co-occurrence of behavioral and metabolic risk factors
57 increasing the risk of NCDs among themselves and in future generation.[5-7] Similarly,
58 compared to men, women experience fewer symptoms and show less apparent signs of certain
59 NCDs like cardiovascular disease. They are thus less likely to be identified and treated or less
60 likely to be the focus of disease prevention.[8]

61 NCDs have broader impact that varies from –impact on maternal to child health, individual to
62 national level and physical burden to financial burden. Thus to tackle with NCDs, the best
63 strategy is to identify and modify the behavioral risk factors that causes NCDs. This study,
64 therefore, aims to assess the magnitude of selected risk factors, individually or in cluster and
65 determines their socio-demographic distributions in Nepalese women.

66 **Methodology**

67 This study is based on the data from the Nepal Demographic Health Survey (NDHS)
68 2016.NDHS is periodic survey that consist of a nationally representative sample. A detailed
69 description of NDHS methodology is reported elsewhere.[9] Briefly, NDHS applied the stratified
70 multi-stage cluster sampling to reach to the individual respondent. Firstly, 383 primary sampling
71 units (PSU) (wards) were selected based on probability proportional to PSU size. Subsequently,
72 30 households per PSU (total 11040 households) were selected using an equal probability
73 systematic selection criterion. The 2016 NDHS was first time included the measurements of
74 biomarker information including blood pressure. Blood pressure and anthropometric
75 measurements were only obtained from the systematically selected subsample of the total study
76 participants. For this study, we have only included 6396 women aged between 15 and 49 years
77 who had their blood pressure recorded.

78 **Data collection**

79 *Blood pressure:* Trained enumerator measured blood pressure with UA-767F/FAC (A&D
80 Medical, Tokyo, Japan) blood pressure machines. Enumerators took three readings of blood
81 pressure at the interval of five minutes between each reading and averaged last two readings to
82 get more accurate blood pressure level. Participants whose systolic blood pressure (SBP)at the
83 level of 140 mmHg or higher and/or diastolic blood pressure (DBP) of ≥ 90 mm Hg or higher or
84 currently taking antihypertensive medicines at the time of data collection were considered
85 hypertensive.

86

87 *Overweight*: Weight in kilograms was divided by height in meters-squared to calculate BMI.
88 Women having ($\text{BMI} \geq 25\text{kg}/\text{m}^2$) were categorized as ‘Overweight’ and the remaining ($\text{BMI} <$
89 $25\text{kg}/\text{m}^2$) were categorized as “Not overweight”.

90 *Current tobacco use*: Current tobacco use includes either daily or occasional smoking or use of
91 smokeless tobacco (snuff by mouth, snuff by nose, chewing tobacco and betel quid with tobacco)

92 **Explanatory variables**

93 For this study purpose, information related to socio-demographic variables including age of the
94 participants, ethnicity, educational status, place of residence (rural/urban), province and
95 ecological zone and wealth index were extracted from the NDHS original datasets.

96 **Statistical analysis**

97 All analyses were performed on STATA 15.2 version using survey set command. All estimates
98 were weighted by sample weights and presented with 95% Confidence Intervals. Prevalence
99 estimates were calculated using Taylor series linearization. Chi-square test was used for bivariate
100 analysis to test associations between covariates and dependent variables. Furthermore, multiple
101 Poisson regression was used to calculate adjusted prevalence ratio (APR). The numbers of risk
102 factors present within each participant (from 0 to 3) were counted to assess clustering of risk
103 factors and analyzed using the Poisson regression.

104 **Ethical consideration**

105 The 2016 NDHS ethical approval was sought from Ethical Review Board (ERB) of the Nepal
106 Health Research Council (NHRC), Nepal and ICF Macro Institutional Review Board, Maryland,
107 USA. Written informed consent was obtained from each participant before enrolling in the
108 survey.

109 **Results**

110 Just over half (53.95%) of the participants were of aged 15-29 years. Largest proportions
111 (36.62%) of the participants were from Janjati group (indigenous group). One thirds (33.34%)
112 had no formal schooling while 76.55% of the participants were married. Most of the participants
113 belonged to Terai belt (49.89%) and rural areas (63.30%).Similarly, 22.43% and 20.92% of
114 participants belonged to richer and richest wealth quintile. Most of participants were engaged in
115 agriculture or were self employed.

116 **Table 1: Socio-demographic distribution of participants.**

Characteristics	un-weighted count	weighted percent
Age group		
15-29	3,498	53.95
30-39	1,697	27.09
40-49	1,201	18.96
Educational status		
No education	2,161	33.34
Primary	1,017	16.7
Secondary	2,324	35.48
Higher	894	14.48
Marital status		
Never in union	1,305	20.73
Married or living together	4,919	76.55
Widowed/divorced/separated	172	2.72

Ecological region

Mountain	454	6.05
Hill	2,916	44.06
Terai	3,026	49.89

Residence

Rural	4,129	63.03
Urban	2,267	36.97

Province

Province 1	909	16.84
Province 2	1,051	19.94
Province 3	853	22.07
Gandaki	803	9.81
Province 5	988	16.87
Karnali	888	5.66
Sudurpaschim	904	8.82

Wealth index

Poorest	1,347	16.96
Poorer	1,304	19.11
Middle	1,319	20.57
Richer	1,319	22.43
Richest	1,107	20.92

Occupational status

Did not work	2,003	32.34
--------------	-------	-------

Services	863	15.01
Agriculture/ self-employed	3,196	46.88
Manual	331	5.77
Ethnic group		
Advantage group	2,254	31.31
Dalit	851	12.56
Janjati	2,268	36.62
Other	1,023	19.51
Total	6,396	100

117

118

119

120 **Fig 2: Prevalence of number of NCDs risk factors among participants**

121 26.08% of participants had one NCDs risk factors and 6.3% participants had two NCD risk
122 factors (Fig 1)

123 Distribution of non communicable diseases risk factors

Table 2: Prevalence (%) of non-communicable diseases risk factors among 15-49 years women

never in union	1,305	1.83 [0.97-3.43]	1,305	5.28 [3.97-6.99]	1305	2.98 [2.14-4.13]
married or living together	4,919	10.11 [9.03-11.3]	4,537	27.27 [25.02-29.65]	4919	12.24 [10.97-13.63]
widowed/divorced/separated	172	29.07 [21.1-38.59]	171	25.45 [18.22-34.34]	172	16.87 [11.43-24.2]
P-value		<0.001		<0.001		<0.001
Ecological zone						
Mountain	454	14.56 [10.44-19.93]	412	20.65 [15.01-27.7]	454	10.62 [7.16-15.48]
Hill	2,916	10.99 [9.22-13.05]	2,776	26.92 [23.91-30.16]	2916	12.24 [10.43-14.32]
Terai	3,026	6.38 [5.34-7.62]	2,825	18.46 [16.4-20.71]	3026	8.84 [7.73-10.08]
P-value		<0.001		<0.001		0.008
Residence						
Urban	4,129	8.51 [7.1-10.16]	3,892	26.28 [23.69-29.04]	4,129	11.01 [9.63-12.55]
Rural	2,267	9.59 [8.18-11.21]	2,121	15.64 [13.65-17.86]	2,267	9.49 [8.05-11.16]
P-value		0.334		<0.001		0.171
Province						
Province 1	909	10.78 [8.59-13.46]	863	27.61 [23.61-32]	909	10.74 [8.76-13.1]
Province 2	1,051	3.04 [2.03-4.52]	953	10.95 [8.86-13.47]	1,051	6.6 [5.36-8.09]
Province 3	853	10.11 [7.19-14.03]	815	34.85 [29.49-40.63]	853	13.31 [10.19-17.19]

Gandaki	803	10.14 [7.36-13.82]	774	31.68 [27.72-35.92]	803	15.37 [12.48-18.8]
Province 5	988	7.48 [5.63-9.86]	930	18.77 [15.67-22.34]	988	11.93 [9.52-14.84]
Karnali	888	15.94 [13.06-19.31]	833	10.55 [7.78-14.16]	888	7.41 [5.35-10.19]
Sudurpaschim	904	12.43 [10.04-15.29]	845	9.13 [5.75-14.2]	904	5.05 [3.55-7.14]
<i>P-value</i>		<0.001		<0.001		<0.001
Wealth index						
Poorest	1,347	19.53 [17-22.34]	1,265	10.01 [8.05-12.38]	1347	8.33 [6.61-10.45]
Poorer	1,304	10.73 [9.14-12.57]	1,215	15.62 [13.48-18.04]	1304	10.75 [8.92-12.89]
Middle	1,319	6.21 [4.93-7.8]	1,227	14.08 [11.83-16.67]	1319	9.04 [7.47-10.9]
Richer	1,319	6.64 [4.19-10.37]	1,246	23.41 [20.76-26.3]	1,319	8.49 [6.84-10.51]
Richest	1,107	3.71 [2.39-5.7]	1,060	44.9 [41.09-48.77]	1107	15.36 [13.23-17.76]
<i>P-value</i>		<0.001		<0.001		<0.001
Occupation*						
Did not work	2,003	4.41 [3.48-5.58]	1,826	24.17 [21.69-26.84]	2,003	9.92 [8.55-11.49]
Services	863	6.36 [4.27-9.39]	836	39.47 [34.75-44.4]	863	14.15 [11.08-17.91]
Agriculture (self-employed)	3,196	12.38 [10.94-13.98]	3,035	14.62 [13.04-16.34]	3,196	9.53 [8.31-10.91]
Manual	331	12.57 [8.71-17.8]	313	30.85 [23.76-38.98]	331	11.24 [7.74-16.06]

<i>P-value</i>	<0.001		<0.001		0.014
Ethnicity					
Advantage group	2,254	7.24 [6.06-8.62]	2,142	24.54 [21.14-28.29]	2254 [8.33-11.62]
Dalit	851	14.95 [12.11-18.31]	782	18.45 [15.34-22.04]	851 [8.54-13.33]
Janjati	2,268	11.3 [9.55-13.33]	2,146	26.57 [23.34-30.06]	2268 [10.5-14.00]
Others	1,023	3.2 [2.21-4.62]	943	13.21 [10.97-15.83]	1,023 [6.64-9.72]
<i>P-value</i>		<0.001		<0.001	0.005
Total	6396	8.91 [7.89-10.05]	6,013	22.19 [20.46-24.02]	6396 [9.43-11.56]

125

126 *10 cases missing

127 **Current tobacco use**

128 The prevalence of current tobacco use was 8.91%. Women aged 40-49 years (22.38%), no
129 education (18.81%) and widowed/divorced/separated (29.07%) had the highest prevalence of
130 current tobacco use among their respective categories “Table 2”. Similarly, current tobacco use
131 was significantly associated with ecological zone, province, wealth index, occupation and
132 ethnicity “Table 2”.

133 **Overweight**

134 The prevalence of overweight/obesity was 22.19%. The rate was significantly high in women
135 aged 40-49 years compared to that of 15- 29 (11.96%) years women “Table 2”. Similarly,
136 prevalence of overweight significantly varied by education status “Table 2”. Compared to never
137 union, prevalence of overweight is significantly high among married/ living together women
138 (27.27%) or divorcee/widowed/separated (25.45%). Current tobacco use is also significantly
139 associated with residence status, province, wealth index, occupation and ethnicity “Table 2”.

140 **Hypertension:**

141 Prevalence of hypertension was 10.45%. The prevalence of hypertension significantly varied by
142 the age of the participants, where women aged 40-49 years had the highest rate of hypertension.
143 Secondary education was significantly associated with higher prevalence of hypertension
144 compared to primary and no education. Likewise, the rate of hypertension was also significantly
145 different in province, wealth index, occupation and ethnicity “Table 2”.

146

147 **Multivariable analysis of socio-demographic characteristics with non-communicable diseases risk factors**148 **Table 3: Relationship of socio-demographic characteristics with non-communicable diseases risk factors.**

	Current tobacco use APR	Overweight APR	Hypertension APR	Clustering of NCD risk factors APR
Age group (Years)				
15-29	1	1	1	1
30-39	2.46 [1.77 - 3.43]***	1.85 [1.60 - 2.13]***	2.8 [2.09 - 3.76]***	2.16 [1.90 - 2.46]***
40-49	3.7 [2.65 - 5.17]***	1.97 [1.68 - 2.31]***	5.73 [4.25 - 7.71]***	2.95 [2.58 - 3.38]***
Educational status				
No education	1	1	1	1
Primary	0.71 [0.57 - 0.88]**	1.27 [1.10 - 1.46]**	1.28 [1.03 - 1.59]*	1.07 [0.97 - 1.19]
Secondary	0.28 [0.20 - 0.40]***	1.09 [0.94 - 1.25]	1.2 [0.88 - 1.62]	0.87 [0.77 - 0.98]*
Higher secondary level or more	0.09 [0.04 - 0.22]***	1.12 [0.93 - 1.36]	1.31 [0.90 - 1.91]	0.92 [0.78 - 1.08]
Marital status				
Never in union	1	1	1	1

Married or living together	1.37 [0.75 - 2.49]	4.02 [2.98 - 5.40]***	1.97 [1.35 - 2.89]***	2.91 [2.27 - 3.74]***
Widowed/divorced/separate	2.03 [1.04 - 3.98]*	3.29 [2.06 - 5.25]***	1.91 [1.11 - 3.30]*	3.09 [2.24 - 4.28]***
Ecological region				
Mountain	1	1	1	1
Hill	1.01 [0.72 - 1.43]	0.8 [0.57 - 1.11]	0.79 [0.55 - 1.13]	0.88 [0.74 - 1.04]
Terai	1.19 [0.79 - 1.79]	0.71 [0.50 - 1.01]	0.71 [0.48 - 1.06]	0.85 [0.70 - 1.03]
Residence				
Rural	1	1	1	1
Urban	1.16 [0.96 - 1.41]	0.98 [0.85 - 1.13]	0.94 [0.75 - 1.16]	1.01 [0.91 - 1.12]
Province				
Province 1	1	1	1	1
Province 2	0.28 [0.17 - 0.46]***	0.46 [0.36 - 0.58]***	0.61 [0.43 - 0.87]**	0.45 [0.37 - 0.55]***
Province 3	1 [0.72 - 1.39]	0.9 [0.76 - 1.07]	1.1 [0.80 - 1.51]	0.99 [0.87 - 1.12]
Gandaki	0.92 [0.67 - 1.26]	1 [0.84 - 1.19]	1.3 [0.93 - 1.82]	1.07 [0.92 - 1.23]
Province 5	0.64 [0.45 - 0.90]**	0.71 [0.59 - 0.86]***	1.2 [0.89 - 1.63]	0.8 [0.69 - 0.93]**
Karnali	1.02 [0.75 - 1.39]	0.52 [0.38 - 0.71]***	0.81 [0.53 - 1.25]	0.73 [0.62 - 0.86]***
Sudurpaschim	0.89 [0.66 - 1.21]	0.42 [0.28 - 0.63]***	0.58 [0.37 - 0.89]*	0.61 [0.51 - 0.74]***

Wealth index

Poorest	1	1	1	1
Poorer	0.69 [0.55 - 0.86]***	1.58 [1.27 - 1.97]***	1.34 [1.00 - 1.79]	1.05 [0.92 - 1.18]
Middle	0.51 [0.38 - 0.68]***	1.61 [1.23 - 2.12]***	1.22 [0.88 - 1.69]	0.93 [0.78 - 1.10]
Richer	0.52 [0.34 - 0.81]**	2.32 [1.80 - 2.97]***	1.04 [0.72 - 1.48]	1.1 [0.94 - 1.30]
Richest	0.37 [0.22 - 0.60]***	3.38 [2.63 - 4.34]***	1.45 [1.00 - 2.09]*	1.5 [1.27 - 1.77]***
Occupational status				
Did not work	1	1	1	1
Services	1.5 [0.98 - 2.27]	1.05 [0.93 - 1.19]	1.02 [0.81 - 1.28]	1.09 [0.97 - 1.22]
Agriculture (self-employed)	1.3[0.97 - 1.74]	0.71[0.62 - 0.82]***	0.78[0.64 - 0.96]*	0.83 [0.75 - 0.92]***
Manual	1.4 [0.93 - 2.11]	0.9 [0.73 - 1.12]	0.78 [0.53 - 1.16]	0.94 [0.78 - 1.12]
Ethnic group				
Advantage group	1	1	1	1
Dalit	1.68 [1.27 - 2.23]***	1.09 [0.86 - 1.36]	1.47 [1.09 - 1.97*]	1.34 [1.17 - 1.55]***
Janjati	1.24 [0.98 - 1.57]	1.1 [0.97 - 1.26]	1.28 [1.04 - 1.57*]	1.16 [1.05 - 1.28]**
Others	0.78 [0.49 - 1.26]	0.82 [0.67 - 1.02]	1.34 [0.97 - 1.86]	0.95 [0.80 - 1.13]

149 *** significant at p -value < 0.001.

150 *significant at p -value < 0.01.

151 * *significant at p-value < 0.05.*

152 **Current tobacco use:**

153 Women of age 30-39 years and 40-49 years were 2.56 and 3.70 times more likely to be tobacco
154 user than that of 15-29 years old women “Table 2”. Similarly, educated women were less likely
155 to be tobacco user (APR primary: 0.71, APR secondary: 0.28, APR Higher: 0.09) than that of
156 uneducated women. Widowed/divorced/separated women were 2.03 times more likely to be
157 tobacco user than that of women who were never in union. Furthermore, women residing on
158 province 2 (APR: 0.28) and province 3 (APR: 0.64) were less likely to be tobacco user in
159 comparison to province 1 women. Similarly, poor women (APR: 0.69) were more like to be
160 smoker than that of poorest women. Dalit women were 1.68 times more likely to be tobacco user
161 in comparison to advantage women.

162

163 **Overweight:**

164 Women of age 30-39 years were 1.85 and 1.97 more likely to overweight in reference to 15-29
165 years “Table 2”. Similarly, married and single women were 4.02 and 3.29 respectively times
166 more likely to be overweight than that of never in union women. Further, more women residing
167 in province 2,province 5,Karnali and Sudurpaschim were less likely to overweight in comparison
168 to province 1.Regarding wealth, as the gradient of wealth increases women were more likely to
169 be overweight in comparison to poor women. Women involved self-employed agriculture were
170 less likely to be overweight in reference to who didn’t have work.

171 **Hypertension:**

172 Women of 40-49 years and 30-39 years were 1.97 and 1.85 times more likely to be hypertensive
173 in comparison to 15-29 years women “Table 2”. Primary educated women were 1.27 times more
174 likely to be hypertensive in comparison to uneducated women. Married and single

175 (widowed/separated/divorced women) were 4.02 and 3.29, respectively, times more likely to be
176 hypertensive than that of never in union women. Similarly women residing in province 2
177 province 4 province 5 province 6 and province 7 were less likely to hypertensive in comparison
178 to province 1 women. Richest women were 3.38 times more likely to be hypertensive than that of
179 poorest women. Women whose occupation was agriculture were less likely to be hypertensive in
180 comparison to who didn't have work.

181 **Clustering of NCDs risk factors**

182 Women of 40-49 years age group were 2.95 more times likely to have NCD risk factors than that
183 of 15-29 years of women "Table 3". Women who had pursued secondary level of education were
184 0.87 times less likely to have NCD risk factors. Married and widowed/divorced/separated
185 women were 2.91 and 3.09 times more likely to have NCD risk factors. Similarly, richest women
186 were 1.5 times more likely to suffer from NCDs risk factors in comparison to poorest women.
187 Furthermore, women employed in agriculture sector were 0.83 times less likely to suffer from
188 NCD risk factors than women who were not employed. Regarding ethnicity, Dalit women were
189 more likely to have NCD risk factors in comparison to advantage group.

190

191

192

193

194

195

196

197 **Discussion**

198 NCDs have different consequences for women in comparison to men.[10] In resource challenged
199 setting like Nepal, diagnosis and care for NCDs are less accessible and affordable to women due
200 to limited health infrastructure and human-resource capacity. As a result, NCDs are often
201 detected at the late stage that invites women for a premature death. So, this study aimed to
202 identify at risk women to possess NCDs risk factors. This information could be useful in
203 designing preventative strategies against NCDs risk factors.

204 **Tobacco use**

205 Our study demonstrated that the proportion of tobacco use was nearly 3 fold higher in 30-40
206 years age group women. This finding is in line with previous studies conducted across different
207 countries.[11,12] Women aged between 30 and 40 years are likely to possess the adolescent
208 children thus maternal smoking could significantly contribute to tobacco use in young
209 adolescent.[13] High prevalence of tobacco use in the women with childbearing age is also
210 critical in terms of adverse maternal and child health outcomes in perinatal period.[14]

211 Our study showed a negative association between smoking and education; the prevalence ratios
212 among the participants having secondary and higher education being lower than those having no
213 education. This finding is similar to that of previous studies.[11,12]

214 In this study, tobacco use was higher in divorced women than married women. Similar kind of
215 evidence was reported in other studies, especially related with tobacco smoke.[11,15], which
216 suggest that the death of loved ones can encourage women to opt smoking with intention of
217 coping stress arising from the death of intimate partner.[16,17]

218 Unlike the findings from other national studies, [11,18] it is interesting to note that prevalence of
219 smoking did not vary significantly between rural and urban participants. However, it should be

220 taken into consideration that large number of geographical cluster previously considered as rural
221 areas have recently been upgraded as urban that somehow makes the comparison difficult.
222 Generally, people with low socioeconomic status are likely to use tobacco, probably due to lack
223 of proper social support environment against tobacco use.[19] Our study also demonstrated the
224 same finding that the poorest has the highest proportion of tobacco user across all hierarchies of
225 wealth quintile. Evidence suggest that increase in taxation can be other effective strategy in
226 controlling tobacco as there seem to be high price elasticity particularly low and middle income
227 countries like Nepal.[20] Around 10% increase in price is found to reduce smoking by about 8%
228 in low- and middle-income countries and by 4% in high-income countries.[21]

229 This is the first study to repute and compare smoking prevalence by Provinces of Nepale.
230 Findings show that women from province 2 and province 5 were less likely to use any form of
231 tobacco in comparision to women residing in other provinces. Province 2 and a major portion of
232 province 5 share a similar kind geographical terrain i.e plain, where the media accessibility
233 among women is high in comparison to other.[22]

234 The observed discrepancy in smoking prevalence by socioeconomic status may be related to less
235 successful quiet attempts in disadvantaged groups.[19] Population level interventions such as
236 smoke free legislation and mass media campaign tailored to the need of disadvantaged
237 communities are thus need to reduce high smoking prevalence in the disadvantaged groups.

238

239

240 **Obesity**

241 The current study found that the likelihood of being overweight/obesity is influenced by age,
242 married marital status and wealth status. There is an increase in prevalence of overweight with

243 increase age, this finding is line with findings of STEPS Nepal 2013 survey and studies from
244 Bangladesh[2,4]. Similarly, this study found that married women were more likely to be
245 overweight in comparison to unmarried women. Broadly, literatures explain that smoking and
246 habit of looking attractive is related with obesity. [23,24] However, our another findings related
247 with widowed/divorce were different than established crisis model. This model explains that
248 stresses linked to marital disruption can invite psychological, physiological, and social
249 consequences that might lead to weight loss.[24,25] However, this model explains that weight
250 loss is short lived, individuals are expected to gain weight to their new social and economic
251 environment.

252 Furthermore; wealthy women are on risk of getting overweight in comparison to poor women.
253 The increased risk of getting overweight among wealthy and elderly women may be due to
254 reduced level of physical activity with increased age and wealth status. Maternal obesity is a
255 public health concern. The prevalence of overweight/obesity in reproductive age women is
256 nearly tripled from 9% in last ten years in Nepal.[9,22,26].With the global rise in maternal
257 obesity,[27] more mother and child are at risk of dying. There is a growing evidence that
258 maternal obesity can substantially interfere in fetal development and determines the long term
259 health of the offspring.[28] Similarly, it is also a major risk factor for gestational diabetes,
260 preeclampsia and pregnancy induced hypertension in women. [29,30]
261 On the other hand, societal and nutritional changes due to economic growth and globalization of
262 food market might have contributed the rising obesity rates. The lower level of education and
263 health literacy among poor also contributes to difficulty in purchasing less energy dense food
264 such as fruits and vegetable.

265 Further research in the area of food security, dietary pattern and physical activities by socio
266 economic status is needed to rule out causes of obesity for women from low socioeconomic
267 background versus high socioeconomic status. Intervention to tackle obesity requires targeting
268 social and economic factors.

269 **Hypertension**

270 The prevalence of hypertension seems to increase with increasing age, which is in line with
271 results of secondary data analysis of Nepal STEPS survey 2013 and other evidences as well.[31-
272 33] However, age being a non-modifiable risk factor, hypertension control initiatives should
273 focus on lowering other modifiable risk factors that can be useful in countering the effect of
274 increasing age.

275 The prevalence of hypertension was significantly higher among the richest segment of study
276 participants. Similarly, chance of getting hypertension is significant in richest segment of
277 population. Similar type of evidence was observed i.e higher prevalence of hypertension among
278 richest segment in general population of Bangladesh.[33] It could be because of lower level of
279 physical activity associated with involvement in more sedentary type of occupation, consumption
280 of red meat, smoking and alcohol consumption.

281 Compared to province 1, province 7 have lower prevalence of hypertension. It can be due to
282 differences in level of physical activity associated with occupational practices, dietary pattern,
283 and differences in established risk factors of hypertension like smoking and alcohol
284 consumption.

285 **Clustering of NCDs risk factors and its implication**

286 Our study suggested that clustering of NCDs risk factors increases with growing age, among
287 well-off, and in Dalits and Janajatis - known as the disadvantaged ethnic groups in Nepal.

288 Previous studies have also revealed that clustering of risk factors becomes increasingly common
289 with increasing age [2,3,34]. A multi country study from Bangladesh, Vietnam, India, Indonesia
290 and Thailand shows that there is increase in clustering of risk factors with increasing age among
291 females.[35] As Nepal has been witnessing rapid increase in life expectancy and median age of
292 the population, the problems can escalate in coming years.[36] Country may need additional
293 investment in prevention as well as long term care for NCDs to cater the need of geriatric
294 population. Moreover, NCDs are considered to have serious impact in economic growth of the
295 country reducing it by almost 5–10%. [37]

296 Similarly, this study depicts the odds of clustering of NCDs risk factors higher among wealthiest
297 women. This findings is similar to that of secondary data analysis of national STEPS survey
298 from Bhutan.[38] Clustering of more NCDs risk factors in wealthy group can be linked with
299 adoption of sedentary lifestyle among wealthy women. Furthermore, from provincial point of
300 view provincial 3 and Gandaki province is not related with clustering of NCDs risk factors,
301 however, other provinces had reduced odds of clustering of NCDs risk factors. This can be again
302 viewed from the perspective of sedentary lifestyle with reference to urbanization. In comparison
303 to province 1, province 3 and Gandaki province, other provinces are less urbanized that reduces
304 odds of adoption of sedentary lifestyle. Ultimately, this might have contributed in reducing odds
305 of clustering of NCD risk factors among women residing in province 5, Karnali and
306 Sudurpaschim.

307 In contradiction to the study in Bangladesh, which revealed an increase in clustering of risk
308 factors with increasing educational level, however our study shows that women who have
309 secondary level of education had lower risk of clustering of NCDs risk factors. [35] The

310 difference in evidence may be due to difference in NCDs prevention and control contents in
311 secondary level education.

312 Furthermore, women involved in agriculture (self-employed) sector have low odds of clustering
313 of NCDs risk factors. Generally, self-employed agriculture work is expected to increase the
314 vigorous physical activity. Vigorous physical activity is a protective factor against obesity and it
315 is expected to lower down the risk of clustering NCDs risk factors.[39]

316 As the burden of NCDs is increasing, evidence on clustering of NCDs risk factors is useful
317 from the perspective of allocating and mobilizing resources in public health programme. The
318 clustering of NCDs risk factors in a particular group indicate higher chances of NCDs burden on
319 that particular group. This situation creates public health challenge; however, it can be also be an
320 opportunity to tailor intervention for specific group of population to prevent the burden of NCDs.
321 The limitation of this study is the nature of study i.e cross-sectional design that limit to establish
322 causality. Similarly, all NCD risk factors like physical inactivity, fruit and vegetable intake,
323 cholesterol level related information was not taken main survey. That had limited us to
324 understand completed picture of NCDs risk factors among women.

325 **Conclusion**

326 Overweight is the common NCD related risk factors among the 15-49 years women. The
327 occurrence of NCDs related risk factors is higher in higher age group. However, in case of
328 relationship of smoking with respect to wealth quintile relationship is inverse. Similarly, study
329 reveals that chances of clustering of NCDs related risk factors get increases with increasing age.
330 Furthermore, chances of clustering of NCDs risk factors are higher on disadvantaged ethnic
331 group and richest women.

332

333

334

335

336

337

338

339

340

341

342

343

344

345

346

347 **References**

348 1. World Health Organization(WHO) (2018) Noncommunicable diseases. WHO.

349 2. Zaman MM, Bhuiyan MR, Karim MN, Moniruzzaman, Rahman MM, et al. (2015) Clustering
350 of non-communicable diseases risk factors in Bangladeshi adults: An analysis of STEPS survey
351 2013. *BMC Public Health* 15: 659.

352 3. Ahmed SM, Hadi A, Razzaque A, Ashraf A, Juvekar S, et al. (2009) Clustering of chronic
353 non-communicable disease risk factors among selected Asian populations: levels and
354 determinants. *Global health action* 2: 10.3402/gha.v3402i3400.1986.

355 4. Ministry of Health, Nepal Health Research Council, Organization WH (2013) Non-
356 communicable Diseases Risk Factors: STEPS survey Nepal 2013. Kathmandu: Nepal Health
357 Research Council.

358 5. Khuwaja AK, Kadir MM (2010) Gender differences and clustering pattern of behavioural risk
359 factors for chronic non-communicable diseases: community-based study from a developing
360 country. *Chronic Illn* 6: 163-170.

361 6. Gluckman PD, Hanson MA, Bateson P, Beedle AS, Law CM, et al. (2009) Towards a new
362 developmental synthesis: adaptive developmental plasticity and human disease. *Lancet* 373:
363 1654-1657.

364 7. Godfrey KM, Gluckman PD, Hanson MA (2010) Developmental origins of metabolic disease:
365 life course and intergenerational perspectives. *Trends Endocrinol Metab* 21: 199-205.

366 8. DeVon HA, Ryan CJ, Ochs AL, Shapiro M (2008) Symptoms across the continuum of acute
367 coronary syndromes: differences between women and men. *Am J Crit Care* 17: 14-24; quiz 25.

368 9. Ministry of Health, New ERA, ICF (2012) Nepal Demographic and Health Survey 2011.
369 Kathmandu, Nepal: Ministry of Health, Nepal.

370 10. Peters SAE, Woodward M, Jha V, Kennedy S, Norton R (2016) Women's health: a new
371 global agenda. *BMJ Global Health* 1: e000080.

372 11. Bista B, Mehata S, Aryal KK, Thapa P, Pandey AR, et al. (2015) Socio-demographic
373 Predictors of Tobacco Use among Women of Nepal: Evidence from Non Communicable Disease
374 Risk Factors STEPS Survey Nepal 2013. *J Nepal Health Res Counc* 13: 14-19.

375 12. Das R, Baidya S (2014) Prevalence of tobacco use among rural women of Mohanpur block,
376 West Tripura district. *Al Ameen J Med Sc* 7: 270-274.

377 13. Xi B, Liang Y, Liu Y, Yan Y, Zhao M, et al. (2016) Tobacco use and second-hand smoke
378 exposure in young adolescents aged 12-15 years: data from 68 low-income and middle-
379 income countries. *The Lancet Global Health* 4: e795-e805.

380 14. Andres RL, Day M-C (2000) Perinatal complications associated with maternal tobacco use.
381 *Seminars in Neonatology* 5: 231-241.

382 15. Hodge FS, Casken J (1999) Characteristics of American Indian women cigarette smokers:
383 prevalence and cessation status. *Health Care Women Int* 20: 455-469.

384 16. Doherty EW, Doherty WJ (1998) Smoke gets in your eyes: Cigarette smoking and divorce in
385 a national sample of American adults. *Families, Systems, & Health* 16: 393.

386 17. McKee SA, Maciejewski PK, Falba T, Mazure CM (2003) Sex differences in the effects of
387 stressful life events on changes in smoking status. *Addiction* 98: 847-855.

388 18. Aryal UR, Bhatta DN, Shrestha N, Gautam A (2015) Assessment of nicotine dependence
389 among smokers in Nepal: a community based cross-sectional study. *Tobacco induced diseases*
390 13: 26-26.

391 19. Hiscock R, Bauld L, Amos A, Fidler JA, Munafo M (2012) Socioeconomic status and
392 smoking: a review. *Ann N Y Acad Sci* 1248: 107-123.

393 20. G.Emmanuel Guindon A-MP, David Boisclair Higher tobacco prices and taxes in South-East
394 Asia:An effective tool to reduce tobacco use,save lives and generate revenue. *The World Bank*.

395 21. Jha P, Chaloupka FJ (2000) *Tobacco control in developing countries*: Oxford University
396 Press.

397 22. Ministry of Health, New ERA, ICF (2017) *Nepal Demographic and Health Survey 2016*.
398 Kathmandu,Nepal: Ministry of Health, Nepal.

399 23. Flegal KM, Troiano RP, Pamuk ER, Kuczmarski RJ, Campbell SM (1995) The influence of
400 smoking cessation on the prevalence of overweight in the United States. *N Engl J Med* 333:
401 1165-1170.

402 24. Teachman J (2016) Body Weight, Marital Status, and Changes in Marital Status. *J Fam*
403 *Issues* 37: 74-96.

404 25. Umberson D, Liu H, Powers D (2009) Marital status, marital transitions, and body weight. *J*
405 *Health Soc Behav* 50: 327-343.

406 26. Ministry of Health, New ERA, ICF (2007) *Nepal Demographic and Health Survey 2006*.
407 Kathmandu,Nepal: Ministry of Health, Nepal.

408 27. Godfrey KM, Reynolds RM, Prescott SL, Nyirenda M, Jaddoe VWV, et al. (2017) Influence
409 of maternal obesity on the long-term health of offspring. *The Lancet Diabetes & Endocrinology*
410 5: 53-64.

411 28. Fleming TP, Watkins AJ, Velazquez MA, Mathers JC, Prentice AM, et al. (2018) Origins of
412 lifetime health around the time of conception: causes and consequences. *The Lancet* 391: 1842-
413 1852.

414 29. Athukorala C, Rumbold AR, Willson KJ, Crowther CA (2010) The risk of adverse pregnancy
415 outcomes in women who are overweight or obese. *BMC Pregnancy and Childbirth* 10: 56.

416 30. Ayensu J, Annan RA, Edusei A, Badu E (2016) Impact of maternal weight on pregnancy
417 outcomes: a systematic review. *Nutrition & Food Science* 46: 542-556.

418 31. Aryal KK, Mehata S, Neupane S, Vaidya A, Dhimal M, et al. (2015) The Burden and
419 Determinants of Non Communicable Diseases Risk Factors in Nepal: Findings from a
420 Nationwide STEPS Survey. *PLOS ONE* 10: e0134834.

421 32. Yoon SS, Carroll MD, Fryar CD (2015) Hypertension Prevalence and Control Among
422 Adults: United States, 2011-2014. *NCHS Data Brief*: 1-8.

423 33. Khanam MA, Lindeboom W, Razzaque A, Niessen L, Milton AH (2015) Prevalence and
424 determinants of pre-hypertension and hypertension among the adults in rural Bangladesh:
425 findings from a community-based study. *BMC public health* 15: 203-203.

426 34. Barreto SM, Passos VMA, Firmo JOA, Guerra HL, Vidigal PG, et al. (2001) Hypertension
427 and clustering of cardiovascular risk factors in a community in Southeast Brazil: the Bambuí
428 Health and Ageing Study. *Arquivos Brasileiros de Cardiologia* 77: 576-581.

429 35. Ahmed SM, Hadi A, Razzaque A, Ashraf A, Juvekar S, et al. (2009) Clustering of chronic
430 non-communicable disease risk factors among selected Asian populations: levels and
431 determinants. *Global health action* 2: 1986.

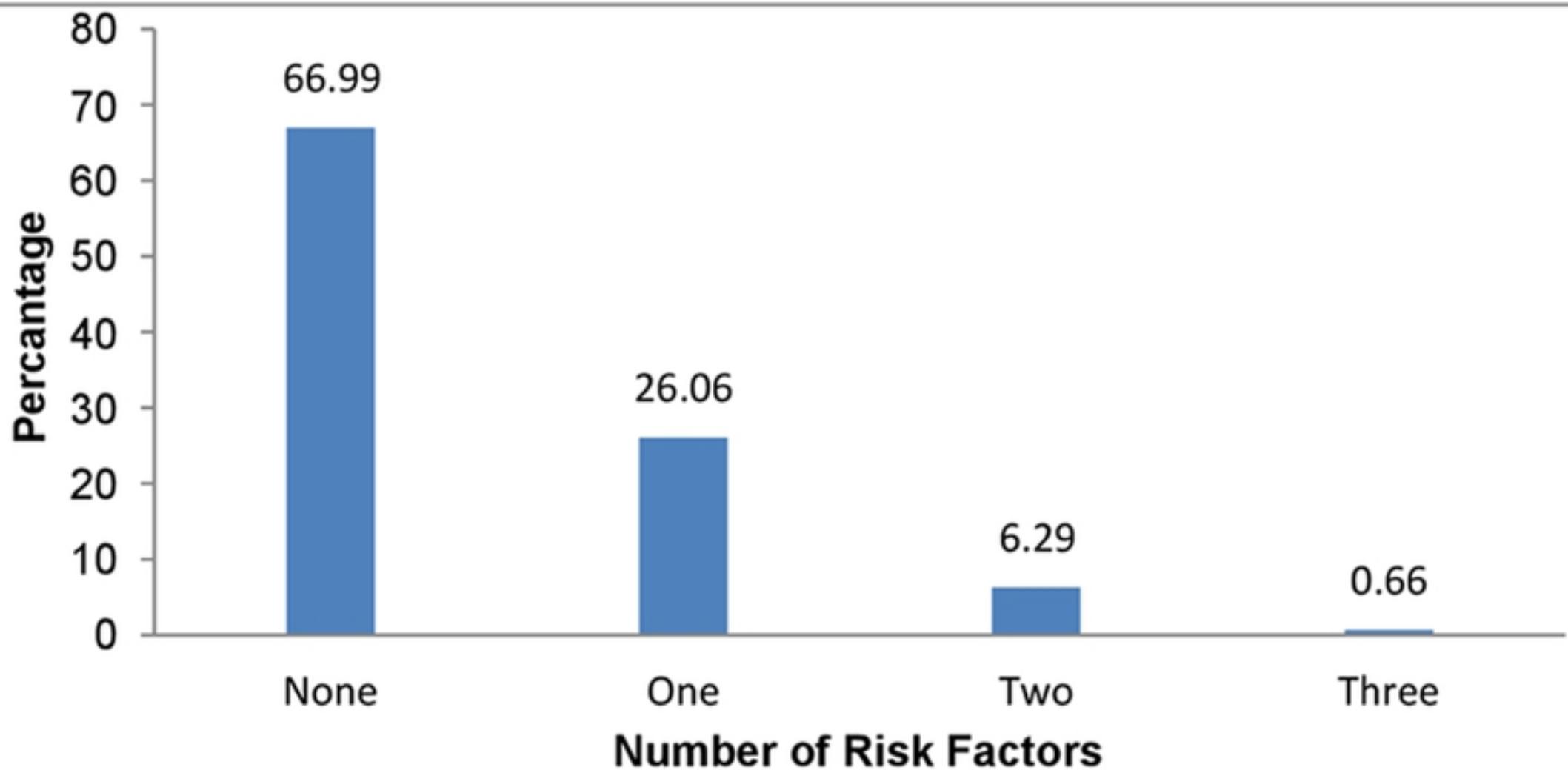
432 36. Nepal Health Research Council (NHRC), Ministry of Health and Population(MoHP),
433 Monitoring Evaluation and Operational Research (MEOR) (2019) Nepal Burden of Disease
434 2017: A Country Report based on the Global Burden of Disease 2017 Study. Kathmandu, Nepal:
435 NHRC, MoHP and MEOR.

436 37. Ajay Mahal AK, Michael Engelgau (2010) The Economic Implications of Non-
437 Communicable Disease for India. Washington Dc: The world bank.

438 38. Pelzom D, Isaakidis P, Oo MM, Gurung MS, Yangchen P (2017) Alarming prevalence and
439 clustering of modifiable noncommunicable disease risk factors among adults in Bhutan: a
440 nationwide cross-sectional community survey. *BMC Public Health* 17: 975.

441 39. Bradbury KE, Guo W, Cairns BJ, Armstrong MEG, Key TJ (2017) Association between
442 physical activity and body fat percentage, with adjustment for BMI: a large cross-sectional
443 analysis of UK Biobank. *BMJ Open* 7: e011843.

444



Figure