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Fruit and vegetable purchasing patterns and preferences in South Delhi

LAUREN E. FINZER,

Centre for Chronic Disease Control (CCDC), C1/52, Safdarjung Development Area, New Delhi – 110016

VAMADEVAN S. AJAY,

Centre for Chronic Disease Control (CCDC), C1/52, Safdarjung Development Area, New Delhi – 110016; Public Health Foundation of India, PHD House 2ndFloor, 4/2, SIRI Fort Institutional Area, August Kranti Marg, New Delhi – 110016; Public Health Foundation of India, Institute for Studies in Industrial Development Campus, 4, Institutional Area, Vasant Kunj, New Delhi 110070

MOHAMMED K. ALI,

Rollins School of Public Health & School of Medicine, Emory University, 1550 Clifton Road NE, Atlanta, Georgia, USA

ROOPA SHIVASHANKAR,

Centre for Chronic Disease Control (CCDC), C1/52, Safdarjung Development Area, New Delhi – 110016

SHIFALIKA GOENKA,

Public Health Foundation of India, PHD House 2ndFloor, 4/2, SIRI Fort Institutional Area, August Kranti Marg, New Delhi – 110016. Praggya Sharma, Centre for Chronic Disease Control (CCDC), C1/52, Safdarjung Development Area, New Delhi – 110016

DIVYA S. PILLAI,

Centre for Chronic Disease Control (CCDC), C1/52, Safdarjung Development Area, New Delhi – 110016

SHWETA KHANDELWAL,

Centre for Chronic Disease Control (CCDC), C1/52, Safdarjung Development Area, New Delhi – 110016; Public Health Foundation of India, PHD House 2ndFloor, 4/2, SIRI Fort Institutional Area, August Kranti Marg, New Delhi – 110016

NIKHIL TANDON,

Department of Endocrinology, All India Institute of Medical Sciences New Delhi – 110029

K. SRINATH REDDY,

Public Health Foundation of India, Institute for Studies in Industrial Development Campus, 4, Institutional Area, Vasant Kunj, New Delhi 110070

Address correspondence to Lauren Finzer, Fulbright Scholar, Centre for Chronic Disease Control (CCDC), C1/52, Safdarjung Development Area, New Delhi – 110016. Telephone: +91-11-2685-0117. Fax: +91-11-2685-0588. lauren.finzer@gmail.com.

Institution where work was performed: Centre for Chronic Disease Control (CCDC), C1/52, Safdarjung Development Area, New Delhi – 110016.

K.M. VENKAT NARAYAN, and

Rollins School of Public Health & School of Medicine, Emory University, 1550 Clifton Road NE, Atlanta, Georgia, USA

DORAIRAJ PRABHAKARAN

Centre for Chronic Disease Control (CCDC), C1/52, Safdarjung Development Area, New Delhi – 110016; Center for Cardiometabolic Risk Reduction in South Asia (CARRS) Center of Excellence, Public Health Foundation of India or Centre for Chronic Disease Control, C1/52 Second Floor, Safdarjung Development Area, New Delhi, India 110016

Abstract

This study examines associations between consumer characteristics, beliefs, and preferences and fruit and vegetable (FV) purchasing and intake in South Delhi, India. Home interviews were conducted with 245 households, using a structured questionnaire to assess FV consumption and purchasing frequency, spending, place of purchase, mode of travel, knowledge and attitudes towards organics, and beliefs about barriers to FV consumption. In-depth interviews with 62 experts and key informants validated survey findings that street vendors and markets are currently the dominant source of FV in South Delhi and that affordability, not accessibility, is the main barrier to increasing FV intake.

Keywords

fruit and vegetables; affordability; access; food purchasing

Introduction

India is grappling with significant present and future burdens of non-communicable diseases such as coronary artery disease, hypertension, type 2 diabetes, and stroke (Patel *et al.* 2011; Reddy 2011; Shetty 2001; Reddy *et al.* 2007; Misra *et al.* 2001; Gupta *et al.* 2003), while still struggling with micronutrient deficiencies (Chakravarty and Sinha 2002; Pal and Sagar 2007). Evidence links low fruit and vegetable (FV) consumption to these deficiencies and diseases (Ness and Powles 1997; Bazzano 2004; Ford and Mokdad 2001; Zino *et al.* 1997; Ali and Tsou 1997), and supports the benefits of a diet rich in FV (WHO 2003; Lock, Pomerleau, and Causer 2004; Keatinge *et al.* 2011; Halpin, Morales-Suárez-Varela, and Martin-Moreno 2010; Dauchet *et al.* 2006; Rastogi *et al.* 2004). Unfortunately, a significant proportion of all segments of the Indian population fail to consume the 5 daily servings of FV recommended by the World Health Organization (WHO 2006; Hall *et al.* 2009; Yadav and Krishnan 2008; Muehlhoff *et al.* 2011; Radhika *et al.* 2011).

Increasing FV consumption in the Indian population could have a powerful public health benefit (Reddy and Katan 2004). Interventions to increase FV intake have shown success in other countries (Pomerleau *et al.* 2005; Just, Mancino, and Wansink 2007; Thow *et al.* 2010). However, effectively promoting FV consumption will require a better understanding of how the food environment—availability, safety, and affordability of various types of food (Wang *et al.* 2006)—affects FV purchasing and consumption. Almost all studies exploring this

question have been confined to developed countries (Treiman *et al.* 1996; Krebs-Smith and Kantor 2001; Septoe *et al.* 2003). Very little is known about how India's diverse food environments affect FV consumption (Regmi *et al.* 2001; Pandey *et al.* 2005; Hebert *et al.* 1998; Hebert *et al.* 1999; Bharathi *et al.* 2008).

Exploring this topic in India is particularly important given that rapid changes in food environment and habits—such as the rise of modern retailers like supermarkets—are likely to have profound impacts on food consumption (Pingali 2006). Increases in income (Deaton and Dreze 2009), urbanization, and changing preferences are causing large-scale changes in food consumption patterns in India (Kumar, Mruthyunjaya, Dey 2007). At the same time, more women are working outside the home (Goldman, Ramaswami, and Krider 2002), and more people own refrigerators and microwaves (Dittrich 2009). In other countries, similar changes fueled the rise of modern retailers like supermarkets (Reardon *et al.* 2003, Messinger and Narasimhan 1997), with mixed impacts on food consumption (Hawkes 2008). In India, supermarkets are already common in many cities and are likely to play an increasing role in food retailing in urban settings (Reardon and Minten 2011; Reardon, Timmer, and Minten 2010; Franz 2010; Lohr and Dittrich 2007). These modern retailers could support the growing Indian organic movement (Willer 2011, Ramesh, Singh, and Rao 2005; Menon 2009), which is important to consider in discussions of FV given the unsafe levels of chemical residue often present on Indian FV (Sharma, Agarwal, and Marshall 2009; Bhanti and Taneja 2007).

Effectively promoting safe FV consumption will require knowledge of how changes in Indian food retailing affect food purchasing and consumption. Research building upon consumer choice theory suggests that food purchasing and consumption choices are dynamic, affected by the interplay among ecological factors such as economic and physical access, personal factors such as an individual's preferences, and price and non-price factors such as travel time (Becker 1965; Powell, Han, and Chaloupka 2010; Andreyeva, Long, and Brownell 2010; McCann 2004).

Therefore, the purpose of this study was to examine associations among consumer characteristics and preferences, FV purchasing, and FV intake in South Delhi. We used a mixed methods (qualitative and quantitative) approach: In-depth expert and key informant interviews guided the development and analysis of a culturally appropriate FV purchasing questionnaire, which was administered to a representative population of South Delhi. We report data on FV purchasing habits and preferences, beliefs about adequate FV consumption, perceived barriers to greater FV consumption, and awareness of and willingness to pay for organic FV.

Methods

Data collection

Cross-sectional data on FV purchasing was collected through home interviews with 245 households in South Delhi, one of nine districts in India's capital Delhi, as an ancillary study to the Center for Cardiometabolic Risk Reduction in South Asia (CARRS) surveillance study. CARRS collected socioeconomic, dietary, and anthropometric data from one adult

female in each household. Our study administered an additional questionnaire on FV purchasing through home interviews with the person responsible for FV purchasing in each South Delhi household that participated in CARRS (see figure 1).

The CARRS cross-sectional survey assessed chronic disease risk factors in Delhi, Chennai, and Karachi. In each city, 2,000 households were chosen through multi-stage cluster random sampling. Within each household, two participants (20 years of age and not pregnant) from each household were recruited for CARRS using a three-step sampling methodology (Rizzo, Brick, and Park 2004). Culturally adapted questionnaires, including a food frequency questionnaire, were designed with reference to the WHO Multinational MONItoring of trends and determinants in CARDiovascular disease (MONICA) study, WHO STEPwise Surveillance methodology, and other questionnaires used throughout India. Trained field investigators administered these questionnaires through household visits. The food frequency questionnaire was pre-tested separately from survey administration and updated with the names of locally available food items. It included potato as a vegetable. All participants gave written informed consent. CARRS includes plans to follow up with participants for three years and conduct a repeat cross-sectional survey of an independent sample in the same study sites in 2013–14.

For our FV purchasing study, a total of 245 households were interviewed between October 2010 and February 2011. A sample size of 300 households was determined using WHO STEPwise methodology (WHO 2008)—all South Delhi households selected for participation in CARRS—but 55 out of 60 of the households selected for participation in three wealthy neighborhoods declined to participate in CARRS. A questionnaire was designed for the South Delhi context based on observation, expert interviews, and the CARRS food frequency questionnaire. This questionnaire was pre-tested and administered by trained field workers to the person responsible for purchasing most of the FV consumed in each household, or to another adult household member if the primary purchaser was not available. For 24 households that could not be found at home despite repeated visits, interviews were conducted by phone.

Survey data management and analysis

This study's analysis tested hypotheses about associations among household-level responses to the FV purchasing questionnaire, and CARRS socioeconomic, health, and dietary data from one adult female participant in each household (available for 234 households).

First, data was converted into a form usable for analysis. Household per capita income was estimated by dividing the midpoint of the reported income category by the number of people in the household. Reported food consumption frequencies were converted into weekly and daily intake, treated as continuous variables, and divided into fruit and vegetable groups. Whether or not participants shopped at the store types was determined based on whether they reported buying any goods at that type of store. Respondents' ratings of the importance of various characteristics in their FV purchasing decisions were divided into characteristics of modern retailing (supermarkets and cooperative stores) and of traditional retailing (street vendors and markets).

Second, descriptive analyses were run to identify characteristics of households and participants, patterns in FV purchasing and consumption, and responses to questions measuring knowledge and attitudes. Analyses including data related to individual participants were limited to households for which data from a female participant was available ($n=234$).

Third, a list of hypotheses that emerged from the expert and key informant interviews described below was used to test correlations and build multiple regression models testing for associations among diverse variables. Significance was accepted at $p<.05$. Because the regression models did not produce explanatory results, t -tests, comparison of means, Chi-square tests, and correlation analyses were performed to test the validity of hypothesized relationships between characteristics of the households/participants and variables such as per capita spending on FV, location of fruit and vegetable purchase, and mean FV consumption frequency. T -tests assumed that variables were normally distributed, and comparisons of means assumed equal variance in the two populations.

Qualitative interviews and observations

From August 2010 to March 2011, additional in-depth interviews and observations were conducted to gain a qualitative perspective on in the food environment in India and guide questionnaire development and analysis. These interviews included exploratory conversations with traditional and modern retailers along the fruit and vegetable supply chain, including retailers in the section of Delhi in which questionnaires were administered. In addition, 62 in-depth interviews were conducted with experts and key informants from business (32), research (23), government (5), and public health (2) backgrounds, identified through the literature and recommendations. Notes from expert and key informant interviews and observations were typed up and analyzed for themes and major findings. Key findings from individual interviews or observations were checked with other experts throughout the interviews. These findings guided the development of the structured questionnaire and hypotheses for survey data analysis, and provided a useful validation of the results of the survey data.

Results

Household fruit and vegetable purchasing patterns

Table 1 summarizes household-level data, while table 2 summarizes individual-level data from one adult female in each surveyed household. With respect to FV purchasing, the key variables examined were FV purchasing frequency and per capita spending, shown in table 1. While these variables must be interpreted in conjunction with other factors such as price, refrigerator use, and mode of travel, they show general patterns in FV purchasing and are intended to provide a baseline from which further research can track changes over time. Households purchased FV 4 times per week on average (95% CI 3.7–4.3), spending a mean of 14% of per capita income on FV (95% CI 12.3–16.5). Median weekly spending was 48 Indian Rupees (INR).¹

¹The exchange rate was 53 Rupees to the US dollar on December 15, 2011, the midpoint of the survey.

The wife, who tended to be the female for whom data was collected, and head of household tended to be the primary FV purchasers (see table 4). In only one case was a servant (the cook) named as a primary FV; this household identified both the cook and the head of household together as the primary FV purchasers.

The mean time traveled to buy fruit or vegetables from a vendor or market was 17 minutes (95% CI 15.5–17.5). The 85.7% of households that walked to the street vendor or market (see table 1) traveled for a mean of 15 minutes (95% CI 14.4–16.4), slightly but significantly shorter than the mean travel time of 23 minutes (95% CI 20.1–26.4) for households that used another form of transport. Fewer than 10% of respondents used cars to travel to the street vendor or market: Only 4.5% of households stated that they traveled by private car or motorcycle, while 5.3% stated that they both walked and used a car or motorcycle. In contrast, half of the households who purchased FV from the supermarket reported using their own car or motorcycle to get there.

Table 5 summarizes where households reported buying various food items. Some households reported buying FV from multiple types of stores. Almost all households (99%) reported purchasing some fruit or vegetables from traditional retailers (street vendor, open market, or mom and pop grocery store).

Only 13 households (5.3% of total sample) reported purchasing any food items from the supermarket. Of these, the eight households (3.3% of total sample) that reported purchasing fruit or vegetables from the supermarket also tended to purchase other foods there and were more likely to purchase frozen foods ($p < 0.05$). These households also tended to have higher incomes than the rest of the sample (t -test comparing means, $p < .05$) although one had a monthly income of 3,000 and 10,000 INR and two had monthly incomes between 10,001 and 20,000 INR. In the discussion session, we address how refusals among wealthy households may have affected reported frequency of purchasing from supermarkets. Buying FV from a supermarket or cooperative store was associated with a higher mean rating for the set of factors characteristic of modern retailing: air conditioning, buying everything from one store, credit and debit card facilities, and special offers (t -test comparing means, $p < 0.01$). Overall, respondents rated price, appearance, being able to touch items, and cleanliness as the most important factors in buying FV.

Fruit and vegetable consumption patterns, beliefs, and barriers

We present female participants' frequency of FV intake rather than quantity or detailed data on composition, since food frequency questionnaires have been shown to generally reflect food intake (Byers 2001), are commonly used internationally in analyses of FV consumption (Hung *et al.* 2004; Lock *et al.* 2004; Padrao *et al.* 2011), and are well suited to the kinds of ranking and correlation analyses in our study (Field *et al.* 1998).

Our findings suggest a dissociation between the perception of healthy habits and actual FV intake: While 95% of female participants from the households we surveyed reported consuming FV less than five times per day, only 30% of surveyed households thought they should be eating more FV. Average reported FV consumption frequency was 2.5 times per day (95% CI 2.3–2.6), with fruit consumed a mean of 0.6 times and vegetables 1.9 times

(see table 2). Years of formal education ($p<.05$), but not age ($p=0.69$), were significantly correlated with consuming FV more frequently (see table 3). Vegetarians did not report significantly more frequent FV consumption (t -test comparing means, $p=0.27$). About nine in ten households that thought they should be consuming more FV named money as the main barrier to consuming more. Three households mentioned time as a barrier, and none mentioned accessibility.

Socioeconomic factors and FV purchasing and consumption

Table 3 shows correlations between socioeconomic factors, spending on FV, and consumption frequency, calculated using Student's t -test. High levels of significance are shown in bold. There was a small but significant correlation between a household's per capita spending on FV and the per capita income reported by the female participant in that household ($r=0.32$, $p<0.01$). Adding additional variables such as formal education and number of children in the household to per capita income in a regression model of spending on FV did not produce additional explanatory power. We analyzed these variables because they have been shown to be related to a purchaser's desire to buy more nutritious items such as FV in other groups (Turrell *et al.* 2002; Serdula, Gillespie *et al.* 2004). Mean FV purchasing frequency was not significantly different among households that owned refrigerators ($p=.13$).

There was a small but significant association between per capita spending on FV and frequency of FV consumption by female participants ($r=0.15$, $p<.05$). However, FV purchase frequency and per capita spending on FV together cannot be considered explanatory for FV consumption frequency; the R^2 for the multiple linear regression model testing interactions among these variables in our study was less than 0.02.

Organic fruit and vegetables

An estimated 47% of households were aware that chemicals might be present on FV. Of these, most (86%) considered this an important factor in their buying decisions. Of all households, 41% were aware of organic FV. The majority (62%) of households aware of organics indicated that they would be willing to pay more for organic produce. These households reported willingness to pay about a third more on average. They almost exclusively named health reasons in response to an open question about motivation for paying more.

Expert and key informant insights into India's food environment

A total of 62 key informants and experts were interviewed about changes in India's food environment. For the purposes of this study, a key informant was someone who had extensive experience working in the fields of food retailing or nutrition in India. Interviews assessed beliefs about (1) changes in food habits in India, (2) changes in food retailing and food environment in India, (3) FV safety, and (4) potential impact of changes in food environment on nutrition.

All interviewees emphasized that food habits and the food environment are changing in India. They noted that while there has traditionally been a stigma against foods made outside

of the home, more women are working and demanding the convenience offered by ready-made products, mixes, and bags of pre-cut vegetables sold by supermarkets. Most interviewees identified the rise of supermarkets as contributing to India's changing food environment. At the same time, they stressed that supermarkets are still a niche market in Delhi and specifically in the area in which the household survey was conducted, and are not yet reaching rural India.

Pesticides and FV safety emerged as an important concern for nearly all of the experts, reinforcing our decision to include an analysis of attitudes towards organic FV in this study.

Discussion

This is one of the first studies to examine associations between consumer characteristics and preferences, FV purchasing, and FV intake across income groups in urban India. We directly surveyed households from South Delhi, India about FV purchasing and consumption. The frequency of purchasing (mean of 4 times per week), short times walked to buy FV, importance according to price, and primacy of cost as a barrier to eating more FV imply that affordability plays a greater role than physical accessibility in FV purchasing. Our findings also suggest a troublesome dissociation between the perception of ideal FV intake and actual FV intake: Most households thought they ate enough FV, but food frequency questionnaire responses showed low frequencies of FV consumption.

Our participants' mean FV consumption frequency of 2.5 servings per day is consistent with published research finding high prevalence of inadequate FV intake (less than five servings or 400–500g daily) globally (Lock *et al.* 2005; WHO 2003) as well as in India (Yadav and Krishnan 2008; Allender *et al.* 2010; Anand *et al.* 2007). Like our study, research in developed countries highlighted the role of FV affordability and knowledge of appropriate FV consumption (Septoe *et al.* 2003; Wardle, Parmenter, and Waller 2000; Yeh *et al.* 2008; Jeyanthi and Ziebland 2004; Bihan *et al.* 2010).

The characteristics of our sample reflect the demographics of Delhi as a whole (IIPS and Macro Intl 2009; Budget Speech 2009; National Sample Survey Organization 2010; Kumar, Mruthyunjaya, and Dey 2007), and are consistent with other research in India exploring food purchasing patterns (Ali, Kapoor, and Moorthy 2010; Kriesemer, Weinberger, and Chadha 2010) and preferences (Gupta 2009; Ali, Kapoor, and Moorthy 2010). The small percentage of our respondents who purchased from supermarkets matches Delhi (Minten, Reardon, and Sutradhar 2010) and country-wide market share data (Reardon, Timmer, and Berdegue 2004). At the same time, our in-depth interviews supported published research indicating rapid growth in the importance of supermarkets (Reardon and Minten 2011; Reardon *et al.* 2003). Given this trend, future research should further explore the relationship between supermarket purchasing and FV consumption over time (Hawkes 2008; Asfaw 2008; Tessier *et al.* 2008).

The finding that 26% of households were willing to pay more for pesticide-free FV, primarily for health reasons, is generally consistent with the limited available research in India (Birol *et al.* 2008). More households in our survey (41%) than in a 2010 survey of

market customers in Kolkata and Ranchi (20%) were aware of organic FV (without chemicals) (Kriesemer, Weinberger, and Chadha 2010). Future research should further explore consumer habits in purchasing organic FV.

Our findings suggest that affordability is particularly important to FV consumption in India, more so than physical access. This contrasts with research in many developed countries suggesting that access to FV plays an important role (Morland, Wing, Diez Rouz 2002; Cheadle *et al.* 1991; Inglis, Ball, and Crawford 2008; Kamphuis *et al.* 2006; Hill and Peters 1998). Factors such as income, age, and education have all been associated with FV intake in other countries (Darmon and Drenowski 2008; Ball, Crawford, and Mishra 2006; Subar *et al.* 1995; Nayga 1995; Hall *et al.* 2010; Thorne-Lyman *et al.* 2010). The only variable that emerged as significant in our regression models, however, was income. This association is consistent with country-wide trends suggesting that rising incomes are driving overall increases in demand for FV (Kumar, Mruthyunjaya, and Dey 2007).

This study has several limitations. First, our sample was small and limited, which demands caution in extrapolating results to a diverse country such as India. Furthermore, as noted, many respondents from wealthy areas of South Delhi declined to participate, which may have limited our findings related to supermarkets (Reardon, Henson, and Gulati 2010). Future research should overcome this sampling problem. Second, the key purchasing variables analyzed—FV purchasing frequency and per capita spending on FV—present only limited information and must be interpreted in the context of more detailed information about variables such as refrigerator ownership, type of store visited, and mode of transport. Third, our FV consumption data is limited to self-report (Willet 2001; Bharathi *et al.* 2008) and neglects quantities consumed, differences among types of FV, and seasonal changes (Lock, Pomerleau, and Causer 2004). Since consumption of different FV types has different health impacts and is likely affected by different factors, future research should separate results for different kinds of fruit and vegetables (Rose and Richards 2004). Additional research could also investigate how gender dynamics and familial hierarchy affect FV consumption.

Despite these significant limitations, our study provides important data to suggest that affordability and awareness of adequate FV consumption, not accessibility, are the main barriers to greater FV consumption in urban India. Furthermore, most respondents' pattern of walking to buy FV is desirable and important from a public health perspective.

Our primary data serves as a baseline from which researchers can track how changes in the food environment affect FV purchasing and consumption over time. Such longitudinal research could further elaborate associations among consumer characteristics and preferences, FV purchasing, and FV intake across income groups. Policymakers can use these data to help ensure that FV are safe, affordable, and easily accessible, especially compared to unhealthy foods.

Abbreviations

FV	Fruit and vegetable
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Figure 1.
Methodology

Table 1**Household-level data (*n* 245)**

Number of children (under age 20) in household	
No children (%)	24.8
1 child (%)	17.2
2 children (%)	24.4
3 or more children (%)	32.7
Household income	
Less than 3,000 INR/month (%)	2.4
3,000–10,000 INR/month (%)	60.0
10,001–20,000 INR/month (%)	25.7
20,001–30,000 INR/month (%)	6.9
30,001–40,000 INR/month (%)	2.0
40,001–50,000 INR/month (%)	.4
More than 50,000 INR/month (%)	1.2
Household asset ownership	
Television (%)	88.9
Refrigerator (%)	65.4
Microwave/toaster oven (%)	5.8
Car (%)	1.1
Bicycle (%)	36.5
Motorcycle or scooter (%)	33.9
Number of times buying FV per week	
Median	4
Mean	4.0
Time traveled to buy FV per trip	
Median (minutes)	15
Mean (minutes)	16.8 (95% CI 15.8–17.9)
Household per-capita spending per time buying FV	
Median (INR)	15
Mean (INR)	22.5 (95% CI 19.3–25.8)
Household per-capita spending on FV per week	
Median (INR)	48
Mean (INR)	82.5 (95% CI 56.1–109)
Percentage of household income spent on FV	
Median (%)	9.6
Mean (%)	14.4 (95% CI 12.3–16.5)

Table 2Information about female participants (*n* 234)

Demographic information	
Age (years)	
Median	37
IQR	14
Socioeconomic information	
Illiterate (%)	32.9
Median years of formal education (years)	5
Marital status (%)	
Married (%)	90.6
Single (%)	0.43
Widowed (%)	8.5
Divorced/separated (%)	0
Occupation	
Employed (%)	13.2
Housewife (%)	84.6
Unskilled manual laborer (%)	4.7
Skilled manual laborer (%)	3.4
Trained, clerical (%)	3.0
Religion	
Hindu (%)	67.9
Muslim (%)	30.3
Born in Delhi (%)	18.8
Born in Uttar Pradesh (%)	42.7
Born outside of Delhi and Uttar Pradesh (%)	38.5
Dietary information	
Vegetarian—does not eat meat or poultry (%)	30.8
Currently following a special diet (%)	4.7
Blood pressure and obesity	
Pre-hypertension (systolic blood pressure 120–139 mmHg or diastolic blood pressure of 80–89 mmHg) (%)	30.3
Hypertension (systolic blood pressure of >140 mm Hg or diastolic blood pressure of >90 mmHg) (%)	20.5
Central obesity (waist circumference 80 cm) (%)	65.3
Adult female respondents' mean frequency of consuming any FV (mean times/day)	2.5
Strawberries, pineapples, jamuns, or apples (mean times/day consumed)	0.26
Other seasonal fruit (mean times/day consumed)	0.35
Leafy greens, either raw or cooked (mean times/day consumed)	0.35
Other raw vegetables (mean times/day consumed)	0.51
Pickles or pickled foods (mean times/day consumed)	0.30
Other cooked vegetables (mean times/day consumed)	0.76

Table 3Correlation between factors for households with female respondents (*n* 234)

Factors	Correlation coefficient (significance)	
	Household per capita mean weekly spending on FV	Mean times female participant reported consuming fruit or vegetables weekly
Characteristics of household		
Estimated per capita income	0.32 (<i>p</i><.0001)	0.27 (<i>p</i><.0001)
Number of children in household	-0.19 (<i>p</i><.05)	-.071 (<i>p</i> =.3)
Frequency of FV purchasing	0.49 (<i>p</i><.0001)	0.05 (<i>p</i> =.44)
Household per capita mean weekly spending on FV	--	0.15 (<i>p</i><.05)
Characteristics of female participant		
Age	0.25 (<i>p</i><.01)	-0.028 (<i>p</i> =.69)
Female participant's years of formal education	0.20 (<i>p</i><.01)	0.14 (<i>p</i><.05)

Table 4Person named as primary FV purchaser for household (*n* 245)

Wife named as a primary FV purchaser	69%
Wife purchases most FV alone	23%
Head of household and wife together purchase most FV	42%
Head of household purchases most FV alone	17%