Int J Public Health (2012) 57:945–951
DOI 10.1007/s00038-012-0343-3

ORIGINAL ARTICLE

Who are eating and not eating fruits and vegetables in Malaysia?

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Received: 13 June 2011 / Revised: 23 January 2012 / Accepted: 26 January 2012 / Published online: 14 February 2012

Abstract
Objective To investigate the roles of sociodemographic factors in fruit and vegetable (FV) consumption in Malaysia.
Methods Data are obtained from the Malaysia Non-Communicable Disease Surveillance-1. Logistic regressions are conducted using a multiracial (Malay, Chinese, Indian and other ethnic groups) sample of 2,447 observations to examine the factors affecting individual decisions to consume FV on a daily basis.
Results Based on the binary outcomes of whether individuals consumed FV daily, results indicate that work hours, education, age ethnicity, income, gender, smoking status, and location of residence are significantly correlated with daily fruit consumption. Daily vegetable consumption is significantly correlated with income, gender, health condition, and location of residence.
Conclusions Our results imply the need for programs to educate and motivate consumers to make healthier dietary choices. Interventions to increase FV consumption by changing behaviors should be considered, as should those that increase public awareness of the dietary benefits of FV. These intervention programs should be targeted at and tailored toward individuals who are less educated, younger, less affluent, males, smokers, and metropolitan dwellers.

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Keywords Fruits · Logistic regression · Malaysia · Sociodemographics · Vegetables

Introduction

Fruits and vegetables (FV) are important for health due to their low natural calories and rich nutrients (Lampe 1999). FV also play an important role in prevention of chronic illnesses such as cardiovascular diseases and certain cancers of the digestive system (USDHHS and USDA 2005; Steinmetz and Potter 1996). The World Health Organization (WHO) recommends a minimum daily diet of five servings of FV to prevent cancer and other chronic diseases (WHO 1990). Similarly, the World Cancer Research Fund and American Institute for Cancer Research (2007) proposes at least five portions/servings (at least 400 g or 14 oz) of an assortment of non-starchy vegetables and fruits daily against some cancers and weight gain.

Low FV consumption causes 19% of gastrointestinal cancers, 31% of ischaemic heart diseases, and 11% of strokes worldwide in 2002. Low FV intakes also rank as a top-10 global mortality risk factor, and sufficient consumption can save up to 2.7 million lives annually (WHO 2003). Despite these widely known facts, few people consume enough FV. Instead, factors such as rapid urbanization, rising affluence, busier and faster-paced lifestyles, and dietary changes have all contributed to consumers opting for processed foods and animal food products with a more palatable taste and a longer shelf life (Popkin 1993; Regmi and Dyck 2001).

Statistics from the United Nation's Food and Agriculture Organization (FAO) indicate that from 1980 to 2003, Malaysians on average consumed 150 g of fruits and 78 g of vegetables daily (FAOSTAT 2009). Nonetheless, the

228 g of combined daily FV intake was far below the 400 g (five servings) recommended by WHO. Malaysians are not consuming enough FV compared to their intake of other staple foods such as meat and rice.

The reasons for the low FV consumption amongst Malaysians are confounding. Are prices or income a deterrent factor? Are FV incompatible with Malaysian tastes and preferences? Who are eating and not eating FV in Malaysia? While studies have investigated these issues in western countries (Cox and Wohlgenant 1986; Huang 1993; You et al. 1998; Feng and Chern 2000; Huang and Lin 2000), none has examined the sociodemographic determinants of FV consumption in Malaysia. This study attempts to narrow this gap by examining the influence of sociodemographic characteristics on FV consumption, for a newly industrialized nation for which few demand studies existed. Further, despite WHO guidelines on combined consumption, we draw on the empirical literature of typically separate analyses of FV and investigate consumption of the two products separately. Findings are relevant to policy makers concerned with the nutritional status of the population and to industry analysts interested in distinguishing their target markets.

Methods

Data and variable definitions

Data are obtained from the Malaysia Non-Communicable Disease Surveillance-1 (MyNCDS-1) (Ministry of Health Malaysia 2006). The survey encompassed 13 states and the Kuala Lumpur federal territory, and lasted from September 2005 to February 2006 based on a two-stage stratified random sampling procedure. While a total of 3,040 individuals, age 25–64, responded to the survey, the sample contains 2,447 observations (80.5%) after excluding those with missing and incomplete information. Further details are available in the survey documentation (Ministry of Health Malaysia 2006).

Outcome variables

In response to the survey question, "In a typical week, on how many days do you eat fruits (vegetables)?", fruits are consumed daily (seven days a week) by 668 (27%) of the 2,447 individuals and vegetables by 1,816 individuals (74%) (Figs. 1, 2). These excessive high counts of the outcome variables, especially for vegetables, cannot be adequately accommodated by a conventional statistical distribution such as the normal and Poisson distributions and calls for an innovative statistical procedure. We single out these 27% of daily consumers of fruits and 74% of daily consumers of vegetables and carry out logistic regressions for these discrete (binary) outcomes against the less enthusiastic consumers (Table 1).

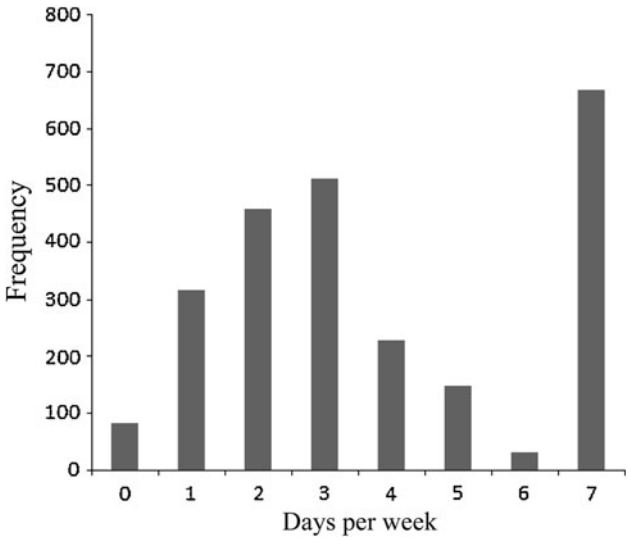

Fig. 1 Frequency histogram for fruit consumption (days per week) in Malaysia, 2006

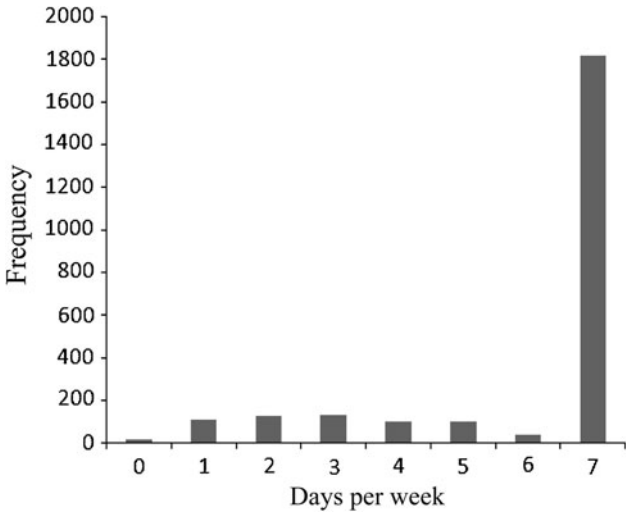

Fig. 2 Frequency histogram for vegetable consumption (days per week) in Malaysia, 2006

Exposure variables

Drawing on previous studies (Blisard et al. 2004; Stewart et al. 2004; Gustavsen and Rickertsen 2002, 2006; Casagrande et al. 2007), sociodemographic characteristics associated with FV consumption include: length of typical work day, education, age, ethnicity/race, income, gender, marital status, location, smoking status, health status, and

Table 1 Definitions and sample means of variables ($n = 2,447$) based on the Malaysia Non-Communicable Disease Surveillance-1 (MyNCDS-1), 2006

Variable	Definition	Mean
Binary outcome variables		
Fruits	Consuming fruits 7 days a week	0.27
Vegetables	Consuming vegetables 7 days a week	0.74
Continuous exposure variable		
Work hours	Length of typical work day (h)	7.40 (3.17)
Binary exposure variables (1 = yes; 0 = no)		
Education		
Primary	Primary as highest level of education (reference)	0.42
Junior high	Junior high as highest level of education	0.22
Senior high	Senior high as highest level of education	0.26
Tertiary	Tertiary as highest level of education	0.10
Age		
≤30	Age is 30 years or below (reference)	0.13
31–40	Age is between 31 and 40 years old	0.27
41–58	Age is between 41 and 58 years old	0.51
≥59	Age is 59 years or above	0.09
Ethnicity		
Malay	Ethnicity is Malay	0.55
Chinese	Ethnicity is Chinese	0.18
Indian	Ethnicity is Indian	0.09
Others	Ethnicity is one of others (reference)	0.18
Income		
Poverty	Monthly household income is RM0–399	0.11
Low	Monthly household income is RM400–999	0.36
Middle-low	Monthly household income is RM1000–2999	0.38
Middle-high	Monthly household income is RM3000–5999	0.06
High	Monthly household income RM6000 or above (reference)	0.09
Male	Gender is male	0.41
Single	Marital status is single, divorced or widowed	0.13
Rural	Reside in rural area	0.50
Smoker	Currently smoking cigarettes	0.21
Hyperchol	Diagnosed with hypercholesterolemia	0.56
High BP	Diagnosed with high-blood-pressure	0.32
Diabetes	Diagnosed with diabetes	0.13
Regions		
Metro	Metropolitan states in Peninsular Malaysia (Penang, Selangor, Federal Territory	0.19
Non-metro	Non-metropolitan states in Peninsular Malaysia (Perlis, Kedah, Perak, Melaka, Negeri Sembilan, Johor, Pahang, Kelantan, Terengganu) (reference)	0.56
East Malaysian	East Malaysian states (Sabah, Sarawak)	0.25

Compiled from Ministry of Health Malaysia (2006)

Standard deviations are in parentheses

As of 2 June 2009, exchange rate was approximately US$1.00 = RM3.51. The five income categories correspond to poverty (US$0–113.90), low (US$114–284.90), middle-low (US$285–853.90), middle-high (US$854–1708.90) and high (≥US$1709)

regions. Education level is represented by the respondent's highest level of education (primary, junior high, senior high, and tertiary). Age brackets include younger (age ≤30), middle-age younger (age 31–40), middle-age older (age 41–58), and retiree (age ≥59). The unique racial composition in Malaysia allows an examination of the role of ethnicity in FV consumption. Income was collected in ten categories but re-coded to five categories: poverty, low, middle-low, middle-high, and high-income groups (Table 1).

Since smokers are deemed to have lower concerns for their health than non-smokers, smoking status is expected to yield a negative relationship with FV demand (McClure et al. 2009). Current health status is conjectured to increase FV demand and individuals diagnosed with hypercholesterolemia (Hyperchol), hypertension (High BP), and diabetes (Diabetes) are indicated with these dummy variables. Respondents are categorized into those from the metropolitan states, East Malaysian states, and non-metropolitan states in Peninsular Malaysia (reference). These regional variables may also reflect other sources of differences besides prices. Length of a typical work day (work hours) is used as a proxy for time available for healthy food consumption. Finally, dummy variables are introduced for gender and location (Rural).

Statistical analysis

Our measurements of FV consumption contain excessive counts at 7 days per week, which cannot be accommodated with a conventional statistical distribution. We focus on the binary variables indicating whether an individual consumes FV daily, using logistic regression (Kleinbaum and Klein 2010) for FV separately. Odds ratios (ORs) and confidence intervals (CIs) are calculated. All analyses are carried out

using STATA (version 11.1, 2010, STATA Corp, College Station, TX).

Results

Our first empirical task was to examine potential multicollinearity among the regressors by calculating their variance inflation factors (VIFs). A VIF value in excess of 20 is indicative of a multicollinearity problem (Chatterjee and Hadi 2006), which can cause unreliable (imprecise) parameter estimates and misleading statistical inference. All VIFs are very small, ranging from 1.06 for "single" to 3.66 for "Malay". Since these values are much lower than the criterion for multicollinearity suggested in the literature, we conclude that multicollinearity is not an issue for the current analysis.

From Table 1, fruits are consumed daily by 27% of the total sample, compared to 74% for vegetables. On average, individuals work about 7.4 h per day. About 42% of the respondents report having primary education as their highest level of education, followed by senior high school (26%), junior high school (22%), and tertiary education (10%). The majority of the respondents are between 41 and 58 years old (51%), with 27% between 31 and 40 years, 13% 30 years or below, and 9% 59 years or above. The ethnic breakdown consists of 55% Malays, 18% Chinese, 9% Indians and 18% of other ethnic backgrounds, which is fairly representative of the Malaysian population: 54.7% Malays, 24.7% Chinese, 7.4% Indians, and 13.2% of other races (Department of Statistics Malaysia 2008).

A large proportion of the overall sample are in the middle-low income group (38%), followed by those in the low (36%), poverty (11%), high (9%), and middle-high (6%) income groups. Approximately 41% of the overall samples are males, while 13% are either single, divorced or widowed. The sample consists of an equal distribution of urban and rural residents. Only a minority (21%) of the sample are smokers. Slightly more than half of the respondents (56%) suffer from hypercholesterolemia, with lower proportions diagnosed with hypertension (32%) and diabetes (13%). Last, the majority of the sample (56%) reside in the non-metropolitan states in Peninsular Malaysia (Perlis, Kedah, Perak, Melaka, Negeri Sembilan, Johor, Pahang, Kelantan, Terengganu), followed by 25% in the East Malaysian states (Sabah and Sarawak) and 19% in the metropolitan states in Peninsular Malaysia (Penang, Selangor, Federal Territory).

Estimates of the logistic regressions, presented in Table 2, suggest that 73.5% of the binary outcomes are correctly predicted for fruits and 77.6% for vegetables.

Table 2 Logistic regressions for daily fruit and vegetable consumption in Malaysia, 2006

Variable	Fruits		Vegetables	
	Odds ratio	95% CI	Odds ratio	95% CI
Work hours	1.04*	(1.01, 1.07)	1.03	(1.00, 1.07)
Education				
Primary	1.00		1.00	
Junior high	1.38*	(1.06, 1.79)	1.23	(0.94, 1.60)
Senior high	2.13**	(1.63, 2.76)	1.32	(0.99, 1.75)
Tertiary	2.24**	(1.56, 3.23)	1.36	(0.88, 2.11)
Age				
Age ≤30	1.00		1.00	
Age 31–40	1.02	(0.73, 1.43)	0.74	(0.52, 1.05)
Age 41–58	1.99**	(1.43, 2.75)	1.07	(0.75, 1.51)
Age ≥59	2.49**	(1.57, 3.93)	1.23	(0.76, 1.99)
Ethnicity				
Malay	1.23	(0.87, 1.76)	0.73	(0.48, 1.12)
Chinese	1.83**	(1.28, 2.63)	1.30	(0.80, 2.12)
Indian	1.78*	(1.12, 2.82)	1.26	(0.74, 2.16)
Others	1.00		1.00	
Income				
Poverty	0.41**	(0.27, 0.64)	0.35**	(0.21, 0.57)
Low	0.55**	(0.40, 0.77)	0.41**	(0.27, 0.62)
Middle-low	0.74	(0.54, 1.01)	1.15	(0.76, 1.74)
Middle-high	0.69	(0.45, 1.07)	1.24	(0.67, 2.23)
High	1.00		1.00	
Male	0.76*	(0.61, 0.95)	0.58**	(0.46, 0.74)
Single	1.27	(0.97, 1.68)	0.86	(0.64, 1.15)
Smoker	0.70*	(0.52, 0.93)	0.78	(0.59, 1.03)
Hyperchol	1.21	(1.00, 1.47)	1.21	(0.98, 1.49)
High BP	1.08	(0.88, 1.34)	0.88	(0.70, 1.11)
Diabetes	1.04	(0.79, 1.39)	0.74*	(0.55, 1.00)
Regions				
Metro	0.94	(0.73, 1.21)	0.33**	(0.26, 0.42)
Non-metro	1.00		1.00	
East Malaysian	2.03**	(1.51, 2.74)	2.89**	(1.92, 4.35)
% correct predict	73.50%		77.60%	
Efron's pseudo R^2	0.08		0.16	

Asterisks indicate levels of statistical significance: $^{**}p < 0.01$ and $^{*}p < 0.05$

Efron's pseudo R^2 (Kleinbaum and Klein 2010) (0.08 for fruits and 0.16 for vegetables), which are typically low for cross-sectional samples, suggests the regression equations are fairly reasonable fits.

Results for the odds ratios suggest that an additional hour of work per day increases the odds of consuming fruits daily by 4.0% (OR = 1.04; 95% CI 1.01–1.07). Higher education levels increase the likelihood of

consuming fruits daily as those with junior high school (OR = 1.38; 95% CI 1.06–1.79), senior high school (OR = 2.13; 95% CI 1.63–2.76) and tertiary educated individuals (OR = 2.24; 95% CI 1.56–3.23) face higher odds of consuming fruits than those with primary school education. Additionally, older individuals are also more likely to eat fruits on a daily basis as those age between 41 and 58 (OR = 1.99; 95% CI 1.43–2.75) and age ≥59 (OR = 2.49; 95% CI 1.57–3.93) exhibit higher likelihoods of daily fruits consumption compared to their cohorts age ≤30.

Ethnic Chinese (OR = 1.83; 95% CI 1.28–2.63) and Indians (OR = 1.78; 95% CI 1.12–2.82) have higher odds of consuming fruits daily than individuals of other ethnic backgrounds. Compared to high-income earners, lower income individuals are less likely to consume fruits daily, with ORs of 0.41 (95% CI 0.27–0.64) for poverty-income earners and 0.55 (95% CI 0.40–0.77) for low-income earners. Similar effects are found amongst lower income individuals in vegetable consumption, as poverty-income (OR = 0.35; 95% CI 0.21–0.57) and low-income (OR = 0.41; 95% CI 0.27–0.62) earners display lower odds of consuming vegetables on a daily basis compared to high-income earners.

Males have lower odds of consuming fruits (OR = 0.76; 95% CI 0.61–0.95) and vegetables (OR = 0.58; 95% CI 0.46–0.74) daily than females. Smokers have lower odds of eating fruits (OR = 0.70; 95% CI 0.52–0.93) daily than non-smokers. Diabetics have lower odds of consuming vegetables daily than non-diabetics (OR = 0.74; 95% CI 0.55–1.00) although such lower odds are not seen in daily fruit consumption by diabetics.

Compared to non-metropolitan inhabitants in Peninsular Malaysia, residents of metropolitan states in Peninsular Malaysia have lower odds of daily vegetable consumption (OR = 0.33; 95% CI 0.26–0.42). East Malaysian consumers have higher odds of consuming fruits (OR = 2.03; 95% CI 1.51–2.74) and vegetables (OR = 2.89; 95% CI 1.92–4.35) than their non-metropolitan counterparts from Peninsular Malaysia.

Discussion

The logistic regression model allows an investigation of the determinants of FV consumption among individuals who consume and do not consume FV on a daily basis. Results indicate that work hours, education, age ethnicity, income, gender, smoking status, and location of residence are significantly correlated with daily fruit consumption. Daily vegetable consumption is significantly correlated with income, gender, health condition, and location of residence.

Specifically, the results indicate that FV consumption is invariably associated with wealth, as affluent individuals are able to afford more FV than those with a tighter budget. These findings are expected as low-income individuals allocate their extra dollar of income to more essential food and non-food items, such as rice, clothing, and housing. Thus, public policies to provide dietary assistance to the underprivileged could be considered with the primary aim of promoting FV consumption. Subsidies in the forms of price and income assistance have been found to be supportive of promoting FV consumption in the US (Lin et al. 2010).

Gender differences are found to be associated with FV consumption in Malaysia as males have lower odds of consuming FV than females. This is likely attributable to social and cultural norms, whereby women in most Asian countries play an integral role in household decision making, and thus may be more particular about healthy diets than men. Another possible reason for the lack of preference for FV amongst men could be due to the fact that some foods (e.g., meat) may be labeled as masculine while others (e.g., FV) symbolize feminity (Prattala et al. 2006). Thus, to reduce gender differences in nutrition and diet, educating males on the health benefits of FV consumption is an important agenda item.

Our results also corroborate previous findings (Trudeau et al. 1998; Wallstrom et al. 2000) that differences exist between the sociodemographic correlates of FV intakes. This is evident amongst higher educated individuals and individuals age 41 years and above who display higher likelihoods of consuming fruits than their less educated and younger cohorts, although this association is less evident for intake of vegetables. Similarly, although ethnic Chinese and Indians have higher fruits consumption odds than others, these relationships are not obvious for vegetables. As expounded by Wallstrom et al. (2000), this phenomenon can be explained by the differing consumption or preparation behaviors of the two goods. For instance, fruits can be usually eaten between meals while vegetables are primarily consumed as part of regular meals. Further, fruits often possess a natural sweet taste and are generally viewed as a pleasurable snack. Hence, intervention strategies to address the motives for and attitudes about keeping a healthy diet should take note that such outcomes may be easier to implement for fruits than vegetables, particularly amongst higher educated, ethnic Chinese and Indians, and those above the middle-age group.

In light of the findings that education levels are significantly associated with increased levels of fruits consumption, we conclude that information is an integral part of the decision-making process as better educated and more knowledgeable consumers are likely to make more nutritious dietary choices. Therefore, health-promotion and

market-expansion programs should focus on raising consumer awareness and extolling the distinctive nutritional benefits of FV.

The results also corroborate findings by McClure et al. (2009) in identifying smoking status as significantly associated with FV consumption. As smokers have lower odds of eating fruits than non-smokers, health awareness programs should be targeted towards the former. This is in light of the well-accepted notion that smokers by and large have worse dietary habits and may have the most to gain from dietary improvements (McClure et al. 2009).

Among the remaining variables, positive determinants of FV consumption include being a resident of East Malaysian states, while negative contributing factors of vegetables consumption include residing in the metropolitan areas of Peninsular Malaysia. Therefore, the key message is that FV should be viewed as part of a wholesome diet to reduce the risk of chronic illnesses. These health awareness programs should be aimed primarily at urbanites with hectic and busy lifestyles, with a reminder that one should be mindful of a healthy diet while in pursuit of career advancement.

Our results imply the need for programs to educate and motivate consumers to make healthier dietary choices. Interventions to increase FV consumption by changing behaviors should be considered, as should those that increase public awareness of the dietary benefits of FV. However, nutritional interventions should go beyond increasing awareness and targeting groups of individuals. These programs should attempt to eliminate barriers to healthy eating, provide support for persons making healthy changes, and emphasize nutritional policies that impact the society. Simply put, these intervention programs should be targeted at and tailored toward those who have lower FV consumption. Based on our findings, these groups in Malaysia include individuals who are less educated, younger, less affluent, male, and smokers for fruits. Individuals with lower likelihood of consuming vegetables include those in the lower income groups, males, diabetics, and metropolitan dwellers.

While this study provides interesting new findings for a newly industrialized country like Malaysia, future research might focus on identification of barriers to eating more FV and on evaluating environmental changes that could potentially increase FV consumption (e.g., increasing the proportion of FV in vending machines; promoting healthful food advertising and availability of healthful foods). Additionally, while information such as portion size and preparation style (e.g. whether vegetables were consumed raw, steamed, boiled, fried, pickled) were not available in the current survey, it is admittedly a limitation to be considered in future studies of energy and nutrient intake. Last, while the lack of price and quantity/expenditure data in health surveys may be common, it is certainly a limitation of the present study.

Acknowledgments Yen's research was supported in part by USDA-ERS Cooperative Agreements Nos. 58-5000-7-0123 and 43-3AEM-2-80063. Tan's research support was obtained from Universiti Sains Malaysia (Research University Grant No. 1001/PSOSIAL/816169). The views in this paper are those of the authors and do not necessarily reflect the views or policies of the above funding agencies. We thank the Director General of the Ministry of Health Malaysia for sharing the data and permission to publish.

Conflict of interest The authors declare that they have no conflicting interests.

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