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Assessment of Short Term Cardiovascular Risk Among 40 Years and Above Population in a Selected Community of Kathmandu, Nepal

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ABSTRACT

Background: Cardiovascular disease (CVD) risk assessment is effective for identifying whether people are at low or high risk of CVD events. It is also useful for determining the intensity of intervention. People with low risk of CVD can take more benefit by lifestyle modifications, whereas people at high risk need pharmacological intervention in addition. But, there is dearth of related study in Nepal. Therefore, this study aimed to assess short term CVD risk prediction in selected community of Kathmandu, Nepal.

Methods: We conducted a cross-sectional study in Sitapaila Village Development Committee, Kathmandu, Nepal between November 2014 and April 2015. We, first selected the household randomly to enroll 347 participants with 18 to 70 years of age, and later assessed the short term CVD risk prediction among ≥ 40 years age group using WHO/ISH chart.

Results: The mean age of respondents was 52years. The majority of participants were female (58.4%), homemakers (45.2%), from Newar ethnic group (31.9%), and without formal education (42.8%). Smoking was present in 21.7% of respondents, diabetes in 19.9 %, and hypertension in 53.6%. The ≥10% CVD risk was seen in 14.6% (95% CI: 9.2, 20) of the respondents. It was significantly associated with age ($p<0.001$), education ($p=0.027$), smoking ($p = 0.002$), cholesterol level ($p = 0.021$), systolic hypertension ($p <001$), and diabetes ($p = 0.019$).

Conclusions: The study population is in high risk of developing CVDs in near future. Lifestyle modifications and pharmaceutical interventions to manage the risk factors among study population are highly recommended.

Keywords: Cardiovascular disease; CVD risk assessment; CVD risk prediction; nepal

INTRODUCTION

Cardiovascular disease (CVD) mortality and morbidity are the major causes of the global health burden.[1] Over 80% of cardiovascular disease occurs in low and middle income countries.[2,3] CVD mortality and morbidity rate are estimated to be higher in Nepal in comparison to the neighboring countries: China and India,[4] accounting for 22 % of all cause of death.[5]

Short term CVD risk prediction is the estimation of risk of developing fatal and non-fatal coronary heart disease (CHD) and cerebrovascular disease in next 10 years.[6] Rather than assessing and dealing with each individual risk factor separately, this approach combines a relative risk of each risk factor with the population-level estimate of absolute risk and helps to determine the appropriate intervention in treatment and control of CVDs based on high, moderate and low risk levels.[6,7] But, we lack the studies on CVD risk assessment in Nepal. Therefore, our study assessed

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the short term CVD risk in a selected community of Kathmandu.

METHODS

This study is a part of a study titled "Prevalence of cardiovascular risk factors in selected community of Kathmandu" The original study was analytical, community-based, cross-sectional study carried out in Sitapaila Village Development Committee (VDC) from November 2014 to April 2015. Study site represents one of the rapidly urbanizing places positioned nearby Kathmandu with soaring in-migration and is inhabited by 7,785 people of having age 18 years and more.[8]

The Ethical Review Board (ERB) of Nepal Health Research Council (NHRC) assessed the ethical part of study and provided ethical approval. We obtained written informed consent from respondents after detailed explanation of research purpose and assurance of maintaining privacy and confidentiality. During study, those who needed further treatment were referred to tertiary care centers and also provided free medical consultation at one private hospital.

We calculated the sample size using one sample situation of estimating population proportion with specified absolute precision formula.[9] We considered the estimation of population prevalence of risk factors as 25.7%[10] with allowable error and level of significance as 5% and taking 15% non-response rate. The sample size for estimating prevalence of CVD risk factors was 347. Of total 347 participants, we included 166 respondents who were of age 40 years or above for analysis of the short term CVD risk prediction, considering the fact that WHO/ISH tool only incorporates people having age 40 years or above. We excluded the self-reported cases of established myocardial infarction, angina, stroke, intermittent claudication and other cardiovascular diseases.

We applied systematic random sampling method to select the household. Data enumerators first mapped the study site and assigned a number to each household, beginning from left hand side (while data enumerator facing west) of first lane of Eastern North corner of the site. After randomly selecting first household among first 13 houses using random number table, data enumerators approached to every 13 household systematically until the end of data collection. One individual from each household was enrolled in the study by KISH method[10], given that written consent was granted.

We utilized the WHO STEP wise questionnaires to collect the data on the demographics and health behavior of respondents.[11] Demographic information included age, sex, ethnicity, marital status, years at school and primary occupation. The health behavior questionnaire comprised questions related to tobacco use, alcohol consumption, fruit and vegetable consumption, physical activity and salt and oil intake. Besides, we also collected the data on anthropometric, clinical and biochemical measurements mainly height, weight, waist and hip circumference, systolic and diastolic blood pressure, fasting blood glucose (FBS) and lipid. Of these, data related to smoking, systolic blood pressure, FBS and total cholesterol were extracted for assessing the short term CVD risk among respondents.

Data enumerators recorded the seven days history of physical activity. The physical activity related to work, transport and recreational activities into vigorous, moderate and low levels of activity in accordance with Centers for Disease Control (CDC) and American College of Sports Medicine (ACSM) guidelines.[12] Vigorous physical activity was defined as any activity that had more than six Metabolic Equivalent MET values. Moderate physical activity was any activity that had METs value between three and six.[12] Physical activity having less than three METs like spending time sitting at a desk, sitting with friends, travelling in a car, bus or train, reading a book etc was considered low or sedentary physical activity.[12] The references for METs of each activity were taken from 2011 Compendium of Physical Activities.[13]

We measured the height and weight of respondents using portable standard stature scale and digital weighing machine. Standard procedures were followed while measuring waist and hip circumference using a constant tension tape.[14]

Trained data enumerators measured blood pressure using Doctor's Aneroid Sphygmomanometer (BP Set). A medium sized sphygmomanometer cuff was placed on the left arm with the respondent resting their forearm on a table with the palm facing upward. Before taking the measurements, we asked respondents to sit quietly and rest for 15 minutes with legs uncrossed. We took three readings of the systolic and diastolic blood pressure with three minute rest between each reading and recorded the mean of the second and third reading.

For collecting biochemical samples for FBS and lipid, we requested participants to fast overnight for 12 hours. A certified lab technician team collected the venous blood samples and stored it in an ice pack carrier, then, brought to the hospital laboratory and analyzed using semi-automated procedures with commercially available kits (Acurex) within two hours.

We adopted the standard operational definition for current smokers, alcohol users, physical activity level, hypertension and diabetes. Current smokers were defined as those smoking tobacco products in the last 30 days. Similarly, those who engaged in alcohol drinking within last 30 days were labeled as current drinker. Sufficient physical activity was defined as involving in ≥ 600 METs of moderate and vigorous activities in a week.[10] The diagnostic criterion for hypertension was set as systolic blood pressure ≥ 140 mmHg and/or a diastolic blood pressure ≥ 90 mmHg or taking any antihypertensive medicine as recommended by Joint National Committee-VII.[15] Whereas, a fasting blood sugar level of 126 mg/dl and higher or taking any anti-diabetic medicines was considered as diagnostic criteria for diabetes.[10]

We calculated the 10 year CVD risk level among respondents by WHO/ISH risk prediction chart designed for South East Asia Sub Region D.[16] The tool utilizes the individual age, sex, systolic blood pressure, presence or absence of diabetes, smoking status and cholesterol level to indicate total 10 year risk of fatal or non-fatal cardiovascular events (coronary heart disease or stroke). The World Health Organization (WHO) has categorized 10 year CVD risk into five levels: <10%, 10 to < 20 %, 20 to<30 %, 30 to <40% and ≥ 40% risk [Fig 1] and has recommended appropriate intervention approaches targeting mainly the low resource settings.

Data were compiled, edited and checked to maintain consistency prior to coding and entering in Epidata V.2.1. Data were then exported to SPSS V.16.0 for further analysis. Data were expressed in frequency, proportion and mean±one standard deviation (SD), and presented in table. Chi-square and t tests were conducted for comparing proportions of categorical and mean of continuous variables respectively. Normality test was performed by Kolmogorov-Smirnov and Shapiro-Wilk tests. All tests were two-tailed and $p < 0.05$ was considered statistically significant.

RESULTS

Among 166 participants, 97 (58.4 %) were female and 69 (41.6%) were male. The mean±SD of age was 52±8.5 years. The majority of participants (47%) were from age group 40-49 years, belonged to Newar ethnic group (31.9%), and were married (85.5%) Most respondents (42.8%) had not been to school and were involved in household activities (45.2%) [table 1].

Table 1. Categorical demographics.

Socio-demographic characteristics		Gender		Total No (%)	P Value
		Male No (%)	Female No (%)		
Age groups	40 to 49 years	37 (22.3)	41(24.7)	78 (47)	.189
	50 to 59 years	16 (9.6)	35 (21.1)	51 (30.7)	
	≥60 years	16 (9.6)	21 (12.7)	37 (22.3)	
Ethnicity	Brahman	21 (12.7)	28 (16.9)	49 (29.5)	.899
	Chhetri	19 (11.4)	23 (13.9)	42 (25.3)	
	Newar	20 (12)	33 (19.9)	53 (31.9)	
	Janajati, Dalit and others	9 (5.4)	13 (7.8)	22 (13.3)	
Marital status	Unmarried	3 (1.8)	3 (1.8)	6 (3.6)	.026
	Married	66 (39.8)	76 (45.8)	142 (85.5)	
	Separated	0	2(1.2)	2(1.2)	
	Widow	0	16 (9.6)	16 (9.6)	
Education level	No formal education	12 (7.2)	59 (35.5)	71 (42.8)	<0.001
	Primary and lower	10 (6)	14 (8.4)	24(14.5)	
	Secondary	15 (9)	14 (8.4)	29 (17.5)	
	Higher secondary	18 (10.8)	7 (4.2)	25 (15.1)	
	Bachelor and Higher	14 (8.4)	3 (1.8)	17 (10.2)	

Occupation	Government job	8 (4.8)	4 (2.4)	12 (7.2)	<0.001
	Non-governmental job	9 (5.4)	4 (2.4)	13 (7.8)	
	Self-employed	25 (15.1)	16 (9.6)	41 (24.7)	
	House maker	9 (5.4)	66 (39.8)	75 (45.2)	
	Others (Unemployed and Retired)	18 (10.8)	7(4.2)	25 (15.1)	

Among total participants, 36 (21.7%) were identified as current smoker, whereas 49 (29.5%) participants had a history of drinking alcohol at least once in past 30 days at the time of interview [table 2]. Similarly, nearly a quarter (23.5%) of respondents were insufficiently (<600 METs) involved in moderate and vigorous physical activity [table 2]. The median of METs of moderate and vigorous activities per week was 1800 METs (IQR = 2700).

Table 2. Association of modifiable and non-modifiable CVD risk factors with <10 % or ≥ 10 % risk of CVD predictions.

Variables	Categories	Short term CVD risk prediction		Total No (%)	P Value
		<10 % risk	≥ 10 % risk		
Gender	Male	59 (35.5)	10 (6)	69 (41.6)	0.99
	Female	83 (50)	14 (8.4)	97 (58.4)	
Age groups	49 to 49 years	76 (45.8)	2 (1.2)	78 (47)	<0.001
	50 to 59 years	47 (28.3)	4 (2.4)	51 (30.7)	
	≥60 years	19 (11.4)	18 (10.8)	37 (22.3)	
Ethnicity	Brahman	43 (25.9)	6 (3.6)	49 (29.5)	.648
	Chhetri	37 (22.3)	5 (3)	42 (25.3)	
	Newar	45 (27.1)	8 (4.8)	53 (31.9)	
	Janajati, Dalit and others	17 (10.2)	5 (3)	22 (13.3)	
Education	No formal education	55 (33.1)	16 (9.6)	71 (42.8)	0.027
	Primary and lower	19 (11.4)	5 (3)	24 (14.5)	
	Secondary	27 (16.3)	2 (1.2)	29 (17.5)	
	Higher secondary	24 (14.5)	1 (0.6)	25 (15.1)	
	Bachelor and Higher	17 (10.2)	0	17 (10.2)	
Occupation	Government job	12 (7.2)	0	12 (7.2)	0.253
	Non-governmental job	13 (7.8)	0	13 (7.8)	
	Self-employed	35 (21.1)	6 (3.6)	41 (24.7)	
	House maker	62 (37.3)	13 (7.8)	75 (45.2)	
	Others (Unemployed and Retired)	20 (12)	5 (3)	25 (15.1)	
Smoking	Yes	25 (15.1)	11 (6.6)	36 (21.7)	0.002
	No	117 (70.5)	13 (7.8)	130 (78.3)	
Alcohol consumption	Yes	43 (25.9)	6 (3.6)	49 (29.5)	0.386
	No	99 (59.6)	18 (10.8)	117 (70.5)	
Physical activity	Sufficient (≥600 METs)	111 (66.9)	16 (9.6)	127 (76.5)	0.219
	Insufficient (<600 METs)	31 (18.7)	8 (4.8)	39 (23.5)	
Hypertension	Yes	71 (42.8)	6 (3.8)	77 (46.4)	<0.001
	No	71 (42.8)	18 (10.8)	89 (53.6)	
Diabetes	Yes	24 (14.5)	9 (5.4)	33 (19.9)	0.019
	No	118 (71.1)	15 (9)	133 (80.1)	

The mean±SD of body mass index (BMI) of total participants was 26.6±3.3 kg/m^2. In the same way, mean of waist and hip circumferences were 87.8±10.0 cm and 92.4±8.4 cm respectively. More than half (53.6%) of participants had hypertension and only one third (33.7%) were aware about their raised blood pressure level. One-fifth (10 out of 56) of participants who were aware of their hypertension status were not taking any antihypertensive medication.

The mean fasting glucose among participants was 98.1±28 mg/dl. Diabetes was present on 33 (19.9%) respondents. Twelve of them were taking anti-diabetic medicine. Similarly, mean of cholesterol and HDL were 175.0 ±29.5 mg/dl and 42.9 ± 6.8 mg/dl respectively.

Table 3. Comparing anthropometric and biochemical measurements between <10 % or ≥ 10 % risk of CVD predictions.

Variables	Short term CVD risk prediction		P value
	<10 % risk (mean±SD)	≥10 % risk (mean±SD)	
BMI	26.69±3.15	26.45±4.38	0.743
Waist (in cm)	88±9.8	86±11.9	0.5
Hip (in cm)	92.8±8.3	90±9.1	0.13
HDL (in mg/dl)	42.5±6.7	45.1±7.3	0.09
Cholesterol (in mg/dl)	173.5±28	188.5±34.7	0.021

Large proportion (85.5%) of participants had the <10 % chance of developing CVD in next ten years. Similarly, 9 % of respondents had 10 to <20 %, 2.4% had 20 to <30 % , 1.2 % had 30 to <40 % and 1.8 % had ≥ 40 % risk of developing cardiovascular disease in next ten years if left untreated. Greater than 10% (95% CI: 9.2, 20) CVD risk was significantly associated with age (p<0.001), education (p=0.027), smoking (p = 0.002), cholesterol level (p = 0.021), systolic hypertension (p <001) and diabetes (p =

0.019) [table 2, 3].

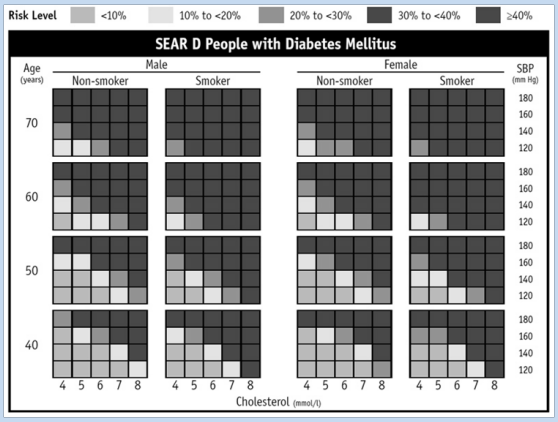

Figure 1.WHO/ISH short term risk prediction tool for diabetes patients. 10-year risk of a fatal or non-fatal cardiovascular event by gender, age, systolic blood pressure, total blood cholesterol, smoking status and presence or absence of diabetes mellitus.

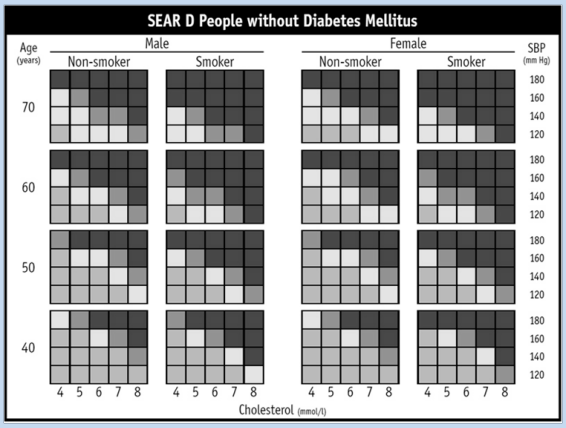

Figure 2.WHO/ISH short term risk prediction tool for people without diabetes.

DISCUSSION

This study presented the CVD risk factors burden and assessment of short term CVD risk prediction in selected community of Kathmandu, Nepal. The result on proportions of smoking, alcohol consumption and insufficient physical activity were in line with other studies[10,17], whereas proportions of hypertension, diabetes and ≥ 10 % risk of CVD were comparatively higher than other national studies.[10,18,19]

The proportion of current smoking was 21.7 % which was lower than the result presented in age group ≥40 years in similar study conducted in Sindhuli, Nepal (38.8%)[17] and prevalence (28.6%) demonstrated by nationwide NCD Risk Factors Survey 2013 in same age group[10].The contrasting result might have been brought by difference in study sites and population. Our study site was comparatively more urbanized than above mentioned studies that had shown the poor education level and low socio-economic status were associated with smoking.[10,17]However, the proportion of participants (29.5 %) who were indulged to alcohol was higher than that NCD Risk Factors Survey 2013 in Nepal (20.44%).[10] Presence of majority of participants from Newar ethnic group where alcohol consumption is culturally accepted might have caused the surge in proportion of alcohol consumption. Compared to other risk factors, hypertension (P =53.6%) and diabetes (19.9%) seemed to be burgeoning burdens in study population. The proportion of hypertensive respondents was higher than that were reported by NCD survey of 2007 (29.8%) [18] and 2013 (46.7%)[10] in the same age group. Similarly, our study showed that one in every five respondent (19.9%) had diabetes whereas above mentioned study reported the presence of diabetes approximately one in 25 participants (3.6%).[10] One the other hand, the finding in diabetes was in line with that of a study (25.9%) conducted among elderly population in urban and rural settings of Kathmandu.[20] Presence of comparatively large proportions of CVD risk factors among study population in our study seem to have increased the number of participants having one in 10 chance of developing CVD in next 10 years. Therefore, the proportion of participants having ≥ 10 % risk (14.5%) largely differed with the result (9.6%) of another study conducted in suburban population of Nepal.[19]Similarly, it was also higher than the findings of Cambodia (3%,), Malaysia (5.6%) and Mongolia (10.5%).[21] However, the result was consistent with another study conducted in rural population of India where moderate to higher risk was 16 %.[22] Our study finding supports that the risk of developing fatal and non-fatal events of cardiovascular disease is high and is increasing in Nepalese population. The association of ≥ 10 % risk of CVD with people having no formal education, smokers, hypertension and

diabetes in this study population also underlines the importance of comprehensive approach for dealing with CVD risk factors. Modification of such risk factors can substantially reduce the mortality and morbidity among people with or without CVD.[22] The magnitude and intensity of intervention for modifying CVD risk factors depend on level of risk of developing CVD in future. People having CVD risk below 10 percent can generally be well managed without drug treatment.[6,7] They get more benefit from healthier lifestyles.[6,7] On the other hand, patients having > 20 % of risk of CVD benefit from anti-hypertensive and/ or lipid-lowering drugs and/ or antiplatelet drugs, above than intensive non-pharmacological interventions.[6,7]Therefore, this study has an implication in quantification of risk factors for the identification of people at high risk and low risk and assigning an appropriate intervention. Furthermore, not like Framingham Risk Score, British Society Chart and European Society of Cardiology, WHO/ISH SEAR D tool was specifically designed for South East Asia Region where health systems do not have the basic infrastructure facilities. This tool is very effective in assessment of CVD risk, particularly in primary healthcare or low resource settings.[16]Thishas great potential to support the local health professional in planning and implementation of CVD preventive activities.

However, this tool lacks in adjustment of the High Density Lipoprotein (HDL) and people who are taking antihypertensive medicine in calculation of CVD risk. It also underestimates the CVD risk among those with target organ damage, individuals with established CVD and diabetic patients with complications.[6]

Overall, This is the first study to assess the short term CVD risk on the outskirt of Kathmandu. It has major implication in development of pragmatic and useful comprehensive intervention approach for prevention and control of CVD among study population. However, small sample size, recall bias and use of uncalibrated tool are concerning limitations of the study. This necessitates a larger study and recalibration of study tool for precise estimation of CVD risk prediction.

CONCLUSION

In light of high CVD risk in the study population, community-based pragmatic and feasible approaches are needed to prevent heart attacks and strokes in future.

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REFERENCES

1. World Health Organization. Global status report on non communicable diseases 2010. Geneva: World Health Organization; 2011.

2. World Health Organization. The World Health Report 1999: Making a difference: message from the Director General. Geneva: World Health Organization; 1999.

3. Murray CJ, Lopez AD. Global comparative assessments in the health sector: disease burden, expenditures and intervention packages. 1994.

4. World Health Organization. Global Atlas on Cardiovascular Disease Prevention and Control. Geneva: World Health Organization; 2011.

5. World Health Organization. Non-communicable Diseases Country Profiles 2014. Geneva: World Health Organization; 2014.

6. Mendis S, Lindholm LH, Mancia G, Whitworth J, Alderman M, Lim S, et al. World Health Organization (WHO) and International Society of Hypertension (ISH) risk prediction charts: assessment of cardiovascular risk for prevention and control of cardiovascular disease in low and middle-income countries. Journal of hypertension. 2007;25(8):1578-82.

7. World Health Organization. Prevention of cardiovascular disease: pocket guideline for assessment and management of cardiovascular risk. Geneva: World Health Organization; 2007.

8. Government of Nepal. National Population and Housing Census 2011. Kathmandu: Central Bureau of Statistics; 2012.

9. Lawanga SK, Lemeshow S. Sample size determination in health studies: a practical manual. Geneva: World Health Organization; 1991.

10. Aryal KK, Neupane S, Mehata S, Vaidya A, Singh S, Paulin F, et al. Non communicable diseases risk factors: STEPS Survey Nepal 2013. Kathmandu: Nepal Health Research Council; 2014.

11. World Health Organization. The WHO Stepwise approach to chronic disease risk factor surveillance (STEPS). Available from: http://www.who.int/chp/steps/STEPS_Instrument_v2.1.pdf.

12. Haskell WL, Lee I-M, Pate RR, Powell KE, Blair SN, Franklin BA, et al. Physical activity and public health: updated recommendation for adults from the American College of Sports Medicine and the American Heart Association. Circulation. 2007;116(9):1081.

13. Herrmann, S. The 2011 Compendium of Physical Activities: Tracking Guide. 2011 [cited 2014 November, 22]; Available from: https://sites.google.com/site/compendiumofphysicalactivities/tracking-guide.

14. World Health Organization.WHO STEPS surveillance manual. Geneva:World Health Organization; 2008.

15. Lenfant C, Chobanian AV, Jones DW, Roccella EJ. Seventh report of the Joint National Committee on the Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC 7) resetting the hypertension sails. Circulation. 2003;107(24):2993-4.

16. World Health Organization. WHO/ISH risk prediction charts for 14 WHO epidemiological sub-regions. From: www. ish-world. com/downloads/activities/colour_charts_24_Aug_07. pdf Accessed: Jan, 2012.

17. Dhungana RR, Devkota S, Khanal MK, Gurung Y, Giri RK, Parajuli RK, et al. Prevalence of cardiovascular health risk behaviors in a remote rural community of Sindhuli district, Nepal. BMC cardiovascular disorders. 2014;14(1):92.

18. Karki KB, Dahal BR, Regmi A, Poudel A, Gurung Y. WHO STEPS Surveillance: Non Communicable Diseases Risk Factors Survey 2008. Kathmandu: Ministry of Health and Population, GoN, Society for Local Integrated Development Nepal (SOLID Nepal) and WHO; 2008.

19. Koju R, Gurung R, Pant P, Humagain S, Yogol C, Koju A, et al. Prediction of Cardiovascular Disease in suburban population of 3 municipalities in Nepal. Nepalese Heart Journal. 2013;8(1):3-7

20. Chhetri M, Chapman R. Prevalence and determinants of diabetes among the elderly population in the Kathmandu Valley of Nepal. Nepal Med Coll J. 2009;11(1):34-8.

21. Otgontuya D, Oum S, Buckley BS, Bonita R. Assessment of total cardiovascular risk using WHO/ISH risk prediction charts in three low and middle income countries in Asia. BMC public health. 2013;13(1):539.

22. Reddy KS, Yusuf S. Emerging epidemic of cardiovascular disease in developing countries. Circulation. 1998;97(6):596-601.