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Ten-Year Trends in Children's Fruit and Vegetable Knowledge, Intent and Behavior

Review Article

Sutcliffe JT^{1*}, Carnot MJ², Palmer. SE³, Elliott E⁴¹ Associate Clinical Professor, Health Sciences, Northern Arizona University, USA.² Associate Professor, Counseling, Psychology & Social Work, Chadron State College, USA.³ Associate Dean, College of Health & Human Services, Northern Arizona University, USA.⁴ Ware Distinguished Professor, College of Physical Activity and Sport Sciences, West Virginia University, USA.

Abstract

This is a report of ten-year trends in US fifth-grade student knowledge of fruit and vegetable (FV) recommendations, behavioral intent, consumption, and relationships between FV knowledge, behavioral intent and behavior. The study was conducted from 2001-2011 through the Healthy Hearts for Kids (HH4K) online instructional program. A total of 17,559 students from 1,048 schools in 49 US states participated. ANOVA and Pearson product-moment correlations were calculated for all variables. Significant changes over the 10-years were found for knowledge of FV recommendations, fruit consumption, intention to consume FV immediately and in one year, and to choose fruits rather than candy tomorrow and in one year. Effect size was small for all variables. No significant changes in vegetable consumption were found. Generally, data revealed significant correlations between behavior and intent items, but not knowledge. Despite ongoing efforts to inform children about FV consumption, there has been minimal change in fifth-grade children's overall FV knowledge, behavior and intent, revealing a need for more than just knowledge based education and interventions. It is critical that effectiveness, sustainability and scalability be considered with future interventions.

Keywords: Children; Fruit and Vegetable Knowledge; Consumption; Behavioral Intent.

***Corresponding Author:**

Jay T. Sutcliffe PhD, RD,
Associate Clinical Professor, Health Sciences, Northern Arizona University, PO Box 15095, Flagstaff, AZ 86011-5095, USA.
Tel: ((928)523-7450
Fax: (928)523-0148
E-mail: jay.sutcliffe@nau.edu

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Introduction

The need to improve the overall dietary habits of children has received extensive attention in recent years, due to a significant increase in the incidence of childhood obesity over the past three decades. The percentage of children aged 6–11 years in the United States who were obese increased from 7% in 1980 to nearly 20% in 2008 according to the National Health and Nutrition Examination Survey (NHANES) [1]. Children and adolescents who

are obese are much more likely to be obese as adults and are at an increased risk for chronic diseases [2, 3].

A primary indicator of dietary quality is fruit and vegetable (FV) consumption. Researchers have found that children need to increase the consumption of FV, whole grains, and legumes and decrease their intake of saturated fat, sodium, and extra calories [4, 5]. Current consumption patterns are not meeting the Dietary Guidelines for Americans' recommendations, especially in regards to FV intake [6, 7].

Several initiatives have been developed to increase FV consumption to meet the recommendations of the Dietary Guidelines [8-10]. Knowledge about recommended FV consumption having a positive correlation with actual FV consumption has been mixed [11-14]. Per capita intakes of vegetables decreased from 1989 to 2010 for 2-18 year olds. Fruit consumption decreased from 1989 to 1991 and through the 2003 to 2006 periods and subsequently increased in 2009-2010 [15].

Lien et al [16] found that behavioral intent to consume FV had no significant effects on attitudes and subjective norms on behavior. Anderson et al [17] found behavioral intention was correlated with increased fruit consumption but not vegetable consumption for primary school children. Several researchers have found that when intent was measured as willingness and motivation by adults to consume FV, it was the strongest predictor of FV intake [18, 19].

Web-based health literacy programs are one of many types of interventions designed to promote a healthy lifestyle among youths [20-22]. Many resources have been directed to increasing FV consumption in the past ten-years, but the impact on dietary health literacy is unclear.

Healthy Hearts for Kids (HH4K) was developed in 2001 as one of the first web-based instructional modules for schools to increase health knowledge and improve health attitudes and behaviors. HH4K has been used by approximately 17,500 fifth-grade children from 49 US states between 2001 and 2011. HH4K includes a survey of FV knowledge, behavior and behavioral intent prior to students completing online lessons. This data can be used to investigate trends in health literacy. In this study, we report 10-year trends in fifth-grade student knowledge of FV recommendations, FV behavioral intent and FV consumption. We also report the relationships between FV knowledge, behavioral intent and actual behavior.

Materials and Methods

Study Population

This study presents an analysis of secondary data collected through HH4K. Teachers registered to use HH4K online and were prompted to enter school and student information. From 2001-2010, student information entered included gender, ethnicity and age except in 2001, 2006, 2008 and 2009, Ethnicity and age were not reported in 2010. A total of 17,559 children, primarily 5th graders aged 10-11, from 1048 schools and 49 states were enrolled to use HH4K. The survey was administered to enrolled students when they logged on to HH4K the first time. Data was collected with each new cohort of students on a yearly basis from 2001 – 2011. Data from 2006 was lost due to a corrupt data file. Gender, ethnicity and age of student participants as reported by teachers are displayed in Table 1.

As use of HH4K expanded to more US states and more schools registered to use the instructional module with their students, the schools continued to be predominately rural, with over half clas-

sified as rural, an average of about 30% designated urban, and less than 10% were inner-city schools. Table 2 provides a snapshot of school demographics over three years during data collection.

The Institutional Review Board (IRB) at Northern Arizona University approved this analysis of secondary data.

Measures

When students first logged on to HH4K, they were asked to complete a 23-item pre-survey that included questions addressing behavior, behavioral intent and knowledge for nutrition, tobacco and physical activity. The survey was derived from the Youth Risk Behavior Surveillance System (YRBSS) [23, 24] and validated instruments used in the Sport, Play and Active Recreation for Kids (SPARK) [25].

Two items required subjects to indicate how often in the past they ate FV (e.g. During the past 7 days, how many times did you eat vegetables). Answer choices included "I did not eat vegetables during the past 7 days," 1-3 times, 4-6 times, and 1, 2, 3 or 4 or more times per day". These responses were assigned numerical values from 1–7.

Behavioral intent items required subjects to indicate how likely they were to eat FV tomorrow, and in one-year. Additionally, subjects were asked how likely they would choose fruit rather than candy or cookies tomorrow and one year from now. Answer choices were based on a five-point Likert-type scale (I definitely will not, probably will not, about a 50/50 chance, probably will and definitely will). Higher scores indicate a greater intention for that particular behavior.

The FV knowledge test item was developed from HH4K instructional objectives and was part of a knowledge pre-test administered before each respective health literacy [21]. A total of 29 knowledge items were included, but this analysis is focused on an item that required subjects to identify the number of FV servings that were recommended each day. This item was scored as either incorrect (0) or correct (1).

Table 1. Participant Characteristics.

	2002	2003	2004	2005	2007	2010
Boys	1093	2606	2013	8816	13396	1804
Girls	1052	2597	1950	8668	13082	1813
Not reported	585	273	653	2363	2772	76
Ethnicity						
Asian	4	30	14	73	294	
Black	41	171	81	350	583	
Hispanic	20	91	178	390	669	
Native American	20	37	22	82	85	
White	1620	3006	1984	10165	15026	
Other	23	29	16	85	613	
Not reported	1002	1847	2299	8702	11977	
Age						
Mean	10.8	10.9	11	10.8	10.7	
SD	1.06	0.99		1.08	1.17	
Range	5-15	5-15	8-14	5-15	5-15	

Table 2. Participating School Characteristics.

	2002-2003	2003-2004	2007-2008
# States	13	36	44
Total # schools	181	451	957
#/% Rural	138 / 76%	258 / 57%	558 / 58%
#/% Urban	39 / 22%	167 / 37%	323 / 34%
#/% Inner-City	4 / 02%	26 / 06%	76 / 08%

Results

Data Analysis

One-way ANOVAs with year as the factor (9 levels) was used to examine changes across time in FV consumption knowledge, behavior intent and behavior. Bonferroni post hoc procedures were used to identify significant differences. The Pearson product-moment correlation was used to examine the relationship between knowledge about healthy consumption, intended consumption and actual behavior. SYSTAT software version 13.1 was used for all analysis (Systat Software, Inc. San Jose, CA USA).

Change in Health knowledge

A one way ANOVA to look at differences in knowledge about FV consumption across years yielded significant differences across time ($F(8, 7805) = 9.118, p < .0001, MSE = .225, \text{Eta squared} = .009$). Bonferroni post hoc tests identified that 2001 – 2002 and 2002 – 2003 were significantly different from all other years except for 2005-2006. 2005-2006 was different than 2008 - 2009 and 2010 – 2011. Mean correct response rate of knowledge items and also mean fruit consumption and vegetable consumption are displayed in Table 2.

Change in Health Behaviors: Fruit and Vegetable Consumption

A one-way ANOVA to look at differences in weekly fruit consumption over the past 10 years yielded significant differences across school years ($F(8, 17548) = 7.579, p < .001, MSE = 3.608, \text{Eta squared} = .003$). Bonferroni post hoc tests indicated that 2009 - 2010 and 2010 - 2011 were different from 2001 - 2002, 2003 - 2004, and 2004 - 2005. Results in 2003 - 2004 and 2007 - 2008 were also different (see Table 1). A one way ANOVA to look at differences in weekly vegetable consumption over the past 10 years yielded no significant differences across school years ($F(8, 17548) = 1.295, p = 0.241, MSE = 3.356, \text{Eta squared} = .001$) (Table 3).

Changes in Behavioral Intent

Table 3 presents the mean, median and standard deviations for the behavioral intent variables. A one-way ANOVA yielded significant differences across school years in the likelihood of making a fruit snack choice tomorrow ($F(8, 17550) = 13.951, p < .0001, MSE = 1.350, \text{Eta squared} = .006$). Based on Bonferroni post hoc tests, 2010-2011 was different from all other years. 2007-2008 and 2008-2009 were different from all previous years. 2009-2010 and 2010-2011 were also different from each other. Intent to make a

fruit snack choice one year from now also changed in the 10 year time period ($F(8, 17550) = 19.408, p < .0001, MSE = 1.256, \text{Eta squared} = .009$). Based on Bonferroni post hoc tests, 2010 – 2011 was different from all other years. 2005 – 2006 was different than 2003 - 2004 and 2004 - 2005.

There were also significant changes in the ten year time period in the likelihood of eating five FV tomorrow, ($F(8, 17550) = 16.292, p < .0001, MSE = 1.314, \text{Eta squared} = .007$). Based on Bonferroni post hoc tests, 2010 - 2011 was different from all other years. 2003 - 2004 and 2004 - 2005 were also different from each other. Similarly there were changes across time in the likelihood of eating five FV one year from now, ($F(8, 17550) = 19.408, p < .0001, MSE = 1.256, \text{Eta squared} = .009$). Based on Bonferroni post hoc tests, 2010 – 2011 was different from all other years. 2005 – 2006 was different than 2003-2004 and 2004- 2005 (Table 4).

Relationship between FV Knowledge, Behavior and Intent

Pearson Product moment correlations between knowledge about optimal FV consumption and intended and actual behaviors indicated no significant correlations, with the exception of a correlation between fruit consumption in the past week and knowledge ($r = -.029, p < .05$). All other intent and behavior variables were significantly correlated ($p < .001$) (Table 5).

Health Knowledge

There was a statistically significant improvement in knowledge of the recommended number of servings of FV from 2001-2011. The small effect size, however, suggests true change is minimal. Despite no meaningful change, the knowledge scores in this study reveal a higher correct rate than in other investigations [13, 27]. Researchers have suggested that a lack of adequate knowledge is a primary reason for low FV intake [13, 28].

The increase in knowledge has been reported in the U.S. and Australia, indicating that messages being provided through educational means, primarily via social marketing and emphasizing a specific number of servings of FV per day, have been effective [29].

Health Behaviors (Self-Reported Consumption)

The ten-year trends for fruit intake reveal a statistically significant increase in consumption over time. This is consistent with Anderson et al [17], Pettigrew et al [27], and Fischer et al [30]. However, the ten-year trends for vegetable consumption remained flat (unchanged). This is also consistent with Anderson et al [17] and Fischer et al [30]. One concern is that popular choices include fruit juice and fried potatoes, which are considered less nutrient dense than several other potential FV choices [31].

Table 3. Change Across Time in Knowledge about Fruit and Vegetable Consumption and Fruit and Vegetable Consumption Reports.

Year	Correct response rate of knowledge of recommended servings of FV/day				Vegetable consumption in past 7 days				Fruit consumption in past 7 days			
	Mean	SD	n	Median	Mean	SD	n	Median	Mean	SD	n	Median
2001 – 2002	0.55	0.5	606	1	3.6	1.78	1073	3	3.79	1.87	1073	3
2002 – 2003	0.54	0.5	319	1	3.61	1.84	706	3	3.74	1.93	706	3
2003 - 2004	0.64	0.48	1796	1	3.56	1.77	3440	3	3.75	1.85	3440	3
2004 - 2005	0.68	0.47	970	1	3.66	1.82	2271	3	3.84	1.89	2271	3
2005 - 2006	0.62	0.49	810	1	3.63	1.83	1919	3	3.91	1.91	1919	3
2007 - 2008	0.67	0.47	1166	1	3.67	1.89	3120	3	4	1.9	3120	4
2008 – 2009	0.7	0.46	870	1	3.59	1.85	2348	3	3.88	1.95	2348	3
2009 – 2010	0.68	0.47	709	1	3.68	1.87	1842	3	4.04	1.93	1841	4
2010 – 2011	0.71	0.46	568	1	3.69	1.82	839	3	4.12	1.9	839	3

Table 4. Change Across Time in Intention to Select Fruit and Intention to Eat Specified Fruit and Vegetable Quality.

Year	Intention to choose fruit rather than candy/cookies tomorrow				Intention to choose fruit rather than candy/cookies one year from now				Intention to eat five fruits and vegetables tomorrow				Intention to eat five fruits and vegetables a day one year from now			
	Mean	SD	n	Median	Mean	SD	n	Median	Mean	SD	n	Median	Mean	SD	n	Median
2001 – 2002	3.12	1.2	1074	3	3.29	1.11	1073	3	3.15	1.13	1074	3	3.45	1.1	1074	3
2002 – 2003	3.12	1.18	706	3	3.22	1.11	706	3	3.17	1.18	706	3	3.37	1.18	706	3
2003 - 2004	3.14	1.14	3440	3	3.25	1.07	3440	3	3.14	1.14	3440	3	3.45	1.13	3440	3
2004 - 2005	3.17	1.15	2271	3	3.28	1.1	2271	3	3.25	1.12	2271	3	3.47	1.11	2271	4
2005 - 2006	3.23	1.16	1919	3	3.34	1.1	1919	3	3.23	1.13	1919	3	3.57	1.1	1919	4
2007 - 2008	3.28	1.15	3120	3	3.28	1.15	3120	3	3.24	1.13	3120	3	3.51	1.09	3120	4
2008 – 2009	3.28	1.17	2348	3	3.29	1.11	2348	3	3.24	1.15	2349	3	3.47	1.12	2349	3
2009 – 2010	3.23	1.14	1841	3	3.68	1.87	1841	3	3.25	1.13	1841	3	3.48	1.1	1841	4
2010 – 2011	3.54	1.34	839	3	3.69	1.33	839	3	3.62	1.33	839	3	3.93	1.26	839	5

Table 5. Pearson Correlations among Knowledge of Fruit and Vegetable Recommendations, Behavioral Intentions and Reported Behaviors.

	Knowledge	Intent Amount Tomorrow	Intent Amount One Year	Intent Fruit Choice Tomorrow	Intent Fruit Choice One Year	Behavior Past Week Vegetables
Intent to Consume FV Tomorrow	-0.018					
Intent to Consume FV in One Year	-0.016	.506 ***				
Intent to Choose Fruit Rather than Candy Tomorrow	-0.009	.350 ***	.292 ***			
Intent to Choose Fruit Rather than Candy in One Year	0.002	.284 ***	.329 ***	.524 ***		
Behavior Past Week Vegetables	0	.401 ***	.301 ***	.258 ***	.204 ***	
Behavior Past Week Fruit	-.029 *	.384 ***	.281 ***	.295 ***	.230 ***	.577 ***

List wise deletion resulted in 7812 valid cases

P < .05 * P < .0001 ***

Discussion

Despite evidence showing improvement for select people and groups, national averages continue to reveal that most Americans consume on average far less than the recommended amount of FV servings each day [6, 32]. According to the NHANES, the majority of the US population, across all age-groups, does not meet the recommended requirements within any of the nutrient-rich food groups, including FV, and are over-consuming solid fats, added sugars and alcoholic beverages (in age 19+) [32]. Behan [33] reported that feeding patterns initiated as early as 9 to 11 months reflected a trend of not meeting FV consumption requirements as found in the Feeding Infants and Toddlers (FITS) studies.

Behavioral Intent

The trends related to behavioral intent were statistically significant but once again the effect size was minimal. Pettigrew et al [27] suggested that children's FV intake is far below their own perceived ideal intakes, which may indicate that children would increase consumption if more FV were available. Children seem to have received and internalized the recommended guidelines but are not necessarily acting on them [27]. Behan [33] claims "knowing is not doing" as we continue to see discrepancies between our nation's nutrition knowledge and consumption patterns.

The disconnect between knowledge, behavior, and behavioral intent is supported by this study and needs significant attention. Educational campaigns have "worked" at creating awareness about the specific number of servings, but where are the barriers between knowledge and application?

Relationships between Knowledge, Intent and Behavior

Although the trends in knowledge improved over time in this study, knowledge did not correlate with FV consumption or with behavioral intent. This is consistent with previous findings that the percentage of Americans who know they should eat five or more servings of FV has increased from 8% to 36% since 1991 [34] despite the consumption rates not corresponding proportionately [32]. This discrepancy between knowledge, intent and behavior was also reported by Pettigrew et al [27], who found children's perceptions of ideal intake were much higher than actual reported intake. A similar finding was seen in Australian children [35], US college students [14] and adults [33]. Additionally, Spronk et al [36] found a weak, positive relationship between nutrition knowledge and dietary quality, however, the preponderance of research suggest this may be an anomaly.

Implications for Research and Practice

In infancy and early childhood, parents and caregivers typically make the purchasing decisions for groceries and food at home, and children have minimal influence. Often between the ages of 7-11 children can develop and utilize strategies for influencing their parents' food purchasing decisions as well as their own food choices and purchases [37]. Future efforts seeking to improve dietary quality and FV consumption need to consider utilizing a multi-dimensional and layered approach early in the lifecycle of a child. Such approaches need to consider synergistic plans where households are working in unison with schools, communities, workplaces, industry and government with a cohesive message and approach that takes into consideration many of the com-

pounding inter-related factors.

Components that support such a plan must commence early in the home where parents and caregivers can provide food and meals prepared in an environment where the availability of nutrient dense foods (including FV), parental modeling, parental intake, parental encouragement and family rules, have all been shown to positively impact FV intake for children [38]. When the home serves as the primary basis for meals children consume more FV, are more likely to reproduce the behaviors of parents and caregivers and also develop the skills of self-efficacy [39]. Furthermore, the meal planning at home is more conducive for including the approach suggested by Behan [33] where an FV is included with every food encounter. The home environment also provides an opportunity to teach and model age-appropriate serving sizes which have been shown to be a challenge for some [27].

Involving children and adolescents in a garden-based nutrition education program, at school or in the community, has been shown to be another reinforcing approach to increase FV consumption [40, 41]. In addition to personal gardening, shopping at local markets, and Community Supported Agriculture (CSA's) also assist in altering the foodscape in helping the healthy choice becoming the default choice.

Schools play a key role in a comprehensive approach to improving dietary intake. Often schools have wellness and food service policies that put them at the forefront in altering the foodscape children are exposed to [42, 43]. Schools can also improve FV consumption and overall dietary quality through strategies such as scheduling recess prior to lunch [44], extending lunch to 30-minutes instead of 20 minutes [45], and using the offer versus serve method for lunch [46].

The displacement of FV by energy-dense, nutrient-poor food and beverages are an area of concern especially as children move into adolescence and young adulthood with the increased desires of autonomy and personal food selection. There is a need to create food environments that normalize the consumption of FV by all age groups. Half of all the advertisements being shown during children's television shows are for food [33], thus the importance of using this medium to develop more appropriate social norms for selection of nutrient-dense. There is a discrepancy between marketing expenditures which favors the selection of energy-dense, nutrient-poor products targeted to young people (2006 industry expenditures of \$1.62 billion) and marketing of FV products (\$11.4 million). Kraak et al [47] suggested that governments, agencies and industries should be setting policy on marketing, pricing and availability of FV. The United States has been proactive in developing an action plan that promotes the consumption of FV through the National Fruit & Vegetable Alliance national action plan [48].

In summary, despite ongoing national, state, and local efforts to better inform and educate children and their parents about FV consumption; there has been minimal change over the last ten-years in 5th-grade children's overall FV knowledge, behavior and intent. Since our findings mirror those of other countries [49], it is critical that future efforts involve parents and children in practical educational models such as shopping, recipes and food preparation labs. In addition, effectiveness, sustainability and scalability must also be top priorities among funding agencies.

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Special Issue on

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Theme Edited by:

Shun-Wan Chan, The Hong Kong Polytechnic University, Hong Kong.
sw.chan@polyu.edu.hk