Disparities in fruit and vegetable intake by socio-demographic characteristics in peri-urban Nepalese adults: findings from the Heart-Health Associated Research and Dissemination in the Community (HARDIC) Study, Bhaktapur, Nepal

Vaidya A[1,2], Oli N[3], Aryal UR[2,4], Karki DB[5], Krettek A[6,7]

[1]Assistant Professor, Department of Community Medicine, Kathmandu Medical College
[2]DrPH-fellow, Nordic School of Public Health NHV, Gothenburg, Sweden
[3]Lecturer, Department of Community Medicine, Kathmandu Medical College
[4]Assistant Professor (Biostatistics), Department of Community Medicine, Kathmandu Medical College
[5]Professor and Head, Department of Internal Medicine, Kathmandu Medical College
[6]Professor, Nordic School of Public Health NHV, Gothenburg, Sweden
[7]Department of Internal Medicine and Clinical Nutrition, Institute of Medicine, Sahlgrenska Academy at University of Gothenburg, Gothenburg, Sweden

Abstract

Background: Inadequate fruit and vegetable intake and other adverse dietary habits – along with tobacco and alcohol abuse and sub-optimal physical activity - make up the four most important behavioural risk factors of non-communicable diseases. Low fruit and vegetable intake is particularly associated with burden of high cardiovascular disease. It has received more attention in the last decade, with studies that explore disparities and determinants in their intake, as well as interventions that attempt to improve the intake.

Objectives: Our study aimed to determine fruit and vegetable consumption in a peri-urban community of Nepal and to compare this intake in relation to various socio-demographic variables.

Methods: This cross-sectional study was conducted as a part of the HARDIC (Heart-Health Associated Research and Dissemination in the Community) study in the Jhaukhel-Duwakot Health Demographic Surveillance Site in the Bhaktapur district of Nepal during September-December 2011. Adults from six randomly selected clusters were interviewed by 12 trained interviewers after taking informed consent. WHO-STEPS questions were used to elicit information on fruit and vegetable intake.

Results: Fruit and vegetable intake in the community was low with 2.1 percent of the study population consuming the WHO-recommended five servings per day. There were differences in the intake according to the various socio-demographic factors.

Conclusions: Our study reaffirms low fruit and vegetable intake as a public health problem in the Nepalese context. Health-promotional activities aimed at specific target groups are essential. Multi-sectoral coordination of health and other health-related sectors is therefore vital in addressing the issue.

Key words: Fruit and vegetable intake, Health Demographic Surveillance Site, Nepal, Non-communicable diseases.

INTRODUCTION

Fruit and vegetables are essential components of a healthy diet. Conversely, inadequate consumption of fruit and vegetables is an established risk factor of non-communicable diseases[1], particularly of cardiovascular diseases[2]. Low fruit and vegetable intake causes 2.6 million deaths annually worldwide[3]. It is responsible for 11 percent of deaths due to ischemic heart disease (IHD), nine percent stroke deaths and 14 percent of gastrointestinal cancer mortality[4].

Address for correspondence
Abhinav Vaidya
Assistant Professor of Community Medicine,
Department of Community Medicine,
Kathmandu Medical College
E-mail: Abhinav.Vaidya@nhv.se

Fruits and vegetables exert their protective actions through different components such as fibres, folate, potassium, magnesium and various anti-oxidants, low glycemic load and their potential to control weight[5]. While a minimum of 400 grams (5 servings) of fruit and vegetables has been advised[6], the burden of IHD and ischemic stroke can be reduced by 31 and 19 percents, respectively, if the individual daily intake of fruits and vegetables can be increased up to 600 grams[3]. As these two diseases together kill 129 million people annually, i.e. a quarter of all deaths[7], the potential protective impact of adequate fruit and vegetable consumption is substantial.

Studies on fruit and vegetable intake in different parts of the world have demonstrated wide variations in consumption[8]. Ghanaian men and women have the lowest prevalence of low fruit and vegetable consumption (36.6 and 38.0 percent, respectively) while Pakistani men and women have a staggeringly high prevalence of 99.2 and 99.3 percent[8]. Besides the inter-country variation, there are discrepancies within a region[9], country[10], and even within a community[11]. There have been attempts to explore reasons for these differences and, besides the obvious ecological, availability and affordability variations, many socio-demographic aspects and psychosocial factors have surfaced[12-15].

Like many other low-income countries, Nepal is also facing an epidemic of non-communicable diseases [16,17]. Urbanization and globalization have led to a shift in eating habits of its population. While the impact is more obvious in the urban areas, for example, in the form of rising obesity trends[18], the peri-urban and rural areas are also increasingly becoming affected. This is exemplified by a 2002-2003 study that showed that 98.1 percent of men and 99 percent of women in Nepal did not have adequate fruit and vegetable consumption, even though only 13.7 percent of the study population was urban[8]. This and other studies from Nepal have not, however, explored possible socio-demographic variations[8,19,20]. Hence, the aim of our study was to determine fruit and vegetable consumption in a peri-urban community near the capital Kathmandu, and to compare this intake in relation to various socio-demographic variables. This study is part of the ongoing HARDIC (Heart-Health Associated Research and Dissemination in the Community) study that investigates community-based cardiovascular health literacy and behaviour issues.

METHODS

This population-based cross sectional study was conducted from September to November 2011in the Jhaukhel- Duwakot Health Demographic Surveillance Site (JD-HDSS). The establishment of the surveillance site has been described elsewhere[21]. Jhaukhel and Duwakot are two adjacently located, almost twin-like, rapidly urbanizing settlements in the Bhaktapur district in the outskirts of Kathmandu valley. Once a source of fresh vegetables for the locality and the nearby towns, the landscape is speedily converting into an unplanned mosaic of new settlements and diminishing greenery. Our baseline study in 2010 showed a total population size of 13 669 in 2712 households[21]. Newars, Chhetris and Brahmins are the major ethnic groups. Less than 11 percent of the population is involved in agro-based work. About a fifth aged more than six years is illiterate. Hypertension and diabetes are common morbidities[21].

Six out of the total 18 administrative clusters (called wards) of Duwakot and Jhaukhel were randomly selected for the study. All households in the selected six wards were intended to be enrolled into the study. One adult aged between 25-59 years old from each household was interviewed face-to-face. Kish technique[22] was applied to the pre-determined sampling frame if there were more than one eligible adult in one household. Data was collected by 12 locally recruited enumerators who had studied at least up to grade 10. They received five-day training along with pretesting of the questionnaire. They were supervised by field supervisors and PhD students. The questionnaire on fruit and vegetable consumption was based on the standard World Health Organization (WHO)-STEPS Non-communicable Disease Survey questions[23]. The questions had been translated into Nepalese language and pre-tested. The enumerators used examples of locally available fruits and vegetable for explaining the concept of servings to the respondents. Commercially available canned or tetra-packed fruit juices or artificially flavoured fruit drinks were not considered as fruit intake.

Data was entered in Epidata 2.1 and analysed with SPSS version 17.0 (IBM, Armonk, New York, USA). Average fruit and vegetable intake was calculated separately for men and women and expressed as mean±standard deviation. We used t-test and Analysis of Variance (ANOVA) to compare the average values across each socio-demographic variable. We present prevalence of nominal data with 95 percent confidence intervals (95% CI). $P<0.05$ was considered statistically significant.

During data collection, the enumerators explained the purpose of the study to the respondents and thereafter, sought their consent. Confidentiality of the interview,

of the filled-up forms and that of the digital data was thoroughly maintained. Ethical approval for the study was obtained from the Nepal Health Research Council.

RESULTS

Out of the 840 eligible households in the six clusters, adult representatives from 789 households consented to participate in the study (non-response rate: 6.1 percent). Complete data on fruit and vegetable intake was available for 777 individuals for the final analysis. The socio-demographic distribution of the study population is presented in Table 1. More women were without formal education. About two-thirds of the female respondents were housewives while most of the men were involved in government, non-government or self-employed jobs.

FRUIT INTAKE

Tables 2 and 3 show the average fruit intake in terms of days/week and servings/day for males and females, respectively. On the whole, females consumed more fruits than males in terms of both days/week ($p<0.001$) and servings/day ($p=0.184$). Age-wise, there was less variation among both males and females. Both Newar men and women had less fruit intake compared to other ethnic groups ($P<0.001$ for both sexes). In general, those with higher education had more fruit intake except for men who had completed their post-graduation. Occupation-wise, those who were unemployed because of inability to work had the lowest fruit intake. Retired women, but not retired men, consumed more fruits. Those doing government jobs, of either sex, took fruits on more number of days.

VEGETABLE INTAKE

Compared to fruit intake, both males and females consumed more vegetables (Tables 2 and 3). Females consumed vegetables on more number of days than males ($P=0.016$). The average number of servings of vegetables was also higher in women, but the difference was not statistically significant ($P=0.210$). Chhetri men and women consumed more vegetables than men and women of other ethnicities, both in terms of days/week ($P=0.016$ for men, $P<0.001$ for women) and servings per day ($P<0.001$ for men, $P=0.032$ for women). Unlike fruit consumption, educational level of the respondents did not influence vegetable intake.

COMBINED FRUIT AND VEGETABLE INTAKE

Number of servings per day of combined fruit and vegetable were 2.34±0.88 for men and women 2.49±0.93, but the difference was not statistically significant ($P=0.056$). There were no significant differences across different demographic parameters in neither males nor females (Tables 2 and 3).

LOW FRUIT AND VEGETABLE INTAKE

In our study population, only 2.1 percent were consuming the recommended five servings of combined fruit and vegetable. Hence, 98.3 percent (95% CI: 96.5-99.9) of the males and 97.8 percent (95% CI: 96.5-99.0) of the females had low fruit and vegetable intake.

Table 1: Demographic characteristics of the study population.

	Male		Female		Total
	Number	Percent	Number	Percent	
Age (years)					
25-34	69	30.1	188	34.3	257
35-44	78	34.1	202	36.9	280
45-59	82	35.8	158	28.8	240
Ethnic group					
Brahmin	85	37.1	209	38.1	294
Chhetri	55	24.0	139	25.4	194
Newar	67	29.3	127	23.2	194
Others	22	9.6	73	13.3	95
Highest education					
No formal schooling	27	11.8	182	33.2	209
< primary school	7	3.1	53	9.7	60
Primary school	67	29.3	119	21.7	186
Secondary school	74	32.3	124	22.6	198
High school	28	12.2	42	7.7	70
Graduation	17	7.4	20	3.6	37
Post graduation	9	3.9	8	1.5	17

Table 1 continue

Main work					
Government job	31	13.5	16	2.9	47
Non-government job	39	17.0	30	5.5	69
Self employed	72	31.4	36	6.6	108
Non-paid	4	1.7	1	.2	5
Student	7	3.1	3	.5	10
Housewife	0	0.0	369	67.3	369
Retired	13	5.7	5	.9	18
Unemployed (able to work)	9	3.9	6	1.1	15
Unemployed (unable to work)	6	2.6	4	.7	10
Agriculture	48	21.0	78	14.2	126
All	**229**	**100.0**	**548**	**100.0**	**777**

Table 2: Average fruit and vegetable intake (Males)

	Fruit		Vegetable		Fruit and vegetable combined
	Days/week	Servings/day	Days/week	Servings/day	Servings/day
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
Age (years)					
25-34	2.78 (2.10)	0.94 (0.70)	5.12 (1.73)	1.45 (0.64)	2.40 (1.11)
35-44	2.67 (1.92)	0.99 (0.49)	5.12 (1.75)	1.35 (0.51)	2.32 (0.71)
45-59	2.45 (1.93)	0.85 (0.68)	5.72 (1.53)	1.42 (0.57)	2.34 (0.88)
Ethnic group					
Brahmin	3.07 (1.94)	1.10 (0.44)	4.87 (1.81)	1.15 (0.36)	2.23 (0.62)
Chhetri	2.76 (2.05)	1.08 (0.81)	5.81 (1.47)	1.74 (0.65)	2.82 (1.19)
Newar	1.80 (1.57)	0.58 (0.56)	5.73 (1.50)	1.51 (0.53)	2.12 (0.66)
Others*	3.05 (2.35)	0.84 (0.60)	4.70 (1.69)	1.40 (0.68)	2.28 (1.02)
Highest education					
No formal schooling	2.69 (2.61)	0.68 (0.56)	5.93 (1.41)	1.59 (0.51)	2.27 (0.70)
< primary school	1.86 (1.46)	1.14 (1.07)	5.71 (1.90)	1.71 (0.75)	2.86 (1.67)
Primary school	1.88 (1.50)	0.83 (0.68)	5.23 (1.83)	1.37 (0.54)	2.20 (0.88)
Secondary school	2.88 (2.04)	0.99 (0.62)	5.27 (1.65)	1.43 (0.60)	2.41 (0.87)
High school	3.43 (1.93)	1.12 (0.51)	5.00 (1.84)	1.37 (0.56)	2.52 (0.91)
Graduation	3.41 (1.77)	1.06 (0.43)	5.82 (1.23)	1.35 (0.61)	2.41 (0.71)
Post graduation	2.33 (1.66)	0.63 (0.52)	4.67 (1.58)	1.22 (0.44)	1.88 (0.35)
Main work					
Government job	3.19 (2.36)	0.97 (0.62)	5.61 (1.69)	1.35 (0.49)	2.30 (0.75)
Non-government job	2.31 (1.34)	1.05 (0.45)	4.90 (1.94)	1.26 (0.44)	2.31 (0.69)
Self employed	2.91 (1.93)	1.06 (0.65)	5.20 (1.74)	1.57 (0.66)	2.63 (1.06)
Non-paid	4.50 (3.00)	0.67 (0.57)	5.50 (1.73)	1.50 (1.00)	2.33 (1.53)
Student	2.57 (2.51)	0.67 (0.52)	4.57 (1.39)	1.14 (0.38)	1.83 (0.41)
Retired	2.31 (1.75)	0.69 (0.63)	5.83 (1.30)	1.25 (0.45)	1.92 (0.52)
Unemployed (able to work)	2.56 (1.59)	0.78 (0.44)	5.63 (1.30)	1.22 (0.44)	2.00 (0.71)
Unemployed (unable to work)	2.50 (2.33)	0.75 (0.50)	5.50 (1.76)	1.51 (0.58)	2.00 (0.82)
Agriculture	2.07 (1.96)	0.73 (0.72)	5.60 (1.54)	1.42 (0.57)	2.28 (0.85)
All	**2.63 (1.97)**	**0.92 (0.63)**	**5.33 (1.69)**	**1.42 (0.57)**	**2.34 (0.88)**

Note: P<0.05 for number of days/week of vegetable consumption in the variable 'age-group'; across all the five parameters for the variable 'ethnicity'; for number of days/week of fruit consumption in the variable 'highest education'; across all five parameters for the variable 'main work'.
*Others include ethnic groups Tamang, Magar, Rai, Dalit, etc.

Table 3: Average fruit and vegetable intake (Females)

	Fruit		Vegetable		Fruit and vegetable combined
	Days/week	Servings/day	Days/week	Servings/day	Servings/day
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
Age (years)					
25-34	3.32 (2.17)	0.95 (0.59)	5.52 (1.59)	1.47 (0.62)	2.44 (0.88)
35-44	3.40 (2.12)	1.04 (0.68)	5.70 (1.51)	1.52 (0.64)	2.57 (0.99)
45-59	3.34 (3.31)	0.98 (0.64)	5.71 (1.56)	1.44 (0.59)	2.44 (0.90)
Ethnic group					
Brahmin	3.84 (2.29)	1.07 (0.49)	5.24 (1.71)	1.27 (0.48)	2.35 (0.73)
Chhetri	3.54 (2.05)	1.17 (0.62)	5.84 (1.37)	1.70 (0.63)	2.89 (0.96)
Newar	2.43 (1.75)	0.68 (0.65)	6.06 (1.37)	1.51 (0.60)	2.21 (0.83)
Others	3.12 (2.18)	0.94 (0.80)	5.68 (1.45)	1.61 (0.78)	2.58 (1.22)
Highest education					
No formal schooling	2.90 (2.23)	0.81 (0.70)	5.73 (1.51)	1.57 (0.60)	2.40 (0.94)
< primary school	3.06 (2.21)	0.89 (0.53)	5.46 (1.66)	1.35 (0.59)	2.27 (0.82)
Primary school	3.01 (1.91)	1.02 (0.66)	5.84 (1.83)	1.49 (0.59)	2.52 (0.93)
Secondary school	3.80 (2.06)	1.23 (0.62)	5.41 (1.59)	1.41 (0.67)	2.56 (0.86)
High school	4.40 (2.07)	1.26 (0.65)	5.79 (1.51)	1.45 (0.63)	2.70 (1.07)
Graduation	4.25 (2.17)	1.00 (0.00)	5.30 (1.89)	1.45 (0.60)	2.74 (0.99)
Post graduation	5.00 (2.04)	0.63 (0.52)	5.71 (1.70)	1.38 (0.74)	2.33 (0.82)
Main work					
Government job	4.50 (2.34)	1.31 (0.60)	5.69 (1.74)	1.38 (0.50)	2.69 (0.87)
Non-government job	3.83 (2.12)	1.22 (0.64)	5.76 (1.24)	1.40 (0.67)	2.67 (1.14)
Self employed	3.81 (2.04)	1.08 (0.60)	5.94 (1.37)	1.69 (0.74)	2.78 (1.04)
Non-paid*	5.00	1.00	6.00	2.00	3.00
Student	3.67 (1.15)	1.00 (0.00)	6.33 (1.15)	2.33 (1.15)	3.33 (1.15)
Housewife	3.37 (2.12)	0.96 (0.63)	5.71 (1.53)	1.48 (0.61)	2.47 (0.89)
Retired	5.20 (2.68)	1.25 (0.50)	5.80 (1.30)	1.60 (0.54)	2.75 (0.95)
Unemployed (able to work)	3.33 (2.94)	1.00 (0.00)	6.33 (1.63)	1.40 (0.54)	2.50 (0.58)
Unemployed (unable to work)	1.25 (0.95)	0.75 (0.50)	5.00 (1.41)	1.50 (0.57)	2.25 (0.50)
Agriculture	2.51 (2.16)	0.93 (0.72)	5.05 (1.75)	1.38 (0.54)	2.29 (0.95)
All	**3.34 (2.17)**	**0.99 (0.64)**	**5.64 (1.55)**	**1.48 (0.62)**	**2.49 (0.93)**

Note: P<0.05 across all five parameters for the variable 'ethnicity'; for number of days/week and servings/day of fruit consumption in the variable 'highest education'; for number of days/week of fruit consumption for the variable 'main work'.
*Only one woman was non-paid in the study

DISCUSSION

We determined fruit and vegetable consumption in adults of a peri-urban community near the capital Kathmandu using WHO-STEPS questions. When compared to the recommended servings of five per day for combined intake of fruit and vegetables, we found that the average intake in the population is half the recommended amount[6]. Concurrently, the burden of low fruit and vegetable in the population is alarmingly high at 97.9 percent (95% CI: 96.9-98.9). The high prevalence of low fruit and vegetable intake is strikingly similar to the Nepalese data from the World Health Survey conducted in 2002-2003[8]. Additionally, fruit and vegetable intake prevalence was 60.5 percent for men and 63.5 percent for women in a nationally representative WHO-STEPS survey conducted in Nepal in 2007[20].

When compared to other South-Asian countries such as India (approximately 74 percent inadequate fruit and vegetable intake), Sri Lanka (68 percent) and Bangladesh (47 percent), Nepal stands next to Pakistan (99 percent) when it comes to the overall insufficient fruit and vegetable consumption[8]. Comparatively, a high-income country like Canada has on average a fruit and vegetable consumption of 4.95 servings per day[10]. Fruit and vegetable intake has been studied in other Asian health demographic surveillance sites (HDSS) as well[24]. A wide variation has been noted with the proportion of inadequacy ranging from 63.5 percent in men and 57.5 percent in women in Chililab HDSS in Vietnam to 100 percent in Vadu HDSS in India and WATCH HDSS in Bangladesh[24].

We here demonstrated variation in fruit and vegetable consumption within a community according to socio-demographic variables. Women in our study area consumed more fruits and vegetables than men while a reverse trend had been observed earlier in all the HDSS of Bangladesh, India, Vietnam and Thailand[24]. Variations according to race/ethnicity, educational status, and employment status have been demonstrated[10,11,25]. Socio-economic status, which we did not explore in our study, is another significant determinant of fruit and vegetable consumption[25]. Though statistical models show that family income is a less important determinant compared to education[10], food insufficiency in the household[26] and accessibility to fruit and vegetables[14] are established pertinent factors that influence fruit and vegetable intake, particularly for the impoverished population[25].

Besides to delineate the influence of socio-demographic and external factors, fruit and vegetable consumption has been explored through health behaviour models such as the theory of planned behaviour[12,27]. Some of the variables that predict behaviour include habit, attitudes, motivation, knowledge, taste and beliefs about capabilities[12]. Furthermore, these models have been useful in planning and implementing interventions to improve fruit and vegetable intake as well[28-31]. However, such psycho-social determinants and behavioural aspects of fruit and vegetable consumption have been studied more often among children than adults. For example, parental/mother's education[32-34], parental fruit and vegetable intake[32,35] and food preferences[33-35] all influence a child's fruit and vegetable intake. Besides, access to unhealthy food, eating time, symbolic value of food for image, and social interactions with peers also influence fruit and vegetable consumption of children and adolescents[36]. These individual and societal determinants have been targeted in intervention programmes to improve fruit and vegetable intake by intervening the parents[37] or the mothers[38]; improving accessibility at restaurants[39], worksites[40], and schools[41]; by providing vouchers[42], and by conducting behavioural[43] and nutritional interventions[44] . The success of these interventions, however, has been moderate[45,46].

Because Nepal is ecologically and culturally divergent, our study area does not represent peri-urban areas of higher or lower altitudes, or areas where people of other ethnic groups predominantly reside. In addition, there can be seasonal variations, particularly in the intake of fruits. The WHO-STEPS questionnaire that we used is based on the dietary recall method and memory bias might be a confounder[47].

Our study has underpinned the previous findings that the burden of inadequate fruit and vegetable intake is high in Nepal[8,20]. Though WHO and other agencies have begun advocating the need to incorporate this issue at national and local levels since a decade[48], Nepal is yet to see any policy or programme that targets fruit and vegetable intake, or any non-communicable disease issue for that matter. A reason for this is that the issue is multi-layered, multi-dimensional and multisectoral. Lack of coordination between the ministries, for example, has put a halt to the non-communicable disease policy draft.

There are other problems and issues when it comes to fruit and vegetable consumption in Nepal. In relation to availability of fruits, local fruits are replaced in the markets by costlier imported fruits. Locally available fruits are often wrongly considered inferior in terms of

nutrition or social reputation. Difficult terrains and lack of transportation facilities lead to wastage of tons of fruits that grow in the highlands. Use of pesticides, artificial colours and other harmful chemicals that rapidly ripen the fruit discourages people from consuming fruits and vegetables. Besides, artificially flavoured instant drinks, coupled with high salt and trans-fat laden fast-food snacks, are gaining widespread popularity, especially among children, and gradually replacing consumption of fresh fruits.

CONCLUSION

Our study has highlighted that the burden of low fruit and vegetable intake as a cardiometabolic risk factor is a public health problem in the Nepalese context. Ninety eight percent population of the peri-urban community that we studied did not meet the recommended five servings. Further, there were differences in the intake according to gender, ethnicity, education and occupation.

Unlike negative health behaviours such as smoking and harmful intake of alcohol, which are more overt and perhaps socially stigmatizing, fruit and vegetable intake is more of a subtle and private human behaviour. Besides, there are no subjectively observable direct or indirect, short or long term impacts of low fruit and vegetable intake unlike other behavioural risk factors. But positive health behaviours like fruit and vegetable intake should be advocated too through health promotional activities at different settings, particularly in the light of the fact that a tenth of ischemic heart disease alone is attributable to inadequate fruit and vegetable intake. With the growing invasion of unhealthy food in low-income settings like Nepal, the need of such health promotion is now more urgent than ever.

References

1. World Health Organization. Fruit and vegetables for health: Report of a joint FAO-WHO Workshop, 1–3 September 2004, Kobe, Japan. Geneva, Switzerland: World Health Organization, 2005. 39 p. Report No.: WB 430.
2. Hung H, Joshipura KJ, Jiang R, Hu FB, Hunter D, Smith-Warner SA, et al. Fruit and vegetable intake and risk of major chronic disease. J Natl Cancer Inst. 2004;96(21):1577-84.
3. Lock K, Pomerleau J, Causer L, Altmann DR, McKee M. The global burden of disease attributable to low consumption of fruit and vegetables: implications for the global strategy on diet. Bull World Health Organ. 2005;83(2):100-8.
4. World Health Organization. Global health risks. Geneva, Switzerland:World Health Organization, 2009. 70 p. Report No.: WA 105.
5. Bazzano LA. Dietary intake of fruit and vegetables and risk of diabetes mellitus and cardiovascular diseases. Geneva, Switzerland: World Health Organization; 2005. 66 p.
6. World Health Organization. Package of essential noncommunicable (PEN) disease interventions for primary health care in low-resource settings. Geneva, Switzerland: World Health Organization;2010. 66 p. Report No.: W 84.6.
7. Lozano R, Naghavi M, Foreman K, AlMazroa MA, Memish ZA, et al. Global and regional mortality from 235 causes of death for 20 age groups in 1990 and 2010: a systematic analysis for the Global Burden of Disease Study 2010. Lancet. 2012;380 (9867):2095-128.
8. Hall JN, Moore S, Harper SB, Lynch JW. Global variability in fruit and vegetable consumption. Am J Prev Med. 2009;36(5):402-9. e5.
9. Ruel MT, Minot N, Smith L. Patterns and determinants of fruit and vegetable consumption in sub-Saharan Africa: a multicountry comparison. Geneva, Switzerland: World Health Organization; 2005. 45p. Report No.: WB 430.
10. Azagba S, Sharaf MF. Disparities in the frequency of fruit and vegetable consumption by socio-demographic and lifestyle characteristics in Canada. Nutri journal. 2011;10(1):1-8.
11. Nepal VP, Mgbere O, Banerjee D, Arafat RR. Disparities in Fruits and Vegetables Consumption in Houston, Texas Implications for Health Promotion. J Prim Care Community Health. 2011;2(3):142-7.
12. Guillaumie L, Godin G, Vézina-Im L. Psychosocial determinants of fruit and vegetable intake in adult population: a systematic review. Int J Behav Nutr Phys Act. 2010;7(1):12.
13. Johnson JS, Nobmann ED, Asay E. Factors related to fruit, vegetable and traditional food consumption which may affect health among Alaska Native People in Western Alaska. Int J Circumpolar Health. 2012;71: 17345.
14. Rose D, Richards R. Food store access and household fruit and vegetable use among participants in the US Food Stamp Program. Public Health Nutr. 2004;7(8):1081-8.
15. Pearson N, Timperio A, Salmon J, Crawford D, Biddle SJH. Family influences on children's physical activity

and fruit and vegetable consumption. Int J Behav Nutr Phys Act. 2009;6: 34.

16. Nepal Health Research Council. Prevalence of Non-communicable Disease in Nepal: Hospital-based Study. Kathmandu, Nepal: Nepal Health Research Council; 2010. 69 p.
17. Vaidya A. Tackling cardiovascular health and disease in Nepal: epidemiology, strategies and implementation. Heart Asia. 2011;3(1):87-91.
18. Vaidya A, Shakya S, Krettek A. Obesity prevalence in nepal: public health challenges in a low-income nation during an alarming worldwide trend. Int J Environ Res Pub Health. 2010;7(6):2726-2744.
19. Sharma SK, Ghimire A, Radhakrishnan J, Thapa L, Shrestha NR, Paudel N, et al. Prevalence of hypertension, obesity, diabetes, and metabolic syndrome in Nepal. Int J Hypertens. 2011; doi:10.4061/2011/821971.
20. Ministry of Health and Population, Nepal. Nepal non-communicable diseases risk factors survey 2007. Kathmandu, Nepal: Ministry of Health and Population, 2008. 163 p.
21. Aryal UR, Vaidya A, Shakya-Vaidya S, Petzold M, Krettek A. Establishing a health demographic surveillance site in Bhaktapur district, Nepal: initial experiences and findings. BMC Research Notes. 2012;5(1):489.
22. Kish L. Sampling organizations and groups of unequal sizes. Am Sociol Rev. 1965:564-572.
23. World Health Organization. WHO STEPS Instrument (Core and Expanded): The WHO STEPwise approach to chronic disease risk factor surveillance (STEPS). Geneva, Switzerland: World Health Organization; 2008. Available from: http://www.who.int/chp/steps/STEPS_Instrument_v2.1.pdf.
24. Kanungsukkasem U, Ng N, Van Minh H, Razzaque A, Ashraf A, Juvekar S, et al. Fruit and vegetable consumption in rural adults population in INDEPTH HDSS sites in Asia. Global Health Action. 2009; doi: 10.3402/gha.v2i0.1988.
25. Yeh M, Ickes SB, Lowenstein LM, Shuval K, Ammerman AS, Farris R, et al. Understanding barriers and facilitators of fruit and vegetable consumption among a diverse multi-ethnic population in the USA. Health Promot Internation. 2008;23(1):42-51.
26. Klepp K, Wind M, De Bourdeaudhuij I, Rodrigo CP, Due P, Bjelland M, et al. Television viewing and exposure to food-related commercials among European school children, associations with fruit and vegetable intake: a cross sectional study. Int J Behav Nutr Phys Act. 2007;4(1):46.
27. Bihan H, Castetbon K, Mejean C, Peneau S, Pelabon L, Jellouli F, et al. Sociodemographic factors and attitudes toward food affordability and health are associated with fruit and vegetable consumption in a low-income French population. J Nutr. 2010;140(4):823-30.
28. Robinson T. Applying the socio-ecological model to improving fruit and vegetable intake among low-income African Americans. J Community Health. 2008;33(6):395-406.
29. Shaikh AR, Vinokur AD, Yaroch AL, Williams GC, Resnicow K. Direct and mediated effects of two theoretically based interventions to increase consumption of fruits and vegetables in the healthy body healthy spirit trial. Health Educ Behav. 2011;38(5):492-501.
30. Kothe EJ, Mullan B, Butow P. Promoting fruit and vegetable consumption. Testing an intervention based on the theory of planned behaviour. Appetite. 2012;58(3):997-1004.
31. De Vet E, de Nooijer J, de Vries NK, Brug J. The Transtheoretical model for fruit, vegetable and fish consumption: associations between intakes, stages of change and stage transition determinants. Int J Behav Nutr Phys Act. 2006;3(1):13.
32. Cooke L, Wardle J, Gibson E, Sapochnik M, Sheiham A, Lawson M. Demographic, familial and trait predictors of fruit and vegetable consumption by pre-school children. Public Health Nutr. 2004;7(2):295-302.
33. Hilsen M, van Stralen MM, Klepp K, Bere E. Changes in 10-12 year old's fruit and vegetable intake in Norway from 2001 to 2008 in relation to gender and socioeconomic status-a comparison of two cross-sectional groups. Int J Behav Nutr Phys Act. 2011;8:108.
34. Bere E, Klepp K. Changes in accessibility and preferences predict children's future fruit and vegetable intake. Int J Behav Nutr Phys Act 2005;2(1):15.
35. Rasmussen M, Krølner R, Klepp K, Lytle L, Brug J, Bere E, et al. Determinants of fruit and vegetable consumption among children and adolescents: a review of the literature. Part I: quantitative studies. Int J Behav Nutr Phys Act. 2006;3(1):22.
36. Krølner R, Rasmussen M, Brug J, Klepp K, Wind M, Due P. Determinants of fruit and vegetable consumption among children and adolescents: a review of the literature. Part II: qualitative studies. Int J Behav Nutr Phys Act 2011;8(1):112.
37. Prelip M, Le Thai C, Erausquin JT, Slusser W. Improving low-income parents' fruit and vegetable intake and their potential to impact children's nutrition. Health Educ 2011;111(5):391-411.
38. Te Velde SJ, Wind M, Perez-Rodrigo C, Klepp K, Brug J. Mothers' involvement in a school-based fruit and

vegetable promotion intervention is associated with increased fruit and vegetable intakes–The Pro Children study. Int J Behav Nutr Phys Act. 2008;5(1):48.

39. Glanz K, Yaroch AL. Strategies for increasing fruit and vegetable intake in grocery stores and communities: policy, pricing, and environmental change. Prev Med. 2004;39(2):75-80.
40. Backman D, Gonzaga G, Sugerman S, Francis D, Cook S. Effect of fresh fruit availability at worksites on the fruit and vegetable consumption of low-wage employees. J Nutr Educ Behav. 2011;43(4):s113-21.
41. Somerset S, Markwell K. Impact of a school-based food garden on attitudes and identification skills regarding vegetables and fruit: a 12-month intervention trial. Public Health Nutr. 2009;12(2):214.
42. Bihan H, Mejean C, Castetbon K, Faure H, Ducros V, Sedeaud A, et al. Impact of fruit and vegetable vouchers and dietary advice on fruit and vegetable intake in a low-income population. Eur J Clin Nutr. 2011;66(3):369-75.
43. Thomson CA, Ravia J. A systematic review of behavioral interventions to promote intake of fruit and vegetables. J Am Diet Assoc 2011;111(10):1523-35.
44. Oldroyd J, Burns C, Lucas P, Haikerwal A, Waters E. The effectiveness of nutrition interventions on dietary outcomes by relative social disadvantage: a systematic review. J Epidemiol Community Health 2008;62(7):573-9.
45. Pomerleau J, Lock K, Knai C, McKee M. Effectiveness of interventions and programmes promoting fruit and vegetable intake. Geneva, Switzerland: World Health Organization; 2005. 133 p. Report No.: WB 430.
46. Wolfenden L, Wyse RJ, Britton BI, Campbell KJ, Hodder RK, Stacey FG, et al. Interventions for increasing fruit and vegetable consumption in children aged 5 years and under (review). Hoboken, New Jersey: JohnWiley & Sons; 2012. 60 p.
47. Agudo A, Joint F. Measuring intake of fruit and vegetables. Geneva, Switzerland: World Health Organization; 2005. 40 p. Report No.: WB 430.
48. World Health Organization. Global strategy on diet, physical activity and health. Geneva, Switzerland: World Health Organization; 2003. 18 p.