

BMJ Open Consumption of fruits and vegetables and associations with risk factors for non-communicable diseases in the Yangon region of Myanmar: a cross-sectional study

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ABSTRACT

Objectives: To explore the intake of fruits and vegetables in the Yangon region, Myanmar, and to describe associations between intake of fruits and vegetables (FV) and established risk factors for non-communicable diseases.

Design: 2 cross-sectional studies, using the STEPs methodology.

Setting: Urban and rural areas of the Yangon region of Myanmar.

Participants: 1486, men and women, 25–74 years, were recruited through a multistage cluster sampling method. Institutionalised people, military personnel, Buddhist monks and nuns were not invited. Physically and mentally ill people were excluded.

Results: Mean intake of fruit was 0.8 (SE 0.1) and 0.6 (0.0) servings/day and of vegetables 2.2 (0.1) and 1.2 (0.1) servings/day, in urban and rural areas, respectively. Adjusted for included confounders (age, sex, location, income, education, smoking and low physical activity), men and women eating ≥ 2 servings of fruits and vegetables/day had lower odds than others of hypertriglyceridaemia (OR 0.72 (95% CI 0.56 to 0.94)). On average, women eating at least 2 servings of fruits and vegetables per day had cholesterol levels 0.28 mmol/L lower than the levels of other women. When only adjusted for sex and age, men eating at least 2 servings of fruits and vegetables per day had cholesterol levels 0.27 mmol/L higher than other men.

Conclusions: A high intake of FV was associated with lower odds of hypertriglyceridaemia among men and women. It was also associated with cholesterol levels, negatively among women and positively among men.

INTRODUCTION

Dietary factors contribute to a large share of the global burden of disease. Lim *et al*¹

Strengths and limitations of this study

- Our study had a high response rate.
- Research was carried out in a population in which knowledge about risk factors for non-communicable diseases is scarce.
- The questions on fruit and vegetable consumption were brief, including few details which could have enhanced the interpretation.
- Data collection was confined to one area of the country, thus making it difficult to make nationwide implications.

estimate that in 2010, 10% of all deaths (12.5 million) were attributable to such risk factors. The number of deaths attributed to a diet low in fruits and vegetables (FV) alone was ~6.6 million.¹ The protective effects of FV in the diet may be because of their high content of vitamins and minerals, as well as fibre, acting through mechanisms such as lowering blood pressure (BP), reducing antioxidant stress, improving lipoprotein profile and increasing insulin sensitivity.²

The WHO has recommended a daily intake of ≥ 5 portions (400 g) of FV.³ However, many people have lower intakes, both in high-income and low-income countries.⁴ A study from 52 low-income and middle-income countries reported low intakes of FV, defined as < 400 g/day, which varied from 37% among men in Ghana to 99% for women and men in Pakistan.⁵ In many Southeast Asian countries, large proportions of the population had a low intake.⁵ In Myanmar, the proportions were 83%

among men and 85% among women.⁵ A low intake of FV was more common with increasing age and in lower income groups in many countries, and with rural settlement in some.⁵

A low intake of FV is associated with non-communicable diseases (NCDs), such as cardiovascular diseases (CVDs), cancer and diabetes,^{1–3} as well as with its risk factors.^{3–7} Most studies are conducted in Western countries, and little is known about the association between the intake of FV and NCD risk factors in developing countries.⁸

Ischaemic heart disease and stroke are now the two leading causes of death in Southeast Asia, with 22% of all deaths attributable to them, which leads to 10% of the disability-adjusted life years (DALYs).⁹ Diabetes is the eighth leading cause of death in this region.⁹ The high prevalence of, and mortality from these diseases, makes prevention an urgent task. Estimations of the occurrence of risk factors, and of associations between distal and more proximal factors, could help in directing the efforts of NCD prevention in a country. Based on previous studies, increasing the intake of FV could potentially be a means to reduce the risk of NCDs. Nonetheless, more knowledge is warranted on the association between the intake of FV and NCDs in this region, and about the differences in intake of FV in various sociodemographic groups.

Therefore, we first aim to explore the intake of FV and its relation with sociodemographic factors, and second, to describe associations between the intake of FV and established risk factors for NCDs; BP, body mass index (BMI), waist hip ratio (WHR), lipid profiles and blood glucose among women and men aged 25–74 years in the Yangon region of Myanmar.

METHODS

Two regional, cross-sectional studies focusing on the risk factors for NCDs were conducted in urban and rural areas of Yangon, Myanmar from September to November 2013 and September to November 2014, respectively. The studies followed the WHO STEPs-wise approach for the surveillance of risk factors for chronic disease.¹⁰ The approach consists of three STEPs: (1) questionnaire survey based on sociodemographic characteristics, lifestyle-related habits and history of hypertension and diabetes; (2) Physical measurements including BP, body height, weight, waist and hip circumference; and (3) laboratory investigation for fasting lipid profiles (total cholesterol (TC), triglycerides (TG)) and fasting blood glucose (FBG) from venous blood sample.

Sampling

Men and women aged 25–74 years were included in the study. Institutionalised people, military personnel, Buddhist monks and nuns were not invited to the study. People who were physically and mentally ill were excluded. Based on the WHO sample size calculator for

the STEP survey,¹⁰ we estimated that with a level of confidence of 1.96, a margin of error of 0.05, a design effect of 1.5 and an expected response rate of 80%, that we would need a sample size of 500 in each of the two studies for many of the risk factors, which has a prevalence of around 10%, for example, hypertension and low levels of physical activity, or alternatively around 90%, like a low intake of FV.¹¹ Other risk factors would require a sample size of ~1000, with a prevalence of around 20–25%, for example, smoking and overweight.¹¹ Based on these numbers and practical limitations, we considered a sample of 800 to be sufficient in each survey. Calculations were separately carried out for the urban and rural survey, with the aim to be able to compare men and women (number of sex/age estimates=2).

A multistage cluster sampling method was performed. First, six urban townships and six rural townships were randomly selected. Second, these townships were divided into clusters, villages in the rural townships and wards (urban unit of township) in the urban townships. Five villages from each of the six rural townships and five wards from each of the six urban townships were randomly selected (60 clusters altogether). Finally, 26–27 households were randomly chosen within each cluster. Eligible household members were listed from selected households, and one was randomly invited to participate in the study. A male participant was selected from half the households and a female participant from the other half, and it was decided in advance which households should include a male and which should include a female. Data were collected during the daytime the first day, and then in the morning of the next day (blood samples). If a participant was not at home, she/he was contacted and an appointment was made for the next day if she/he was willing to participate, most often right after blood samples were taken. As a result, we had 1608 invitees with an equal gender distribution (804 from urban and 804 from rural areas). A total of 755 (94%) from urban areas and of 731 (91%) from rural areas completed STEPs 1 and 2. A total of 692 (86%) participants from urban and 676 (83%) participants from rural areas completed all three STEPs. The reasons given for not participating in STEPs 1 and 2 were 'not willing' and 'not having time'. In STEP 3, non-response was due to worries about blood tests. We excluded 13 pregnant women (3 from urban and 10 from rural areas), as maternal physiological changes in pregnancy might affect some of the risk factors assessed.

Data collection and measurements

Trained medical doctors interviewed the participants on sociodemographics and risk factors, and anthropometric measurements (body height, weight, waist and hip circumference) were taken using the WHO standard technique.¹⁰ For the urban study in 2013, four research assistants were recruited through the Myanmar Medical

Association. A 2-day training and pretest were conducted in the Myanmar Medical Association with technical input from the Department of Medical Research (Lower Myanmar). The trainees were exposed to the methods of sampling and interpersonal communication, obtaining informed consent and a survey questionnaire on the first day. The second day of training was focused on interactive sessions to introduce data collection methods and correct measuring methods for all the STEPs. Anthropometric measures, physiological measurements and laboratory tests were practiced and trained according to the standardised method of the WHO guidelines. The standardisation of the instruments used in the field-work was carried out both before and during the training. The trained field researchers conducted a pretest comprising STEPs 1 and 2 of the survey in the Yangon region. Questionnaires were further clarified after the pretest, and the trained field researchers underwent a trial in practical skills after the clarification. The rural study in 2014 had the same principal investigator and person responsible for the training as in the urban study. Four new research assistants were recruited, using the same methods as in the urban study, and we used identical methods of training.

A measuring tape was used to measure individual's height without foot wear and any head gear, (measured to the nearest to 0.1 cm). Body weight was measured with a portable electronic weighing scale to the nearest 0.1 kg, and the participants were requested to wear light clothes without footwear during weighing. Waist and hip circumference measurements were conducted in a private place with the measuring tape. Waist circumference was taken at the midpoint between the lower margin of the last palpable rib and the top of the iliac crest (hip bone), in the standing position directly over the skin, according to the WHO STEP survey guidelines. The hip circumference was horizontally taken at the maximum circumference over buttocks, with both measured to the nearest 0.1 cm.

Fifteen minutes after a face-to-face interview, BP was measured three times with a 3 min pause, using an OMRON M6 automatic BP monitor. Mean BP was calculated from the average of the second and third measurements. Venous blood samples were collected in a lipid tube and glucose tube containing fluoride and transported in cold boxes to the National Health Laboratory, Yangon, a reference laboratory of the Ministry of Health, Myanmar, by boat and/or car or motorcycle. FBG concentration was measured by the enzymatic reference method with hexokinase, using reagents of COBAS from Roche Diagnostics, Indianapolis, Indiana, USA. The serum concentration of TC and TG were determined by using an enzymatic colorimetric test with reagents of COBAS from Roche Diagnostics, all within 3 hours of collection.

Variables

Data on the intake of FV were collected with questions on the number of days a week vegetables or fruit were

eaten, in addition to the number of servings on those days. Servings were defined with a pamphlet with pictures of examples of one serving. The number of servings per day of FV combined were calculated and recoded into the following variables: '≥daily intake', '≥2 servings daily' and '≥5 servings daily', as well as 'number of servings/day'. As the numbers of participants reaching the recommended five servings per day was very low, the cut-off '≥2 servings daily' was used in the analyses.

FBG (mmol/L), TG (mmol/L), TC (mmol/L) and BP (mm Hg) values were dichotomised according to established cut-offs for increased risk.¹⁰ For estimating BP, the average of the two last of three measurements were used. BMI was calculated from the measured height and weight (kg/m^2), and the ratio between waist and hip circumference was also calculated. Diabetes was defined as FBG \geq 7 mmol/L and/or self-reported diabetes, hypercholesterolaemia as TC $>$ 5.17 mmol/L, hypertriglyceridaemia as TG \geq 2 mmol/L, hypertension as systolic BP \geq 140 mm Hg and/or diastolic BP \geq 90 and/or self-reported current antihypertensive treatment for hypertension within 2 weeks prior to the interview, overweight and obesity as BMI \geq 25 kg/m^2 and central obesity as WHR $>$ 0.90 in men and $>$ 0.85 in women. There were no missing data for BMI, WHR and BP, although 104 participants had missing values on lipid profile and 102 participants on FBG.

Educational level was assessed by asking for the highest level of completed education and recoded into 'primary' (completed primary school or less), 'secondary' (completed secondary school or high school) and 'higher' (completed college or university or a postgraduate). Income details were collected by asking for the average household earning per week, month or year. This was converted into US dollars (US\$) per day and recoded according to the World Bank cut-offs for moderate poverty (US\$2/day), '<US\$2/day' and '≥US\$2/day'.¹² Smoking was recorded as currently smoking tobacco products, 'no' or 'yes'. Physical activity was estimated across all domains of work, household tasks, transportation and leisure-time activity. Low physical activity was defined as <3 days of vigorous-intensity activity for at least 20 min/week, or <5 days of moderate-intensity activity (with a minimum of at least 600 metabolic equivalent of task (MET)-min) per week, using standard METs based on the WHO guidelines. All participants gave information on their education, smoking and physical activity, and 91 had missing information (refused to answer) on income. Since income was a covariate in statistical analyses, those with missing information on income were excluded (total n=1395, having completed STEPs 1 and 2).

Statistical methods

We explored associations between risk factors for chronic disease and a daily intake of at least two servings of FV using linear regressions. Risk factors (BMI, WHR, FBG, BP, TC, TG) and intake of FV were included as outcome

and exposure variables, respectively. We also described the relationships between our variables in a causal graph (directed acyclic graph (DAG))¹³ (figure 1). Based on the DAG, sex, age, location, education, income, smoking and low physical activity were possible confounders and were therefore adjusted for. BMI was included as a mediator in the analyses in which BMI was not the outcome, and was hence not adjusted for. To explore associations between diabetes, overweight, obesity, hypertension, hypertriglyceridaemia and hypercholesterolaemia and intake of FV, we used logistic regressions, with adjustments for the same potential confounders. We declared the complex sample design using 'svyset' command in STATA based on the different stages of sampling units of the study population using 2014 Myanmar census data.

We tested the assumptions of the linear model (linear effects and constant error variance) and the logistic model (linear effects) by plotting residuals versus predicted values. We looked for observations with a high influence by plotting $\delta\beta$ s versus the observation numbers and three outliers were removed for FBG. Possible interaction effects between the intake of FV and

sex, and between the intake of FV and location, were checked for. Interactions between sex and the intake of FV were found regarding cholesterol and hypercholesterolaemia. Results from these analyses were presented for men and women separately, and Stata V.14 (StataCorp 2015) was used for the analyses.

The paper was written as a part of a course in scientific writing in Myanmar (see online supplementary material).

Ethics

Written informed consent was obtained from the study participants; all information was handled with strict confidentiality and the results of blood tests were provided to the participants. Participants with abnormal biological risk factors were advised to attend the closest health facility.

RESULTS

The mean age of the participants was 47 years (table 1). Of those living in urban areas, approximately half had an income of \geq US\$2/day and one-third had a primary education only, whereas 21% had a college or university degree. In rural areas, almost two-thirds had an income of $<$ US\$2/day and three-fourths had a primary education only. Roughly one-fourth of the sample was tobacco smokers, and 11% had low levels of physical activity. The mean intake of fruits was 0.8 (SE 0.1) servings/day in urban areas and 0.6 (0.0) servings/day in rural areas, while the mean intake of vegetables was 2.2 (SE 0.1) servings/day in urban areas and 1.2 (0.1) servings/day in rural areas. Few participants reached the recommended five servings a day. The intake of FV varied with sociodemographic variables (table 2). It increased with education in urban and rural areas, and in rural areas it was highest among women.

On average, women eating at least two servings of FV per day had cholesterol levels 0.28 mmol/L lower than the levels of other women, adjusted for all included confounders (table 3). When adjusted for sex and age only, men eating at least two servings of FV per day had cholesterol levels 0.27 mmol/L higher than the levels of other men. In logistic regressions, adjusted for all included confounders, those eating at least two servings of fruits and vegetables daily had lower odds than others for hypertriglyceridaemia (0.72 (95% CI 0.56 to 0.94); table 4).

DISCUSSION

The intake of FV among adults in the Yangon region of Myanmar was low. A higher intake of FV was associated with lower odds of hypertriglyceridaemia, and among women lower levels of TC. Among men, a higher intake of FV was associated with higher levels of TC before adjustment for confounders other than age and sex.

The present study had a reasonable sample size and a high response rate, thereby strengthening the internal

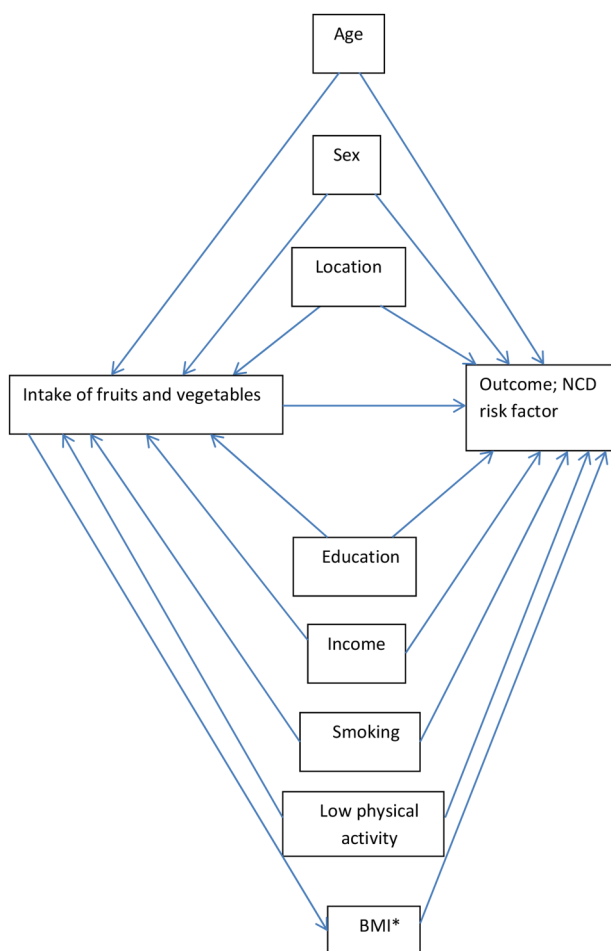


Figure 1 DAG of causal relationships. *BMI was included as a mediator in analyses with all outcomes, except when BMI was the outcome. BMI, body mass index; DAG, directed acyclic graph; NCD, non-communicable disease.

Table 1 Characteristics of the sample in STEP survey in the Yangon region of Myanmar, 2013–2014

	Urban	Rural	p Value	Total
Sex			NS	
Men (%)	50.0	50.6		50.3
Women (%)	50.0	49.4		49.7
Age, mean (SE)	48.2 (0.8)	46.3 (0.8)	NS	47.4 (0.6)
Education			0.003	
Primary (%)	35.2	74.7		51.5
Secondary or high school (%)	44.2	20.1		34.3
College/university or postgraduate (%)	20.5	5.2		14.2
Income			NS	
≥US\$2/day (%)	47.7	34.9		42.4
<US\$2/day (%)	52.3	65.1		57.6
Smoking tobacco (%)	26.5	31.9	NS	28.7
Low physical activity (%)	10.9	10.4	NS	10.7
Servings of fruits per day, mean (SE)	0.8 (0.1)	0.6 (0.0)	0.006	0.7 (0.0)
Servings of vegetables per day, mean (SE)	2.2 (0.1)	1.2 (0.1)	<0.001	1.8 (0.1)
Fruits and vegetables			<0.001	
≥Daily (%)	88.7	76.7	0.008	83.8
≥2 servings daily (%)	65.9	30.3	<0.001	51.3
≥5 servings daily (%)	22.8	6.0	<0.001	16.1

N=1395; sampling weights.
NS, not significant.

validity of the study. Non-attendance could have introduced a selection bias, but due to a response rate of >90% in STEPs 1 and 2 and >80% in STEP 3, it is unlikely that it has had a high impact.¹⁴ People in the military, monks and nuns were not invited to participate the study. Owing to different life circumstances or a certain lifestyle, differences in their health compared with the rest of the population may lead to a selection bias. If so, the results are not possible to generalise to the entire Yangon population. Moreover, due to large demographic differences throughout Myanmar, the results may not be generalised to the country as a whole.

Questions about the intake of FV were rather simple, but answers could be subjected to recall bias or difficulties in reporting the correct days of eating these items,

especially if consumption took place infrequently. Even though both surveys were carried out between September and November, some seasonal variations in the intake of FV may have occurred. Myanmar is an agricultural country, and fresh FV are available at a low cost throughout the season. Still, based on previous research, a low intake of FV was expected.⁵ The proportion of participants eating ≥5 servings of FV daily declined since the last STEP survey in this region 10 years ago, from 30% to 16%.¹⁵ The low intake was also comparable to other countries in the region.^{5 16} Average vegetable consumption was at the level found in a larger survey in Thailand, where fruit consumption was lower.¹⁷ The study from Thailand reported higher intakes of FV among women, and with a higher education.¹⁷ In our

Table 2 Mean intake of fruit and vegetables (servings/day, mean (SE)) in various sociodemographic groups among participants in STEP survey in the Yangon region of Myanmar, 2013–2014; N=1395; sampling weights

	Fruit and vegetable intake Urban	p Value differences Urban	Fruit and vegetable intake Rural	p Value differences Rural	Fruit and vegetable intake Total	p Value difference Total
Income		NS		NS		0.014
<US\$2/day	2.8 (0.2)		1.6 (0.1)		2.3 (0.1)	
≥US\$2/day	3.2 (0.1)		1.9 (0.1)		2.8 (0.1)	
Education		0.03		0.05		0.003
Primary	2.8 (0.1)		1.7 (0.1)		2.1 (0.1)	
Secondary	3.2 (0.2)		2.0 (0.1)		2.8 (0.1)	
Higher	3.1 (0.2)		2.1 (0.2)		3.1 (0.1)	
Sex		NS		0.04		NS
Men	3.1 (0.2)		1.6 (0.0)		2.5 (0.1)	
Women	2.8 (0.1)		2.0 (0.1)		2.5 (0.1)	

NS, not significant.

Table 3 The effect of having ≥ 2 servings of fruit and vegetables daily on various risk factors for NCD, compared with those with lower frequency of intake, among 25–74 years old in the Yangon region of Myanmar, taking part in STEP survey 2013–2014

	Crude β (95% CI)	Adjusted for sex, age β (95% CI)	Adjusted for sex, age, location, education, income, smoking and low physical activity β (95% CI)
Body mass index	0.74 (–0.11 to 1.60)	0.68 (–0.02 to 1.38)	0.23 (–0.27 to 0.73)
Waist hip ratio	–0.00 (–0.01 to 0.01)	0.00 (–0.01 to 0.01)	–0.00 (–0.01 to 0.01)
Blood glucose	0.03 (–0.12 to 0.18)	0.04 (–0.11 to 0.19)	–0.11 (–0.29 to 0.05)
Systolic blood pressure	0.02 (–2.43 to 2.48)	0.24 (–1.68 to 2.16)	–0.04 (–2.86 to 2.77)
Diastolic blood pressure	0.55 (–0.31 to 1.41)	0.59 (–0.22 to 2.16)	0.15 (–1.11 to 1.41)
Triglycerides	–0.03 (–0.17 to 0.12)	–0.02 (–0.16 to 0.13)	–0.11 (–0.23 to 0.01)
Total cholesterol	0.01 (–0.21 to 0.24)	0.27 (0.09 to 0.45) men* –0.23 (–0.49 to 0.22) women	0.15 (–0.02 to 0.32) men* –0.28 (–0.53 to –0.02) women

Linear regression analyses with sampling weights; N=1291–1395.

*For total cholesterol there was a significant interaction effect between intake of fruit and vegetables and sex. This interaction term is included in analyses, and separate effects estimated for men and women.

NCD, non-communicable disease.

study, a gender difference was only seen in rural areas, whereas an educational gradient was found in rural and urban areas. Increasing consumption with a higher income was seen in both studies.¹⁷ A higher intake of FV in higher socioeconomic groups has been reported in studies from low-income and high-income countries.^{18 19} In contrast to our study, several studies have found lower intakes of FV in urban than in rural areas in low-income countries.^{19 20}

In studies from other countries in Asia, a higher intake of FV has been associated with an improved NCD risk profile, such as a lower systolic BP, waist circumference and low-density lipoprotein cholesterol in southern India⁶ and lower odds of obesity in Iran,²¹ as well as a reduced risk of CVD mortality in Japan.²² In China, a protective effect of high fruit consumption on coronary heart disease has been found among women, but not

among men.²³ In our study, the protective effect of a higher intake of FV is confirmed regarding hypertriglyceridaemia, and among women regarding cholesterol levels, though not regarding cholesterol levels among men. Differences between studies may have several explanations. The types of FV commonly eaten may vary between countries, and some FV have more protective benefits than others.^{24 25} How FV are prepared influence their nutritional content, as raw and cooked vegetables may differ in content.²⁶ Fried vegetables are accompanied by fat, which may counteract any health benefits.²⁷ Additionally, salt may be added and influence the association with BP. In Myanmar, many dishes are prepared with fish sauce, which contains quite a large amount of salt. Cooked or fried vegetables may also lose heat-sensitive or water-soluble vitamins. We did not ask about types of FV, or how they were prepared. Such

Table 4 The association (OR) between having ≥ 2 servings of fruit and vegetables daily and various risk factors for NCD, compared with those with a lower frequency of intake among 25–74 years old in the Yangon region of Myanmar, taking part in the STEP survey 2013–2014

	Crude OR (95% CI)	Adjusted for sex, age OR (95% CI)	Adjusted for sex, age, location, education, income, smoking and low physical activity OR (95% CI)
Overweight	1.20 (0.70 to 2.06)	1.18 (0.71 to 1.98)	0.90 (0.62 to 1.56)
Central obesity	1.29 (0.95 to 1.74)	1.31 (0.95 to 1.79)	1.36 (0.98 to 1.89)
Diabetes	1.28 (0.95 to 1.73)	1.30 (0.95 to 1.78)	1.35 (0.98 to 1.86)
Hypertension	0.86 (0.68 to 1.09)	0.85 (0.69 to 1.06)	0.83 (0.63 to 1.11)
Hypertriglyceridaemia	0.78 (0.54 to 1.11)	0.78 (0.59 to 1.11)	0.72 (0.56 to 0.94)
Hypercholesterolaemia	0.98 (0.52 to 1.82)	1.76 (0.86 to 3.59) men* 0.60 (0.29 to 1.12) women	1.41 (0.72 to 2.76) men* 0.52 (0.26 to 1.01) women

Logistic regressions, with sampling weights; N=1291–1395.

*For hypercholesterolaemia there was a significant interaction effect between intake of fruit and vegetables and sex. This interaction term is included in analyses, and separate effects estimated for men and women.

NCD, non-communicable disease.

questions should be included in future studies to inform the interpretation of the relationship between the intake of FV and NCD and its risk factors in this population.

Some of the associations between the intake of FV and NCD risk factors changed when adjusted for the potential confounders location, income, education, low physical activity and smoking. Previous analyses of our sample showed higher levels of BMI, systolic BP, FBG, TC and TG in urban than in rural areas (ASH, unpublished results). Confounding factors could work through lifestyle factors. Better off people may afford more of healthy and unhealthy foods, thus mitigating the positive effect of FV alone. A systematic review of socioeconomic differences in dietary patterns in low-income and middle-income countries reported that people in higher socioeconomic groups and in urban areas tended to eat more calories, protein, total fat, cholesterol, polyunsaturated and monounsaturated fatty acids, vitamins and fibre, as well as more FV.²⁰ Consequently, eating more FV may also be an indicator of higher intakes of more unhealthy foods. A higher intake of FV was associated with lower cholesterol levels among women, but higher levels among men. Other Asian studies have found a protective effect of FV among women, but not men.^{25–28} Gender differences in associations may be confounded by lifestyle-related variables differing between the sexes, or there could be biological differences. In our study, the intake of FV was slightly higher among women than in men in rural, though not in urban areas. Gender differences in amount and types of FV consumed could possibly influence associations between intake of FV and cholesterol levels. It could also be that men eating more FV have a different eating pattern from women eating more FV, including more unhealthy foods.

Implications

The intake of fruits and vegetables among adults in the Yangon region, Myanmar was far below recommended levels, with socioeconomic differences. According to previous research, a low intake of fruits and vegetables should be an important risk factor for NCD. With the exception of cholesterol level among men, this was confirmed in the present study. People eating more fruits and vegetables had lower odds of hypertriglyceridemia, and among women, more favorable cholesterol levels. Unmeasured aspects of diet may explain the positive association with cholesterol levels among men. Future studies including more detailed information, such as types of fruits and vegetables, more food items and ways of preparation, is warranted to provide a better picture of the association between dietary habits and risk of NCD in the Yangon region, Myanmar.

CONCLUSION

A high intake of FV was associated with a lower prevalence of hypertriglyceridaemia. It was also associated

with levels of TC, negatively among women, and positively among men.

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