Motivations for Botanical Use by Socioeconomically Diverse, Urban Adults: Does Evidence Support Motivation?

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Abstract

Objective: The study objectives were to characterize botanical dietary supplement (BDS) use and to compare the motivations for botanical supplement (BS) use to the efficacy of the botanical in a socioeconomically and racially diverse urban adult population.

Methods: Subjects were from the Healthy Aging in Neighborhoods of Diversity across the Life Span (HANDLS) study, a 20-year prospective health disparities study with African American and white adults from Baltimore, Maryland. All study participants completed two dietary recalls and a dietary supplement (DS) questionnaire in Wave 3 ($n=2140$). Diet quality was evaluated by the Healthy Eating Index-2010 and the Mean Adequacy Ratio for 17 micronutrients. A comparison of reported motivations to efficacy reported in the literature of single BS was conducted.

Results: Approximately 50% (1062/2140) of participants took DS. Of these, 8% ($n=178$) reported taking either BS or BDS. It was found that BDS users had better diet quality than DS users as well as nonusers of DS. The top three motivations for BDS users were to improve overall health, to maintain health, and to supplement the diet. There is limited evidence for the efficacy of most BS. Review of the efficacy of the 15 BS reported by $\geq 5\%$ of the study population revealed beneficial health roles for only fiber, ginkgo biloba extract EGb 761, and hawthorn berry.

Conclusion: To the authors' knowledge, this study is the first to report a better quality diet with BDS use for a racially diverse urban population. Yet, improvement in diet is needed because overall quality did not achieve current recommendations. To improve overall health, it may be beneficial for this population to focus on dietary modifications to reduce the risks associated with chronic diseases. In general, the reported motivations for BS use were not supported by clinical evidence.

Keywords: botanical, dietary supplements, motivation, treatment efficacy

Introduction

THE MOST COMMONLY USED complementary health approach in the United States since 2002 is the use of nonvitamin, nonmineral (NVNM) dietary supplements (DS).¹ Complementary health approaches are often employed to improve health and well-being and, in the United States, to complement conventional care. Globally, the DS market is growing. This growth has been associated with an

increase in the aging population, life-style diseases, and healthcare cost. Data from the 2015 Council for Responsible Nutrition Consumer Survey on Dietary Supplements documented an increase in U.S. adult usage of herbs and botanicals by 5%, from 26% to 31% between 2014 and 2015.² Botanical supplements (BS) are projected to be the largest market for DS in 2020.³

A botanical is a plant or plant component utilized for its medicinal qualities or other remedial purposes.⁴ It can be

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classified as a DS if it meets all the criteria, as defined by the Dietary Supplement Health and Education Act of 1994.⁵ In the literature, botanicals are categorized as single or multiple botanical ingredient(s) (BS), NVNM DS with botanicals,^{6–8} or vitamin/mineral DS that contain botanical ingredients (botanical dietary supplements [BDS]).⁹

Few studies have exclusively examined BDS use. Data from a nationally representative sample examined in the National Health and Nutrition Examination Survey (NHANES), 2003–2006 ($n = 18,758$), documented about 20% of U.S. adults used a DS containing one or more botanical ingredients.⁹ Schaffer et al. reported that 28.3% of a population ($n = 15,985$) enrolled in a health maintenance organization used botanicals,¹⁰ while van Breemen et al. reported that 79% of women aged 40–60 years ($n = 500$) from the University of Illinois at Chicago health clinics used BS.¹¹ This high prevalence rate may be attributed to the fact that these individuals were already visiting health clinics and therefore may have been more motivated to take a supplement for their health.

Botanicals possess known active ingredients, as well as unknown ingredients, which can pose a challenge to nutritionists and other health professionals. They have been found to have protective effects against inflammation, cardiovascular disease, cognitive decline, and other age-related diseases in humans and rodents.¹² In *Drosophila*, the interaction of botanicals with macronutrients may modulate life-span, promoting healthy aging.^{13,14} However, botanicals can also interact with nutrients and/or prescription drugs, potentially resulting in adverse health effects.¹⁵ The lack of ingredient labels on botanical products, the quality of the extracts used, potential contamination, dosages, and toxicities raise concerns about the safety and potential risks of BDS.^{4,11} Additionally, botanical use is underreported to healthcare providers.^{16,17}

NHANES 2007–2010 data revealed that the most common motivations for use of DS (including vitamins, minerals, botanicals, and NVNM supplements) were to improve overall health and to maintain health. Use of supplements by these NHANES participants was associated with lower body mass index (BMI), abstinence from smoking, more exercise, moderate alcohol use, and “very good” to “excellent” reported health compared with nonusers.¹⁸ The motivations for use of BS have not been extensively studied in socioeconomically diverse, urban African American and white populations, namely the Healthy Aging in Neighborhoods of Diversity across the Life Span (HANDLS) study participants. Unlike NHANES participants, HANDLS study respondents, who consume a diet that scored lower on the Healthy Eating Index (HEI)-2010 than the national average derived from NHANES data, tend to be overweight or obese and smoke.¹⁹ The primary objective of this study was to characterize BS use in a socioeconomically and racially diverse urban adult population. The secondary objective was to compare the motivations for BS use to the efficacy of the botanical.

Methods

HANDLS study sample

The HANDLS study was designed to explore the roles of race and socioeconomic status (SES) on health disparities with respect to cardiovascular and cerebrovascular diseases and cognitive function. The study design and aims of the HANDLS study, a 20-year prospective study, have been de-

scribed in detail elsewhere.²⁰ Participants were drawn from 32,959 households in 13 predetermined Baltimore neighborhoods, yielding representative distributions of individuals between 30 and 64 years old who were African American (AA) and white (W), male and female, and with a range of SES (operationalized by household incomes below or above the 2004 125% of the Federal poverty guidelines). In the baseline HANDLS study, 3720 AA and W participants were enrolled and examined between August 2004 and March 2009. Of these participants, 2468 were reexamined in Wave 3 between June 2009 and July 2013. This study's sample included only Wave 3 participants who completed both dietary recalls and the DS questionnaire ($n = 2140$). In this sample, 61.5% ($n = 1316$) were AA and 38.5% ($n = 824$) were W.

Wave 3 of the HANDLS study consisted of two phases. The first phase was done on the Mobile Research Vehicles (MRV). This phase consisted of the first dietary recall, a physical examination, cognitive evaluation, a variety of physiological assessments, muscle strength and bone density, and laboratory measurements. The second phase included the second dietary recall and DS questionnaire, completed by phone 4–10 days later. The protocol and a complete listing of the examinations can be found on the HANDLS study website (<http://handls.nih.gov/>). The study protocol was approved by Institutional Review Boards at the National Institute of Environmental Health and University of Delaware. All HANDLS participants provided written informed consent and were compensated monetarily.

Socio-demographic variables

Socio-demographic variables included age, sex, race, SES, self-reported health, education, and literacy. In the baseline HANDLS study, general literacy was assessed by trained examiners on the MRV, using the reading subtest of the Wide Range Achievement Test—3rd Edition (WRAT-3), a widely validated and used measurement of literacy.^{21,22} The Rapid Estimate of Adult Literacy in Medicine (REALM)—a word recognition test focusing on medical words and pronunciation from simple to more complex, multisyllabic words—was performed during Wave 3 to assess health literacy.²³ The WRAT-3 was found to be highly correlated with REALM.

BMI (kg/m^2) was calculated from measured weight and heights. Weight was obtained using a calibrated Med-weigh, model 2500 digital scale, and height was measured with the participant's heels and back against a height meter supplied by Novel Products, Inc.

Diet and DS variables

Two dietary recalls were conducted by trained interviewers using the USDA Automated Multiple Pass Method (AMPM).^{24,25} Dietary recalls were coded using Survey Net, matching foods consumed with eight-digit codes in the Food and Nutrient Database for Dietary Studies.²⁶ After the second recall, the DS questionnaire was administered. Detailed information was collected about over-the-counter BS, BDS, vitamin and/or mineral supplements without botanicals (DS), antacids, and prescription supplements. Information collected included supplement use over the past 24 h, past month, and total length of time taken. The HANDLS study DS database was developed and is maintained by trained nutritionists and registered dietitians based on supplements reported. The

questionnaire and detailed descriptions about the collection and processing of DS data are published elsewhere (<https://handls.nih.gov/06Coll-w03DietSupplements.htm>).

Nutrient-based diet quality was calculated from reported food and beverage intake with and without nutrients from supplements over the past 24 h. The proportion of 17 micronutrients—namely calcium, magnesium, selenium, phosphorus, vitamin A, vitamin C, vitamin D, vitamin E, vitamins B₆ and B₁₂, folate, iron, thiamin, riboflavin, niacin, copper, and zinc—was compared to the Recommended Dietary Allowance (RDA).²⁷ The following formula was used to determine the nutrient adequacy ratio (NAR): Subject's daily intake of nutrient/RDA of nutrient. An adjustment of an additional 35 mg of vitamin C was applied to the RDA for participants who were current smokers.²⁸ The NAR of each nutrient was then converted to a percentage, and percentages >100 were truncated to 100. The mean adequacy ratio (MAR), a measure of total quality of the diet, was calculated using the following formula: MAR = Sum of all 17 nutrient NARs/17. Two MAR scores were used in analysis: a Diet MAR score was calculated using only NAR scores based on both dietary recalls, and a Diet + Supplement MAR score was calculated using nutrients from both dietary recalls plus nutrients from supplements.

Food-based diet quality was evaluated with the HEI-2010. The National Cancer Institute's Applied Research Web site provided the basic steps for calculating the HEI-2010 component and total scores and statistical code for 24 h recalls (<http://appliedresearch.cancer.gov/tools/hei/tools.html>). A detailed description of the procedure used for this study is available on the HANDLS website (<http://handls.nih.gov/06Coll-dataDoc.htm>). Component and total HEI-2010 scores were calculated for each recall day and were averaged to obtain the mean for both days combined.

For each supplement reported, an open-ended question about motivations for use was asked by interviewer. Participants could provide more than one reason. The interviewer recorded the response and assigned it a categorical value. For this study, antacid and prescription supplements were excluded in analyses.

Literature search strategy

Prior to the literature review, a listing of all the single botanicals reported was created. There were 251 single botanicals reported, which were categorized into 39 groups, ranging in use from <5% to 21%. The decision was made to compare the motivation to efficacy for only BS reported by ≥5% of the study population, resulting in a total of 15 single botanicals. As shown in Table 1, the most commonly reported BS were garlic (*Allium sativum*), flaxseed (*Linum usitatissimum*), and ginkgo biloba (*Ginkgo biloba*). The remaining 12 botanicals with their percent usage are reported in Table 1. It should be noted that rose hips was consumed by 16% of the sample but since this botanical was in combination with vitamin C it was not included in the single botanical listing. The primary motivation for taking rose hips was to prevent colds and boost the immune system. It should also be noted that there were no relevant clinical trials found for milk thistle relating to overall health, nails, hair, cleanse, appetite, or weight. Therefore, only reviews concerning the liver were included.

TABLE 1. USAGE OF BOTANICAL SUPPLEMENTS BY HANDLS STUDY PARTICIPANTS

Botanical	%
Garlic (<i>Allium sativum</i>)	21
Flaxseed (<i>Linum usitatissimum</i>)	16
Ginkgo (<i>Ginkgo biloba</i>)	16
Glucoamine chondroitin	11
Milk thistle (<i>Silybum marianum</i>)	11
Cinnamon (<i>Cinnamomum cassia</i>)	11
Echinacea (<i>Echinacea purpurea</i>)	9
Evening primrose (<i>Oenothera biennis</i>)	9
Black cohosh (<i>Cimicifuga racemosa</i> and <i>Actaea racemosa</i>)	7
Ginseng (<i>Panax ginseng</i>)	7
Turmeric (<i>Curcuma domestica</i>)	7
Bilberry (<i>Vaccinium myrtillus</i>)	5
Fiber	5
Hawthorn berry (<i>Crataegus species</i>)	5
Saw palmetto (<i>Sabal serrulatum</i>)	5

Only single botanicals used by ≥5% of the study population are reported.

HANDLS, Healthy Aging in Neighborhoods of Diversity across the Life Span.

Electronic searches were performed using PubMed/MEDLINE, The Cochrane Library, the National Center for Complementary and Integrative Health's "Herbs at a Glance," the National Institutes of Health's Office of Dietary Supplements, and the University of Maryland Medical Center Complementary and Alternative Medicine Guide. Keywords included the scientific and common botanical name and keywords related to motivations listed in Table 1 and Supplementary Table S1 (Supplementary Data are available online at www.liebertpub.com/acm). The initial review included articles from January 2010 to March 2016, focusing on systematic reviews and systematic reviews with meta-analyses. If no relevant articles or trials were found, then review articles or single randomized control trials that pertained to the primary motivation were sought. For single clinical trials, a Jadad score was calculated independently by three researchers, and only studies with a score of ≥4 were included.²⁹ Lastly, if no relevant articles or trials that pertained to the primary motivation existed within the time frame of January 2010 to March 2016, the search was extended from January 2005 to March 2016. The only articles cited for efficacy of a claim were published between 2007 and 2016.

Statistical analyses

Means and standard errors for continuous variables and proportion of participants for relevant categorical variables were calculated. Analysis of variance (ANOVA) was used to compare socio-demographic and life-style factors across DS categories, and *p*-values were adjusted for multiple comparisons of continuous variables using the Bonferroni test. The first set of analyses compared persons taking only BS with persons taking BDS. Since there were no differences in demographic or life-style characteristics between persons using BS and participants using BDS, these two groups were aggregated. The second set of ANOVAs compared users of BDS to nonusers of DS (NDS) and to users of DS. NDS and users of DS were also compared. Chi square analyses were performed to compare motivations

between users of BDS and DS. All analyses were performed with IBM SPSS Statistics for Windows v23. For all statistical analyses, $p < 0.05$ was considered significant.

Results

There were 1062 users of DS of the 2140 Wave 3 HANDLS study sample. Among DS users, 56 people took BS, 122 consumed BDS, and 884 reported using DS. HANDLS study participants who reported using only botanicals tended to be women (36/56), W (34/56), non-smokers (13/56), and had a high SES (45/56). Their health literacy score was 61.7 ± 1.2 , and their general literacy was 43.3 ± 10.9 , equivalent to a 12th grade reading level. On average, these people completed 14 years of education.

As shown in Table 2, compared with nonusers of supplements, people taking supplements with botanicals or solely botanicals were older and had more years of education, higher overall literacy and health literacy scores, and better diet quality, measured by the Diet MAR score and the Diet + Supplement MAR score, as well as the HEI-2010. The BDS group was composed of more women and fewer AAs. There were no differences in self-reported health, energy intake, or BMI.

More Ws compared with AAs composed the BDS group. In contrast, more AAs compared with Ws comprised the DS group (Table 2). The only differences found between DS and BDS users were education, SES, and diet quality. Again, users of BDS had more years of education, more income, and better dietary quality based on Diet MAR, Diet + Supplement MAR, and HEI-2010 scores.

The top three motivations, in descending order, for BDS users were to maintain health, to improve overall health, and to sup-

plement the diet (Table 3). Compared with DS users, significantly more BDS users reported these motivations. Unlike the BDS group, DS users' top motivation was doctor recommended. The next two most frequently reported motivations were the same as the BDS group. Motivations to promote energy, the health of specific systems such as cardiovascular and gastrointestinal, and to boost the immune system were more common reasons than those targeted to men's or women's health-related issues, eye health, or mental health. There were no differences with respect to the reasons "doctor recommended" or "for bone health" between BDS and DS users (Table 3).

The evidence to support or refute the motivations for use of reported botanicals is provided in Supplementary Table S1. With the exception of fiber,^{30–33} ginkgo biloba extract,^{34–36} and hawthorn berry,^{37–39} the reasons for use were not supported by clinical evidence.^{40–68}

Discussion

To the authors' knowledge, this study is the first to report a better quality diet with BDS usage. While botanicals themselves do not have any innate nutritional value, users of supplements with botanicals had higher HEI-2010 scores than nonusers or users of supplements without botanicals, indicating a higher food-based diet quality. However, this finding must be interpreted with caution, since the overall HEI-2010 scores indicated <50% compliance with the Dietary Guidelines for Americans, suggesting different food choices are needed. Additionally, nutrient diet quality was also higher, as evidenced by the higher MAR score. Not only did BDS users have higher Diet + Supplement MAR scores, which would be expected due to the vitamin and mineral nutrient content in

TABLE 2. CHARACTERISTICS OF HANDLS STUDY PARTICIPANTS (N=2140) CATEGORIZED BY DIETARY SUPPLEMENT USE

Socio-demographic and lifestyle factors	Nonusers (n=1078)	Comparison of nonusers to users of BDS ^a (n=178)	Comparison of nonusers to users of DS ^b (n=884)	p-Value for BDS to DS user comparison
Age, baseline, years	46.5 ± 0.3	49.6 ± 0.6***	49.4 ± 0.3***	0.969
Age ^c , Wave 3, years	51.7 ± 0.3	54.7 ± 0.6***	54.6 ± 0.3***	0.999
African American	709 (65.7%)	83 (46.6%)***	524 (59.3%)**	0.003
Female	585 (54.2%)	119 (66.9%)**	556 (62.9%)***	0.317
Literacy ^d	40.5 ± 0.4	44.1 ± 0.8**	42.4 ± 0.4**	0.203
Health literacy ^e	57.6 ± 0.4	61.8 ± 0.6***	59.9 ± 0.4**	0.147
Education, years	12.1 ± 0.1	13.9 ± 0.2***	12.7 ± 0.1***	<0.001
SES ^f	480 (44.5%)	40 (22.5%)***	331 (37.4%)**	<0.001
Self-reported health ^g	229 (29.2%)	47 (34.1%)	178 (27.9%)	0.314
Body mass index, kg/m ²	30.1 ± 0.2	31.2 ± 0.6	31.2 ± 0.3**	0.998
Energy, kcal	2043 ± 26	2044 ± 68	1995 ± 28	0.768
Diet MAR ^h Score	72.6 ± 0.4	78.0 ± 1.0***	74.8 ± 0.5**	0.016
Diet + Supplement MAR ^h	72.7 ± 0.4	90.1 ± 0.8	85.2 ± 0.4***	<0.001
HEI-2010 ⁱ Score	41.0 ± 0.4	48.8 ± 1.4	44.2 ± 0.5***	<0.001

Values for continuous variables expressed as mean ± standard error; categorical variables expressed as N (%).

^ap-Value for nonuser to BDS user comparison: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

^bp-Value for nonuser to DS user comparison: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

^cAge range was 32–70 years.

^dMeasured with WRAT—3rd edition.²¹

^eMeasured with REALM.²³

^fSES, categorized as <125% of 2004 Federal poverty guidelines.

^gRated health as very good or excellent.

^hMAR based on the intakes of 17 micronutrients. Maximum score=100.

ⁱHEI-2010, maximum score of 100 means optimal compliance to *Dietary Guidelines for Americans*.

BDS, botanical dietary supplement; DS, dietary supplement without botanicals; WRAT, Wide Range Achievement Test; REALM, Rapid Estimate of Adult Literacy in Medicine; SES, socioeconomic status; MAR, mean adequacy ratio; HEI-2010, Healthy Eating Index.

TABLE 3. MOTIVATIONS FOR DIETARY SUPPLEMENT USE BY HANDLS STUDY PARTICIPANTS

Motivations	DS users (n = 884)	BDS users (n = 178)	p-Value ^a
To supplement diet	17.69 ± 0.01	30.90 ± 0.03	<0.001
To improve overall health	18.48 ± 0.01	30.90 ± 0.03	<0.001
Doctor recommended	21.20 ± 0.01	19.66 ± 0.03	0.645
For bone health	17.01 ± 0.01	18.54 ± 0.03	0.622
To maintain health	12.70 ± 0.01	31.46 ± 0.03	<0.001
For enhanced energy	11.11 ± 0.01	23.03 ± 0.03	<0.001
For heart health	7.94 ± 0.01	28.09 ± 0.03	<0.001
To boost immunity, to prevent colds	6.58 ± 0.01	18.54 ± 0.03	<0.001
For gastrointestinal health	5.22 ± 0.04	17.98 ± 0.03	<0.001
For healthy joints, prevent arthritis	3.97 ± 0.01	16.29 ± 0.03	<0.001
For hot flashes, breast cancer	2.38 ± 0.01	8.99 ± 0.02	<0.001
For mental health	0.57 ± 0.00	6.18 ± 0.02	<0.001
For eye health	0.45 ± 0.00	5.62 ± 0.02	<0.001
For prostate health, cancer treatment	0.34 ± 0.00	5.62 ± 0.02	<0.001

Values are expressed as percentage ± standard error.

^aChi square or difference between users of dietary supplement with botanicals with users of dietary supplements without botanicals.

many BS, but they also had higher Diet MAR scores. This finding indicates that higher NAR and MAR scores are not simply due to supplementation, but that BDS users actually have a better diet than DS users and NDS do.

Approximately 8% of the HANDLS study population reported taking either BS or BDS. Similarly, 7.5% of the NHANES 2007–2010 population used BDS.¹⁸ A higher prevalence of BS use was reported in studies using the National Health Interview Survey. Investigators found that 17.7% of adults reported using “NVNM natural products.”^{17,69} These differences in prevalence may be due to the inconsistent classification and definitions of NVNM, herbs, and botanicals.⁷⁰ The creation of a more uniform definition is needed in order to compare findings when analyzing DS and botanical data.

Characteristics of BDS users of the HANDLS study population were consistent with other studies that examined BDS usage, with a higher prevalence of women,¹⁸ older people,⁹ Ws, greater education levels, and highly rated self-health.¹⁰ Usage of BDS by AAs was about 46.6%, reflecting roughly the same percentage (45.5%) reported by van Breeman.¹¹ However, van Breeman found the use of BDS was greater among AAs than among Ws, which was not true for the HANDLS study.

BS are typically utilized for medicinal purposes. The most common motivation for BDS among NHANES 2007–2010 participants was “to improve overall health.”¹⁸ This reason was also one of the three most common motivations for HANDLS study participants. The other common motivations were to “maintain health” and to “supplement the diet.” Evidence for the beneficial health roles only currently exists for fiber,^{30–33} ginkgo biloba,^{34–36} and hawthorn berry.^{37–39} However, there is increased risk of bleeding when ginkgo and hawthorn berry are taken with blood-thinning drugs.⁷¹

Among peri- and postmenopausal women, a primary reason to consume BDS is to treat menopausal symptoms,

notably hot flashes, night sweats, and mood swings.¹⁶ Women in the HANDLS study reported the reason for use of black cohosh and evening primrose oil was hot flashes. Unfortunately, the evidence on efficacy of these botanicals is mixed.^{41–44,50–53} Sharing findings of clinical studies with consumers is important, as is the importance for health professionals to be knowledgeable about the clinical evidence related to efficacy and safety of botanicals.

Despite better diet quality with botanical usage, the mean BMI of the study population indicated overweight/obesity, a risk factor for many chronic conditions. Given the motivation to improve overall health, it may be more beneficial for this population to limit their BDS use and focus on improving the quality of their diet through other methods. Perhaps health professionals should develop interventions that assist individuals to develop the skills to modify food choices and preparation methods within their budgets. Dietary changes can improve nutritional status, thereby improving health and reducing risks associated with chronic conditions.

This study has several strengths. First, it focused on a unique, understudied, relatively large AA and W urban population who are at higher risk of health disparities and who are vulnerable to unhealthy eating practices. Second, the measures of diet quality were based on dietary data collected from two 24 h recalls, which likely represents typical intakes. The method used to collect the recalls has been shown to provide valid intakes for normal and overweight individuals²⁴ and better energy estimations compared with intakes based on food frequencies.⁷² As with any research, there are limitations. First, although DS questionnaire and dietary recall interviews were administered, there is still potential for biased data due to underreporting. Energy intake collected by the AMPM has been reported to be underreported by normal weight individuals by 3% and by overweight individuals by 16% when compared with the doubly labeled water technique.²⁴ Second, results describe an urban population that resided in Baltimore, Maryland. Although the findings cannot be generalized to a national population, independent demographic analyses found this population representative of populations from 14 U.S. cities with similar population densities and racial distribution.⁷³ Last, no information on botanical use as adjunctive therapy was gathered by the DS questionnaire.

In conclusion, maintenance of health is the top motivator for use of supplements that contain botanicals or single BS. This finding differs from the top motivation of users of supplements that do not contain botanicals, namely doctor recommended. As anticipated, the Diet + Supplement MAR scores of DS users were significantly higher than those for non-users. Diet quality of users of BDS was significantly higher than for users of DS. These groups were similar with respect to literacy and health literacy, energy intake, self-reported health, and BMI. Perhaps the higher SES and education levels of the users of BDS contributed to healthier food choices. However, the HEI-2010 scores revealed that this urban population was only 50% compliant with current dietary recommendations.

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