

The Relationship of Food Security, Cervical Health, and Produce Intake in Rural
Appalachia

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This thesis titled
The Relationship of Food Security, Cervical Health, and Produce Intake in Rural
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Abstract

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The Relationship of Food Security, Cervical Health, and Produce Intake in Rural
Appalachia

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Food insecurity is associated with lower produce intake. Consumption of produce (vegetables and fruit) high in antioxidants may reduce risk of human papillomavirus (HPV) and cervical dysplasia. This study was designed to examine the differences in HPV status by food security status; differences in risky sexual behaviors by food security status; differences in produce intake/behaviors by food security status; differences in produce intake/behaviors by HPV status; and the association of produce intake/behaviors and food security, adjusted for demographic confounders including the HPV status among women in rural Appalachia who were attending a clinic for gynecological care.

Females who were English speaking and writing, 21 years and older, and attending a health clinic for cervical screening/testing (includes Papanicolaou [Pap] test, HPV test, and/or colposcopy) were recruited. A survey including questions from the U.S. Department of Agriculture household adult food security module, validated produce intake and behavior-related questions, and Community Awareness Resources and Education (CARE) Risky Sexual Behavior Index was used. HPV results were obtained from the clinic.

Participants (n = 153) (HPV negative, n = 139 [91.4%]; HPV positive, n = 13 [8.6%]) were 29 ± 8 years and primarily White/Non-Hispanic (n = 144, 94.1%). For

household adult food security, 113 (75.3%) were fully food secure, while 37 (24.7%) women were not fully food secure. According to the CARE Risk Sexual Behavior Index categorization, there were 49 (35.5%) women at a low-risk level, 28 (20.3%) at a medium-risk level, and 61 (44.2%) who were at a high-risk level. Most (66%) of the study participants met the U.S. recommendations for daily fruit and vegetable intake. There were no significance differences in food security status, produce intake or produce intake behaviors by HPV status. Women who were not fully food secure showed significantly higher Risk Sexual Behavior scores, compared to their fully food secure counterparts ($p < 0.001$). Although produce intake did not differ between food security status groups, perceived diet quality scores were significantly higher in fully food secure women, compared to not fully food secure women ($p = 0.014$), with median scores of 78.68 and 59.57, respectively. After adjusting for demographic confounders, Univariate General Linear Model analysis results showed that perceived diet quality score was a predictor for the household adult food security scale score ($p = 0.019$). Additionally, insurance ($p < 0.001$), education ($p = 0.004$), smoking status ($p = 0.006$) significantly predicted the household adult food security scale score.

Overall, food insecurity appears to lead to or result in higher risky sexual behaviors and poorer perceived diet quality. Further studies with larger samples are required to examine produce intake and related behaviors among women with increased risk for cervical cancer development in rural Appalachian Ohio.

Dedication

I would like to dedicate my work to my ever loving husband who is always with me giving me endless guidance, encouragement, support, patience, and appreciation to stand strong during hard times.

You are my pillar of strength of life.

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I would like to pay my sincere gratitude to everyone who helped me in many ways to excel in my studies at Ohio University.

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Table of Contents

	Page
Abstract.....	3
Dedication	5
Acknowledgments	6
List of Tables.....	11
List of Figures	13
Chapter 1: Introduction.....	14
Study Purposes and Research Questions.....	20
Chapter 2: Literature Review	22
Food Security.....	22
Related Definitions	23
History of the Food Security Measurement Project.....	26
The Current Population Survey Food Security Supplement	28
Household Food Security Survey Module	31
Food Security in the United States.....	37
Geographic Characteristics.....	43
Adult and Women’s Food Security.....	46
Correlation Between Food Insecurity and Poverty	49
Consequences of Food Insecurity	50
Chronic Disease	52
Chronic Disease Risk and Poverty.....	54

	8
Appalachia.....	55
Chronic Disease Risk in Appalachia.....	61
Cancer	63
Cervical Cancer.....	65
Cervical Dysplasia	74
Human Papilloma Virus	76
The Mechanism of the HPV Infection and Host Control of HPV Infection	78
Low-Risk and High-Risk HPV Types	80
Risk Factors	82
Cervical Cancer Preventive Measures	84
Barriers to Prevent Cervical Cancer.....	88
Cervical Cancer, Poverty, and Produce Intake	89
Cervical Cancer in Rural Appalachia.....	92
Antioxidants and Cervical Cancer	94
Produce Intake in the United States	98
Produce Intake in Appalachia.....	102
Produce Intake and Food Security	103
Summary	108
Chapter 3: Methodology	109
Research Design	109
Study Population.....	109
Sampling Procedure	110

Research Instrument and Scoring	111
Research Questions and Statistical Analysis	113
Chapter 4: Results.....	116
Characteristics of the Participant	116
Household Adult Food Security Status	117
HPV Clinical Data	118
Risky Sexual Behavior	119
Produce Intake	119
Produce Intake Related Behaviors	122
Difference in HPV Prevalence by Household Adult Food Security Status	125
Difference in Risky Behavior Score by Household Adult Food Security Status	125
Difference in Produce Intake by Household Adult Food Security	125
Differences in Produce Intake Related Behaviors by Household Adult Food Security.....	126
Difference Difference in Produce Intake by HPV Status.....	127
Difference in Produce Intake Related Behaviors by HPV Status.....	128
Relationship of Household Adult Food Security Scale Score and Adjusted Results of General Linear Model.....	129
Chapter 5: Discussion, Conclusion, and Recommendations	131
Characteristics of Participants	131
Demographic characteristics	131
Food security.....	132

	10
HPV status	134
Risky sexual behaviors	135
Produce intake and produce intake related behaviors	137
Household Adult Food Security and HPV Prevalence	138
Household Adult Food Security and Risky Sexual Behavior	138
Household Adult Food Security and Produce Intake and Related Behaviors	138
HPV Status and Produce Intake and Related Behaviors	142
Predictors of Household Adult Food Security Scale Score.....	145
Conclusion and Recommendations.....	146
References.....	149
Appendix A: U.S. Household Food Security Survey Module	202
Appendix B: U.S. Measurement of Household Food Security Status.....	205
Appendix C: Institutional Review Board (IRB) Approval Letter.....	206
Appendix D: Flyer Used for Participant Recruitment	207
Appendix E: Consent Form for Participant Recruitment	208
Appendix F: Survey.....	211
Appendix G: Food Security Scale Values and Status Levels Corresponding to Number of Affirmative Responses	224
Appendix H: CARE Risky Sexual Behavior Index, 2009 Scale Scoring	225
Appendix I: 13-Item Tool to Assess Psychosocial Indicators of Produce Intake	226
Appendix J: 7-Item Fruit and Vegetable Scale	229

List of Tables

	Page
Table 1: Research Questions and Hypotheses	21
Table 2: Definition of Food Security, Food Insecurity, and Related Terms.....	23
Table 3: Definition of Food Security and Subcategories.....	33
Table 4: Measurement of Household Food Security Status in the United States: Food Security Scales Values and Status Levels Based upon Raw Score to Food Security Survey Modules	37
Table 5: Terminology Used in Cervical Cancer.....	68
Table 6: Cervical cancer-Estimated Disability-adjusted Life Years, Years of Life Lost and Years Lived with Disability of United States (2008)	73
Table 7: Definitions of Psychosocial Constructs related to Produce Intake Behaviors ..	106
Table 8: Scoring for Psychosocial Constructs Related to Produce Intake Behaviors	113
Table 9: Research Questions and Statistical Analysis Tests.....	115
Table 10: Demographic Characteristics of the Study Participants.....	116
Table 11: Household Adult Food Security Status of the Study Participants	118
Table 12: HPV Clinical Data of the Study Participants	118
Table 13: Risky Sexual Behavior Status of the Study Participants.....	119
Table 14: Produce Intake of the Study Participants	120
Table 15: Proportions of the Study Participants Meeting Recommended Daily Produce Intake.....	120

Table 16: Proportions of the Study Participants Meeting Recommended Daily Vegetable Intake by Household Adult Food Security Status.....	121
Table 17: Proportions of the Participants Meeting Recommended Daily Fruit Intake by Household Adult Food Security Status	121
Table 18: Proportions of the Participants Meeting Recommended Daily Vegetable Intake by HPV Status.....	122
Table 19: Proportions of the Participants Meeting Recommended Daily Fruit Intake by HPV Status	122
Table 20: Psychosocial Indicators of Produce Intake Behaviors of the Study Participants	123
Table 21: A Detailed Description of Produce Intake Related Behaviors of the participants	124
Table 22: HPV Prevalence by Household Adult Food Security Status.....	125
Table 23: Differences of Produce Intake of the Study Participants by Household Adult Food Security.....	126
Table 24: Differences of Produce Intake Related Behaviors by Household Adult Food Security.....	126
Table 25: Differences in Produce Intake by HPV Status.....	127
Table 26: Differences in Produce Intake Behaviors of the Study Participants by HPV Status	128
Table 27: Relationship of Household Adult Food Security Scale and Adjusted Results of Univariate General Linear Model	130

List of Figures

	Page
Figure 1: Prevalence of food insecurity, 2012	39
Figure 2: Prevalence of very low food insecurity, 2012.....	40
Figure 3: Trends in prevalence rates of food insecurity and very low food insecurity in the U.S. households, 1995-2012	42
Figure 4: State-level prevalence of food insecurity 2010-2012.....	45
Figure 5: Subregions in Appalachia, U.S., 2009.....	57
Figure 6: County economic status in Appalachia, FY 2014	58
Figure 7: Relative per capita income rates in Appalachia, 2010.....	59
Figure 8: Relative poverty rates in Appalachia, 2007–2011.....	60
Figure 9: Estimated cervix uteri cancer mortality , 2012	66
Figure 10: Estimated cervix uteri cancer prevalence , 2012.....	67
Figure 11: A cross-section of the cervix	68
Figure 12: U.S. cervical cancer incidence rates by state, 2008.....	71
Figure 13: U.S. cervical cancer death rates by state, 2008	72
Figure 14: Progression of cervical cancer.....	75
Figure 15: Biopsychosocial framework for estimation of sensitivity of evaluation tool for increasing fruit and vegetable consumption.....	107

Chapter 1: Introduction

Food is the most fundamental requirement for a healthy life. While it is imperative to have sufficient access to food for health, not everybody can obtain food in adequate amounts. According to the Food and Agriculture Organization (FAO), in 2010 about 925 million people in the world had no means to get enough to eat (Ruane & Sonnino, 2011). Moreover, present reports highlight that women were slightly over half of the world's population, yet they accounted for over 60% of the world's population without adequate access to food (United Nations Economic and Social Council, 2007).

Food security has been defined as “access by all people at all times to enough food for an active, healthy life and includes at a minimum: (a) the ready availability of nutritionally adequate and safe foods, and (b) the assured ability to acquire acceptable foods in socially acceptable ways (e.g., without resorting to emergency food supplies, scavenging, stealing, and other coping strategies)” (Anderson, 1990, p. 1560).

Alternately, food insecurity is “limited or uncertain availability of nutritionally adequate and safe foods or limited or uncertain ability to acquire acceptable foods in socially acceptable ways” (Anderson, 1990, p. 1560).

Food insecurity arises from lack of money and other resources to obtain food (Coleman-Jensen, Nord, Andrews, & Carlson, 2013a). Adults living in food-insecure households exhibit a range of experience, including inability to pay for balanced meals, concern about the sufficiency of their food supply, worry that they will run out of food, cutting down the amount of meals consumed, or skipping meals entirely (Coleman-Jensen et al., 2013a). There is a strong relationship between being food insecure and the

income earned (Nord, & Prell, 2012; Quisumbing, Brown, Feldstein, Haddad, & Peña, 1995; Rose, 1999). In *Household Food Security in the United States in 2012*, Coleman-Jensen and others (2013b) reported that 38.2% of households were earning an income below 130% of the official poverty line were experiencing food insecurity (the federal poverty line was \$23,283 for a family of four).

In 2012, 14.5% of households in United States experienced food insecurity at least some time during the same year (Coleman-Jensen et al., 2013a). Inability to acquire enough food may lead to the development of a range of adverse mental, physical health outcomes and sociofamilial disturbances, depending on the level of severity (Cook & Frank, 2008; Hamelin, Habicht, & Beaudry, 1999; Heflin, Siefert, & Williams, 2005; Siefert, Heflin, Corcoran, & Williams, 2001; Siefert, Heflin, Corcoran, & Williams, 2004). Among the individuals who lived in food insecure households, women were more vulnerable to the negative outcomes of food insecurity (Tarasuk, 2001; Tarasuk & Beaton, 1999). In the United States, food insecurity varies by region (Bartfeld, Dunifon, Nord, & Carlson, 2006). From 2010-2012, 16.1% of Ohio households experienced food insecurity, whereas the national food insecurity rate was 14.7% (Coleman-Jensen et al., 2013a). In the rural Appalachian region of Ohio, food insecurity rates appear to be remarkably high. Holben and Pheley (2006) reported that in 1999 food insecurity was 27.2% in an adult sample from the Appalachian region while the national average for food insecure households was 10.1% (Holben & Pheley, 2006).

One potential negative outcome of food insecurity is poor dietary intake. Consumption of fruits, vegetables, and dairy by U.S. adults living in food insecure

households was limited to fewer weekly servings than their food secure counterparts, resulting in lower levels of dietary micronutrients (including the B complex vitamins, magnesium, iron, zinc, and calcium), and increased risk of chronic diseases (Dixon, Winkleby, & Radimer, 2001; Frongillo, Olson, Rauschenbach, & Kendall, 1997).

Dietary intake is negatively affected by food insecurity, which leads to an increase in risk of chronic disease development such as cardiovascular diseases, cancer, diabetes, and obesity (Holben, 2010). In 2005, 7 out of 10 deaths among Americans were from chronic diseases, with 50% of all deaths being due to heart disease and cancer (Kung, Hoyert, Xu, & Murphy, 2008). Tarasuk, Mitchell, McLaren, and McIntyre (2013) suggested that chronic disease may precipitate food insecurity.

Cancer is one of the leading chronic diseases in the United States, and treating a cancer can be very costly (Centers for Disease Control and Prevention [CDC], 2012). Many cancers are preventable through life style changes, such as refraining from smoking, increasing fruit and vegetable intake, with moderate alcohol use, restricting caloric intake, regular exercise, minimizing meat consumption, protecting skin from direct exposure to sunlight, regular screenings, and vaccinations (Anand et al., 2008).

Cervical cancer is identified as a preventable cancer that affects women (CDC, 2013b). The Ohio Cancer Incidence Surveillance System (OCISS) reported that from 2000 to 2004 the average annual age-adjusted cervical cancer incidence rate in Ohio was 8.1/100,000, which was an average of 489 per year and the annual age-adjusted U.S. incidence rate was 8.7/100,000. The 2000-2004 U.S. age-adjusted cervical cancer mortality rates were 2.6/100,000, which was the same as reported in Ohio (OCISS, 2007).

High incidence and mortality rates of cervical cancer have been reported in the Ohio Appalachian region (Fisher et al., 2008; Hopenhayn, King, Christian, Huang, & Christian, 2008; Huang et al., 2002; Katz, Wewers, Single, & Paskett, 2007; National Cancer Institute [NCI], 2011). During the period of 2000-2004, in 29 Appalachian Ohio counties, the average annual age-adjusted mortality rate was 3.4/100,000. When compared to the mortality rate of women who were not living in the Appalachian region, it was 41.7% greater (2.4/100,000) (OCISS, 2007). During the same period, the average annual age-adjusted cervical cancer rate among women from the Appalachian counties (9.7/100,000) was 24.4% greater than women living outside the Appalachian region (7.8/100,000) (OCISS, 2007). Among the women who live in the rural Appalachian region, cervical cancer screening is not a common practice due to reasons such as concerns about cost, low-income, lack of insurance, lack of education, lack of medical facilities, transportation difficulties, living in rural regions, cultural factors, older age, fear, and embarrassment (Hall, Uhler, Coughlin, & Miller, 2002; Katz et al., 2007; Reiter et al., 2009).

Human papillomavirus (HPV) is the most common sexually transmitted infection in the United States (CDC, 2011), and it is the primary cause of cervical cancer (American Cancer Society [ACS], 2012; Dürst, Gissmann, Ikenberg, & zur Hausen, 1983; Walboomers et al., 1999; zur Hausen, 2000, 2002). As described by Smith-McCune and Weidner (1994), “Cervical dysplasia, also known as Cervical Intraepithelial Neoplasia (CIN) 2, is a premalignant form of disordered growth of the stratified squamous epithelium of the cervix” (p. 800). The most common method to identify the

abnormal cell growth in the cervix is Papanicolaou test (Waxman, 2008). HPV testing may also be conducted, in conjunction with the Pap test (NCI, 2012).

HPV can cause preinvasive precursor lesions called cervical dysplasia or cervical intraepithelial neoplasia (NCI, 2014). These preinvasive precursor lesions can develop into an invasive squamous carcinoma in the cervix. Usually, not all of these abnormal cell growths will advance to an invasive carcinoma. Cervical dysplasia or CIN has been graded into mild dysplasia (CIN1), moderate dysplasia (CIN2), or severe dysplasia (CIN3) (NCI, 2014). Among these three grades, most of the mild and moderate lesions regress (Holowaty, Miller, Rohan, & To, 1999; NCI, 2014). CIN3 has 30% risk of developing into invasive cancer, if it is not treated (McCredie et al., 2008). CIN3 is considered the crucial stage, which has the probability of developing into a cervical cancer (NCI, 2014). Apart from HPV, other risk factors associated with cervical cancer development are smoking, immune suppression, Chlamydia infection, oral contraceptive usage, multiple full-term pregnancies, young age at the first full-term pregnancy, poor diet, and poverty (ACS, 2012).

Manju, Sailaja, and Nalini (2002) uncovered that, among women with low socioeconomic status, malnutrition could be an important cause of high cervical cancer prevalence. Specifically, diets low in fruits and vegetables have been identified as a probable risk factor for high incidence and mortality rates for cervical cancer in the Appalachian region (Fisher et al., 2008). There is scientific evidence to support the claim that frequent produce intake high in antioxidants possibly can reduce the risk of cervical dysplasia (García-Closas, Castellsagué, Bosch, & González, 2005; Sedjo et al., 2002;

Siegel et al., 2010). A study conducted to investigate the relationship between carotenoids and HPV infection revealed that diets low in carotinoids increased the risk of persistent HPV infection. In the same study, the authors suggested that higher levels of carotenoids (and vitamin C) could be protective against HPV (Peterson, Sedjo, Davis, Beam, & Giuliano, 2010). Kwasniewska, Charzewska, Tukendorf, and Semczuk (1998) found that women consuming low amounts of vitamin C, β -carotene, and folate had an increased risk of HPV infections. A study designed to investigate the comparative plasma levels of known dietary antioxidant profile showed that decreased antioxidant intake could promote the pathogenesis of CIN and carcinoma of the cervix (Palan et al., 1996). Tomita et al. (2010) discovered the relationship of low fruit and vegetable consumption to increased risk of cervical cancer among low-income women in Brazil.

Studies have shown the preference for investigating the effectiveness of HPV vaccine as a preventive strategy rather than diet-related interventions in the Appalachian region (Hutson, Dorgan, Duvall, & Garrett, 2011). Because food insecurity appears to be associated with lower produce and micronutrient intake (Dixon et al., 2001; Kendall, Olson, & Frongillo, 1996), and because frequent produce intake high in antioxidants may reduce risk of cervical dysplasia (García-Closas et al., 2005; Giuliano et al., 2003; Ho et al., 1998; Siegel et al., 2010), understanding the association of food insecurity, cervical health, and produce intake/behaviors is imperative. No studies have examined the produce intake and risk of cervical dysplasia among food insecure women, despite its potential to decrease cancer risk and development.

There is a need to understand the factors that are associated with high cervical cancer rates in the Appalachian region. Although previous studies have examined the relationship of food insecurity to produce intake, this was the first study to examine food insecurity, cervical health, and produce intake/behaviors in rural Appalachia.

Study Purposes and Research Questions

This study examined: (a) differences in HPV status by food security status; (b) differences in risky sexual behaviors by food security status; (c) differences in produce intake/behaviors by food security status; (d) differences in produce intake/behaviors by HPV status; and (e) the association of produce intake/behaviors and food security, adjusted for demographic confounders including the HPV status among women in rural Appalachia and attending a clinic for gynecological care. Table 1 summarizes the research questions and hypotheses of the study.

Table 1

Research Questions and Hypotheses

Does HPV differ between women who live in food secure households and food insecure households in rural Appalachia and attending a clinic for gynecological care?	A greater proportion of food insecure women in rural Appalachia will have positive HPV status than food secure women.
Does risky sexual behavior differ between women who live in food secure households and food insecure households in rural Appalachia and attending a clinic for gynecological care?	Food insecure women in rural Appalachia will have a higher riskier sexual behavior score than women who are food secure.
Does produce intake differ between women who live in food secure households and food insecure households in rural Appalachia and attending a clinic for gynecological care?	Food insecure women in rural Appalachia will have lower produce intake levels than food secure women.
Do produce intake behaviors differ between women who live in food secure households and food insecure households in rural Appalachia and attending a clinic for gynecological care?	Food insecure women in rural Appalachia will have scores that reflect poorer produce-related behaviors than food secure women.
Does produce intake differ between positive HPV women and negative HPV women in rural Appalachia and attending a clinic for gynecological care?	Women with positive HPV status will have lower produce intake levels than women with negative HPV status.
Do produce intake behaviors differ between positive HPV women and negative HPV women in rural Appalachia and attending a clinic for gynecological care?	Women with positive HPV status will have scores that reflect poorer produce-related behaviors than women with negative HPV status.
What is the association of produce intake behaviors and food insecurity, adjusted for demographic confounders including the HPV status among women in rural Appalachia?	After adjusting for demographic confounders, low food security will be proportionately associated with poorer produce-related behaviors among women in rural Appalachia.

Chapter 2: Literature Review

Food Security

Food insecurity is limited or uncertain food security (U.S. Department of Agriculture [USDA], 2013). Food security has been a human concern from early days (Maxwell & Smith, 1992). One good example is from the Bible story of Joseph at the Pharaoh's court. He predicted that there would be 7 years of plenty of food followed by 7 years of famine. This was an event that people were aware of food insecurity. The concern about food security started to develop significantly in recent history (1970s) (Devereux & Maxwell, 2001). Ever since, the concept of food security has evolved with numerous paradigms shifts (Devereux & Maxwell, 2001).

According to Hopkins and Puchala (1978), political institutions are facing difficulties in achieving food security in their countries. The importance of food has been appreciated as a basic human right even before the food security concern was developed. "Right to food" was first documented as a human right in the Universal Declaration of Human Rights in 1948: "Everyone has the right to a standard of living adequate for the health and well-being of himself and of his family, including food . . ." (United Nations [UN], n.d.).

Food insecurity can develop due to many circumstances, such as having limited resources, having limited accessibility to food, price hikes, war, poverty, and natural disasters. Food insecurity has not been confined to the developing countries; it also exists in developed countries, such as the United States, the land of abundance (LeBlanc, Kuhn, & Blaylock, 2005; Wunderlich, & Norwood, 2006). When compared to the

developing countries, the intensity of the problem in the United States is very mild (Bickel, Nord, Price, Hamilton, & Cook, 2000).

Related Definitions

As defined by the World Food Conference, Rome, Italy (1974), food security is ~~the~~ availability at all times of adequate world food supplies of basic foodstuffs to sustain a steady expansion of food consumption and to offset fluctuations in production and prices (UN, 1975).” This statement focuses on maintaining self-sufficiency at the national level and contributing to world food security by having sufficient reserves along with appropriate price stabilizations. With further advancement of food security in the world, the concept was narrowed to the household level, and has been coined ~~the~~ food poverty.” In recent years, the notion of individual food security has been established by recognizing the complex interconnection between the individual, the household, the community, the nation, and the international economy (DeRose, Messer, & Millman, 1998). Table 2 provides definitions of food security and other commonly used terms related to food security.

Table 2

Definition of Food Security, Food Insecurity, and Related Terms

Term	Definition
Food deprivation	An individual is unable to obtain adequate amounts of food (DeRose et al., 1998).
Food insecurity	The limited or uncertain availability of nutritionally adequate and safe foods or limited or uncertain ability to acquire acceptable foods in socially acceptable ways” (Anderson, 1990, p. 1560)

Table 2 (Continued)

Term	Definition
Food poverty	A household does not have a sufficient amount of food for consumption (DeRose et al., 1998).
Food security	<p>–Food security exists when all people, at all time, have physical and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life” (Food and Agriculture Organization [FAO], 2003).</p> <p>–Access by all people at all times to enough food for an active, healthy life. Food security includes at a Minimum: the ready availability of nutritionally adequate and safe foods, and 2) an assured ability to acquire acceptable foods in socially acceptable ways (e.g., without resorting to emergency food supplies, scavenging, stealing, or other coping strategies)” (Anderson, 1990, p. 1560).</p>
Food shortage	The food insufficiency on a regional or country level (DeRose et al., 1998).
Stability	–To be food secure, a population, household or individual must have access to adequate food at all times. They should not risk losing access to food as a consequence of sudden shocks (e.g. an economic or climatic crisis) or cyclical events (e.g. seasonal food insecurity). The concept of stability can therefore refer to both the availability and access dimensions of food security” (FAO, 2006).
Utilization	–Utilization of food through adequate diet, clean water, sanitation and health care to reach a state of nutritional well-being where all physiological needs are met. This brings out the importance of non-food inputs in food security” (FAO, 2006).

Note. Adapted from (a) –Trade Reforms and Food Security; Conceptualizing the Linkages, Chapter 2. Food security: Concepts and Measurement” by Food and Agriculture Organization of the United States, 2003. Retrieved January 29, 2014, from <http://www.fao.org/docrep/005/y4671e/y4671e00.htm>; (b) –Core Indicators of Nutritional State for Difficult-to-Sample Populations” by S. A. Anderson, 1990, *The Journal of Nutrition*, 120(Suppl 11), p. 1560; (c) –Food Security. Policy Brief,” by Food and Agriculture Organization, 2006, Agriculture and Development Economics Division, p. 1. Available from ftp://ftp.fao.org/es/ESA/policybriefs/pb_02.pdf; (d) –Who's Hungry? And How Do We Know?: Food Shortage, Poverty, and Deprivation” by L. F. DeRose, E. Messer, & S. Millman, 1998, United Nations University, pp. 92, 93 & 131.

The definition of food security has been expanding over time, and yet evolving with the inclusion of novel concepts (FAO, 2003). At the 1974 World Food Summit, food security was one of the very first initiatives attracting global concern about the quantity and the consistency of food availability (FAO, 2003). Later, the concept was developed into a focus that the balance between supply and demand has to be maintained. Then, in 1983, the FAO (2006) defined food security as “ensuring that all people at all times have both physical and economic access to the basic food that they need.” The definition issued by the World Food Summit of 1996 included the importance of the access (physical and economical), amount, safety, nutrition, and preferences (individual and cultural acceptance) to maintain a healthy life (FAO, n.d.). Similarly, the definition developed by the USDA further explained that all people should be able to acquire food by means that are accepted by society (Anderson, 1990).

The World Health Organization (n.d.) stated that food security is built on three pillars: food availability, food access, and food use. Food availability is when adequate amounts of food are obtainable without any disturbances. Food access is when a person has a sufficient amount of resources to get proper food and a nutritious diet. The third pillar, food use, is proper utilization of food, based on the information of necessary nutrition and care, along with adequate water and sanitation. According to the American Institute for Nutrition Expert Panel, potential hunger and malnutrition can be the ultimate consequences of food insecurity, even though they are not compulsory events (Anderson, 1990).

The severity of U.S. household's food insecurity is expressed as a percentage of the population (Bickel et al., 2000). In 2000, food insecurity was categorized into subcategories (Bickel et al., 2000). In 2006, these subcategories were revised again according to an expert panel gathered at the USDA's request by the Committee on National Statistics of the National Academies (USDA, 2013). Definitions of subcategories are given in the Table 3.

History of the Food Security Measurement Project

There are programs that have been initiated in the United States to combat the nation's food insecurity, such as estimating the prevalence of hunger and assessing lack of access to food (Bickel et al., 2000). The earliest initiative to combat food insecurity problems began in the 1940s. In 1946, the National School Lunch Program was started and followed by the Food Stamp Program, along with other special programs targeting the groups most vulnerable to food insecurity (Bickel et al., 2000). Additionally, in 1984, the President's Task Force on Food Assistance reported that the definition of hunger and documentation of hunger were insufficient. There were many initiatives by private and federal agencies to measure food insecurity. In order to measure the prevalence of hunger among children, the Community Childhood Hunger Identification Project put in place and was sponsored by the Food Research and Action Center (Wunderlich & Norwood, 2006). Radimer, Olson, and Campbell (1990) conducted further studies to define criteria for measuring hunger and food security. During the 1980s the USDA examined information gathered from the adequacy of household food supplies survey (Wunderlich & Norwood, 2006) that was incorporated into the Nationwide Food

Consumption Survey in 1977. In the late 1980s, a food sufficiency questionnaire was included in the third National Health and Nutrition Examination, which was adapted from Nationwide Food Consumption Survey and Community Childhood Hunger Identification Project (Wunderlich & Norwood, 2006).

A report prepared in 1990 used the recommendations made by the Expert Panel in the Core Indicators of Nutritional State for Difficult-to-Sample Populations. The Expert Panel discussion took place in 1989 between the American Institute of Nutrition and the U.S. Department of Health and Human Services (Wunderlich & Norwood, 2006). This reflected appreciation for core indicators used in assessing the nutritional status of difficult-to-sample populations. Further, this led to definitions for the terms “food security” and “food insecurity,” along with the other relationships concerning these terms (Anderson, 1990; see Table 2). Also in 1992, the staff of the USDA evaluated the research findings that were available at that time. This process focused on developing a survey instrument to measure the severity of food insecurity and hunger. Similarly, practical difficulties that would be experienced in the process of using the instrument at different levels (national, state, and local) were considered. As a result, Food Security Supplement Survey was included into the Current Population Survey (CPS) in 1995 (Wunderlich & Norwood, 2006).

The National Nutrition Monitoring and Related Research Act of 1990 (The Library of Congress, n.d.) initiated the National Nutrition Monitoring and Related Research Program for provision of timely information about food consumption, contribution and the nutritional status of the U.S. population (Andrews, Bickel, &

Carlson, 1998). One of the main purposes of the Act was to “make more effective use of Federal and State expenditures for nutrition monitoring, and enhance the performance and benefits of current Federal nutrition monitoring and related research activities” (Library of Congress, n.d.). The National Nutrition Monitoring and Related Research program was a 10-year program guided by the USDA and the Department of Health and Human Services. Moreover, the main objective of this program was to implement a survey instrument applicable to measure food security at all levels of the country. The interagency board of this program consisted of 22 Federal agencies (Moshfegh, 1994). In 1994, the first National Conference on Food Security Measurement and Research was sponsored by USDA and U.S. Department of Health and Human Services (USDHHS) (Andrews et al., 1998). A large number of experts participated from the federal government, academia, and people who were engaged in identifying and measuring hunger and food security. The main purpose of the conference was to develop methods and build public policies that could thoroughly reveal the deficient status of food security in the country (Wunderlich & Norwood, 2006).

The Current Population Survey Food Security Supplement

The CPS was put into use in 1940 (Bregger, 1984). Through the survey, labor force data are collected at national, regional, state, and municipal levels. The information includes unemployment rate and the number of people who do not belong to the labor force (U.S. Department of Labor & Bureau of Labor Statistics [USDOL & BLS], 1993). This information provides in-depth details such as the personal characteristics of those who are involved in employment and unemployment, age, sex, race, ethnicity, education

status, marital status, and number of children. Further, this information completely explains the labor force of a population, since it collects the type of the job industry, hours of working, and earning (USDOL & BLS, 1993). The Bureau of the Census for the BLS conducts the survey, and data are collected through the survey every month. The sample is 60,000 households and represents of the noninstitutional population (Bregger, 1984). There are 2 sessions of interviews in the collection of data. In the first session, the selected households are interviewed for 4 successive months. The second session commences after 8 months. In the second session, the same households are interviewed for another 4 months consecutively. Interviewers visit households in month 1 and in month 5. The rest of the time, over-the-phone interviews are being carried out. If the household does not have a telephone or if they have any hearing or language difficulties, in-person interviews are carried out every month (USDOL & BLS, 1993).

The first step for the CPS Food Security Supplement was taken in 1994 after the interagency agreement was made between the USDA and the Census Bureau. According to the agreement, they have developed, tested, analyzed, and refined a food security questionnaire, which supplemented the CPS in 1995. An expert team consisting of the Center for Survey Methods Research and the CPS Branch of the Census carefully tested, reviewed and revised the preliminary version of the questionnaire. The revised questionnaire was field-tested in April 1994. Results were analyzed by the fall of 1994, and the food security items included as a supplement to the CPS in April 1995 (Andrews et al., 1998).

As previously noted the USDOL carries out a national sample survey of about 60,000 households every month using CPS (Wunderlich & Norwood, 2006). The CPS survey collects primary information of the U.S. labor force. Further, supplementary data is being collected by several other federal agencies following the labor force interview, and the Food Security Supplement Survey is one of them. This is conducted by the U.S. Census Bureau for the USDA. The Food Security Supplement Survey was included in the CPS in 1995 and it has been used ever since as a supplement. There were modifications done in 1996, 1997, and 1998 by the USDA in order to make the survey more user-friendly, and currently it consists of over 70 questions. These questions address five major sections; food expenditures, minimum food spending needed, food assistance program participation, food sufficiency and food security, and ways of coping with not having enough food. The food sufficiency and food security section contains the 18 food security and hunger questions that are used to calculate the household food security scale. The questions are designed to collect information during the 30 days and 12 months before the interview (Wunderlich & Norwood, 2006).

There are several concerns that are still to be addressed. The CPS does not take into account the homeless people who do not live in shelters. Due to this, this population is left behind, and it can affect the actual number of people who may face low and very low food security. Because of the dichotomous categorization, there is a possibility of categorizing food secure households as food insecure. This same problem happens in the subcategories that are at the boundary between low food secure and very low food secure groups. Another problem is that parents hesitate to provide the genuine status of

children's food security, especially those who are not getting a sufficient amount of food, which may skew results. This survey does not reflect the food safety, nutritional status, or ability to obtain food through "socially acceptable" means. Also it fails to measure food supply in terms of nature and sources of attaining food. The CPS Food Security Supplement has been designed to measure only food security status 12 months before the interview. Although this survey allows conclusions about the population's food security, it is unable to provide information about individual household food security status. Because the survey has been revised over time, researchers need to be aware of the latest revision. Finally, because the CPS Food Security Supplement is designed to measure food security status in the United States, additional language and cultural changes will be required if it is employed in other countries (Bickel et al., 2000).

Household Food Security Survey Module

The Food Security Supplement Survey was included into the CPS for the first time in April 1995 by the U.S. Census Bureau (Andrews et al., 1998). Development of the food security supplement was a joint venture of Food and Nutrition Service and Economic Research Service of the USDA and the CDC, the National Center for Health Statistics of the USDHHS, along with the participation of a few other federal and private agencies (Bickel et al., 2000). As the CPS for labor force collects data every month, various supplements to the CPS are being incorporated each month. In the month of March, data collection focused on household income, employment, and social assistance program participation. The food security supplement to the CPS collects details in

December through interviewing the most knowledgeable member in the household about every aspect of food purchase and consumption (Wunderlich & Norwood, 2006).

The sole objective of developing a validated instrument is to practically measure the different severities of food security accurately, and to be able to use this knowledge in each level: federal, state and local. Further, the questionnaire was developed in a way that it consists of a number of different types of questions that helps to categorize each level of severity from a complete array of severity of food security safety (Bickel et al., 2000). The 18- item Household Food Security Survey Module questionnaire is known as the core module or survey module for U.S. food security measurement and it measures food security of households with children and without children (Bickel et al., 2000; see Appendix A). The average time to complete the questionnaire is approximately 4 minutes.

Response to these questions can be used to assign a numerical value on the food security scale. The scale is expressed with a numerical value that ranges from 0 to 10. The food security measurement scale is used to measure the degree of severity of food insecurity in the United States. The scale of the module has been assigned in a way that the households that do not experience any food insecurity at any time are given the value 0, and households who face very high food insecurity are given a value of 10. The assigned values are again subcategorized according to the severity of the problem. Initially, there were four subcategories, namely food insecure, food insecure without hunger, food insecure with hunger (moderate), and food insecure with hunger (severe)

(Bickel et al., 2000; see Appendix B). This classification was redefined in 2006 by the USDA (2013; see Table 3)

Table 3

Definition of Food Security and Subcategories

Term	Definition	
	2000 label ^a	2006 label ^b
Food secure (2000 label)/High food security (2006 label)	Households show no or minimal evidence of food insecurity.	No reported indications of food-access problems or limitations.
Marginal food security (2006 label)		One or two reported indications--typically of anxiety over food sufficiency or shortage of food in the house. Little or no indication of changes in diets or food intake.
Food insecure without hunger (2000 label)/Low food security (2006 label)	Food insecurity is evident in household members' concerns about adequacy of the household food supply and in adjustments to household food management, including reduced quality of food and increased unusual coping patterns. Little or no reduction in members' food intake is reported.	Reports of reduced quality, variety, or desirability of diet. Little or no indication of reduced food intake.

Table 3 Continued

Term	Definition	
	2000 label ^a	2006 label ^b
Food insecure with hunger (moderate) (2000 label)/Very low food security (2006 label)	–Food intake for adults in the household has been reduced to an extent that implies that adults have repeatedly experienced the physical sensation of hunger. In most (but not all) food-insecure households with children, such reductions are not observed at this stage for children.”	–Reports of multiple indications of disrupted eating patterns and reduced food intake.”

Note. Adapted from a) –Guide to Measuring Household Food Security,” by G. Bickel, M. Nord, C. Price, W. Hamilton and J. Cook, 2000, Office of Analysis, Nutrition, and Evaluation, Food and Nutrition Services, U.S. Department of Agriculture, p. 11-12. Retrieved February 6, 2014, from, <http://www.fns.usda.gov/fsec/files/fsguide.pdf>; b) –Definitions of Food Security.” Retrieved February 6, 2014, from USDA website: <http://www.ers.usda.gov/topics/food-nutrition-assistance/food-security-in-the-us/definitions-of-food-security.aspx>

The survey module is adaptable for a shorter time period. The original 18-item module is designed to investigate food security in the last 12-month period. Although, if someone needs to have a survey of data from the last 30 days, questions can be changed accordingly by adding ~~the last 30 days~~” instead ~~the last 12 months~~” (Bickel et al., 2000). Direct and indirect aspects of food security are being measured using the survey. As mentioned earlier, the survey is designed to measure the spending on household food, such as the real amount of money spent; the average or maybe the requirement of money; whether the household members are participating in any food assistance program; coping strategies that are being used to attain food from other emergency assistance, such as

borrowing food from neighbors and food pantries; 12-month and 30-day analysis (Bickel et al., 2000).

The first step of categorizing households into different food security levels is to code the responses from participants. The responses are coded as ~~affirmative~~” or ~~negative~~.” Affirmative responses; yes: often true; sometimes true; almost every month; some months but not every month, are coded as ~~+~~.” Other responses are considered as negative responses and they are coded as ~~-~~.” Responses that say refused; don’t know, are considered as missing data and they are given the code ~~-~~” (Bickel et al., 2000). The food security scale values and status levels for 18-item Food Security Survey module are listed in Appendix A.

Depending on the convenience, a 6-item module has been developed using the most optimum questions from the 18-item module. It was developed by the National Center for Health Statistics. The 6-item module contains question that are able to measure most closely high or marginal food security, low food security, and very low food security. Blumberg, Bialostosky, Hamilton, and Briefel (1999) stated that the Six-Item Short Form is a potential substitution to use in measuring food security at different levels in the United States, particularly when having issues with time and financial limitations (p. 1233). This questionnaire is easily adaptable to measure the food security of 12 months and 30 days. Also, it has a few weaknesses; it is unable to measure very high food insecurity with children and adults (Bickel et al., 2000).

The same questions in the U.S. Household Food Security Survey Module for childless are those used in the U.S. Adult Food Security Survey Module (USDA, 2014).

When compared to the 18-item household module, convenient for participants, it can easily compare food security data with households with and without children and also among households with children who are at different ages. It does not include the questions about children's food security, where parents are reluctant to reveal the real situation. At the same time it can be a disadvantage because this questionnaire will not be able to collect children's food security data (USDA, 2014).

In order to measure child food security, the Child Food Security Survey Module was developed, which consists of self-reported questions (USDA, 2014). This was developed by researchers at the University of Southern Mississippi, and validation was done using a study conducted in a sample of children from a school in Mississippi (Connell, Nord, Lofton, & Yadrick 2004). Connell and others (2004), suggested that in using this instrument, researchers are able to obtain more reliable data about individual levels of child food security including the nutritional, mental and physical health status of children who are at the age of 12 years and older. Even though, for Child Food Security Survey Module, the information on recall for 30-day reference period is more effective than 12-month period recall (USDA, 2014). Table 4 summarizes the raw scores and respective food security level of five different food security measurement surveys. In each survey, the total number of affirmative responses is considered as the raw score on the scale.

Table 4

Measurement of Household Food Security Status in the United States: Food Security Scales Values and Status Levels Based upon Raw Score to Food Security Survey Modules

Food Security level	U.S. Adult Food Security Scale	U.S. Adult Food Security Scale (with no children)	U.S. Adult Food Security Scale	Six-Item Food Security Scale	U.S. Children's Food Security Scale
High food security	Raw score zero	Raw score zero	Raw score zero	Raw score zero	Raw score zero
Marginal food security	Raw score 1-2	Raw score 1-2	Raw score 1-2	Raw score 1	Raw score 1
Low food security	Raw score 3-7	Raw score 3-5	Raw score 3-5	Raw score 3-7	Raw score 3-7
Very low food security	Raw score 8-18	Raw score 6-10	Raw score 6-10	Raw score 5-6	Raw score 5-8

Note: Adapted from “Food Security in the U.S., Survey Tools” by U.S. Department of Agriculture, 2014. Retrieved February 21, 2014, from <http://www.ers.usda.gov/topics/food-nutrition-assistance/food-security-in-the-us/survey-tools.aspx#household>

Food Security in the United States

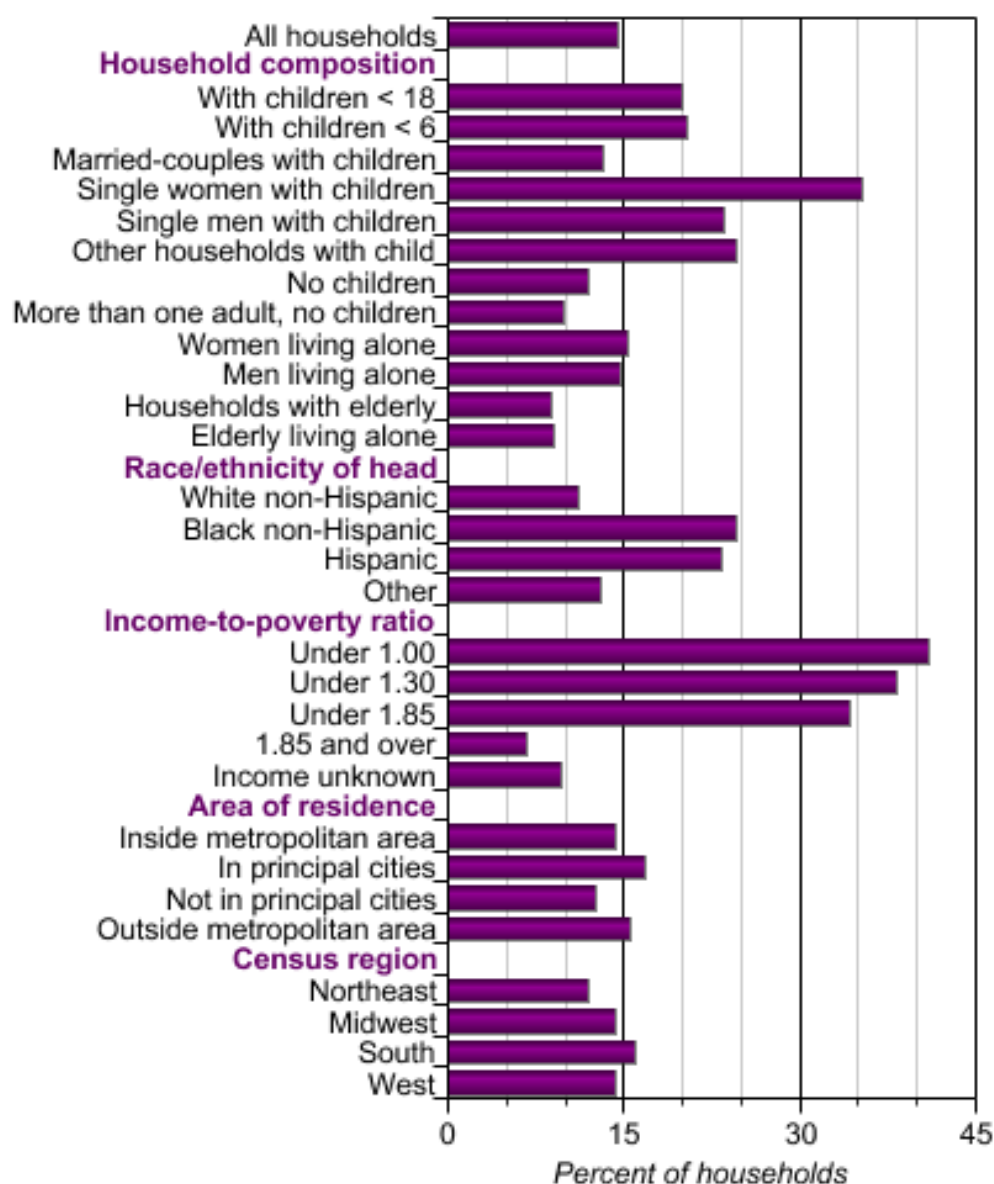
In 2012, 85.5% of households were food secure, while 14.5% were food insecure at some time during the year (Coleman-Jensen et al., 2013a). Among the 14.5% of food insecure households, 8.8% of households experienced low food security, and 5.7% experienced very low food security. Further, in very low food security households, 99% were worried that they would run out of food before they got more money or could buy

more, and 29% of them reported that one of the adults did not eat for the whole day, as there was not enough food (Coleman-Jensen et al., 2013a).

During the 2012 period, the groups that had a food insecurity rate higher than the national rate (14.5%) were households with children (20.0%), households with children under age 6 (20.5%), households with children headed by a single woman (35.4%) or a single man (23.6%), Black, non-Hispanic households (24.6%), Hispanic households (23.3%) and low-income households with incomes below 185% of the poverty threshold (34.3%) (see Figure 1). Married-couple families with children (13.2%), households with more than one adult and no children (9.8%), households with elderly persons (8.8%), White, non-Hispanic households (11.2%), households headed by non-Hispanics of other, or multiple, races (13%), and households with incomes above 185% of the poverty line (6.8%) experienced less food insecurity than the national rate (Coleman-Jensen et al., 2013a).

Very low household food insecurity was more prevalent in households with children headed by a single woman (12.7%), women living alone (7.5%), men living alone (7.3%), households with Black, non-Hispanic origin (10.4%) and Hispanic origin (7.4%), households situated in principal cities of metropolitan areas (6.7%), and households earning incomes below 185% of the poverty line (14.5%) than the national average for very low food insecurity, which was 5.7% (Coleman-Jensen et al., 2013a) (see Figure 2).

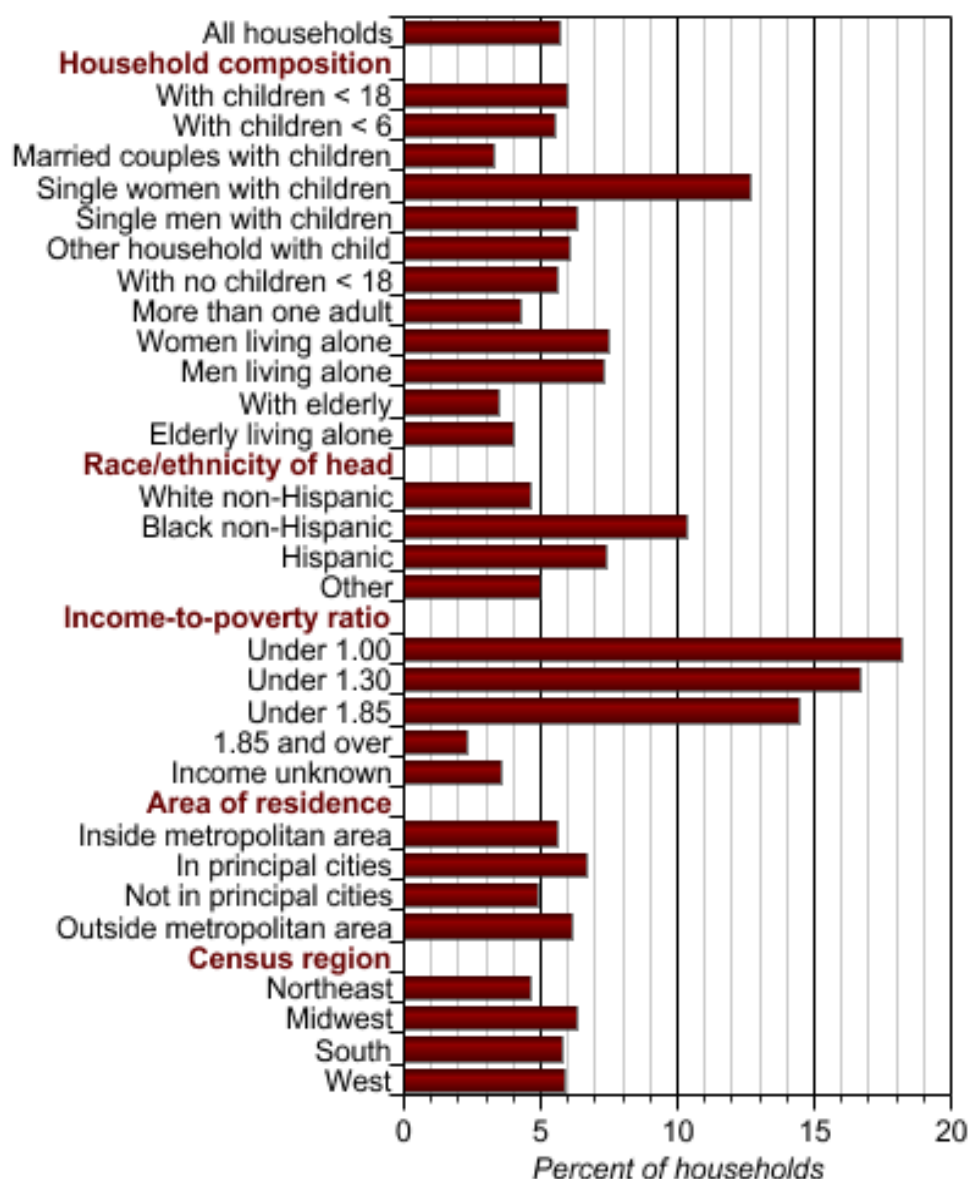
Prevalence of food insecurity, 2012



Source: Calculated by ERS using data from the December 2012 Current Population Survey Food Security Supplement.

Figure 1. Prevalence of food insecurity, 2012. From the U.S. Department of Agriculture (2013, September 4). *Food Security in the United States: Key Statistics & Graphics*. Retrieved February 6, 2014, from http://www.ers.usda.gov/topics/food-nutrition-assistance/food-security-in-the-us/key-statistics-graphics.aspx#.Uvu9A_IdUrU Reprinted with permission.

Prevalence of very low food security, 2012



Source: Calculated by ERS using data from the December 2012 Current Population Survey Food Security Supplement.

Figure 2. Prevalence of very low food insecurity, 2012. From the U.S. Department of Agriculture (2013, September 4). *Food Security in the United States: Key Statistics & Graphics*. Retrieved February 6, 2014, from http://www.ers.usda.gov/topics/food-nutrition-assistance/food-security-in-the-us/key-statistics-graphics.aspx#.Uvu9A_IdUrU Reprinted with permission.

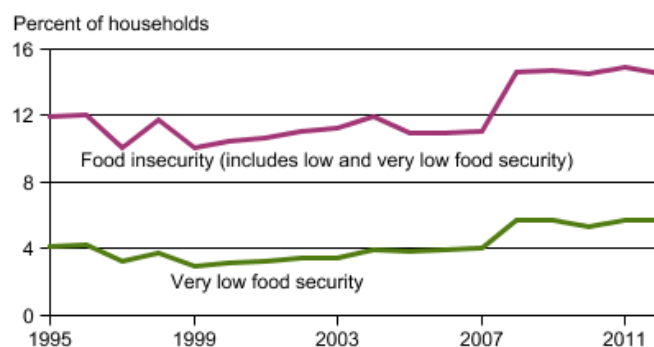
In 1998, food insecurity was 11.8%, and changed to 10.1% in 1999. During the period between 1999 and 2004, food insecurity increased at a consistent rate. In 2004, the prevalence of household food insecurity was 11.9%. In 2005, the prevalence declined to 11% and maintained the same level until 2007 (Coleman-Jensen et al., 2013a). There was a significant increase in the prevalence of food insecurity in 2008 to 14.6%. The prevalence of food insecurity did not change significantly in 2008 (14.6%), 2009 (14.7%), 2010 (14.5%), 2011 (14.9%), and 2012 (14.5%) (Coleman-Jensen et al., 2013a; see Figure 3).

In 1998, the United States experienced 3.7% of very low food security and during the period of 1998-2005 it did not change significantly. The prevalence of very low food security was 4% in 2004. It did not change significantly until 2007 (4.1%). There was an increase in very low food security in 2008 to 5.7% and maintained the same value in 2009. Even though the percentage of very low food security households declined to 5.4% in 2010, in 2011 it increased up to 5.7% and maintained the same value in 2012 (Coleman-Jensen et al., 2013a; see Figure 3).

In order to obtain food and overcome food shortages, food insecure households may get assistance from emergency food assistance or federal food assistance programs, including the Supplemental Nutrition Program for Women, Infants, and Children (WIC), the Supplemental Nutrition Assistance Program, and the School Lunch and Breakfast Programs (Coleman-Jensen et al., 2013a). Some food insecure households limit the purchase of more expensive food items (Grutzmacher & Gross, 2011). In 2012, 51.8% of food insecure households received Supplemental Nutrition Assistance Program benefits,

47.3% of food insecure households received free or reduced-cost school lunches, and 39.5% of food insecure households received WIC benefits (Coleman-Jensen et al., 2013a). In spite of the availability of help, a proportion of food insecure households did not participate in these food and nutrition assistance programs. Of very low food security households, 24% participated in Supplemental Nutrition Assistance Program, whereas 11.3% very low food security households having the same low-income range did not participate in the Supplemental Nutrition Assistance Program. The participation of very low food security households (17.3%) in free or reduced-cost school lunches was 8.9% higher than households with school-age children in the same income range that did not participate (8.4%) in the program (Coleman-Jensen et al., 2013a).

Trends in prevalence rates of food insecurity and very low food security in U.S. households, 1995-2012



Prevalence rates for 1996 and 1997 were adjusted for the estimated effects of differences in data collection screening protocols used in those years.

Source: Calculated by ERS based on Current Population Survey Food Security Supplement data.

Figure 3. Trends in prevalence rates of food insecurity and very low food insecurity in U.S. households, 1995-2012. From the U.S. Department of Agriculture (2013, September 4). Food Security in the United States: Key Statistics & Graphics. Retrieved February 6, 2014, from http://www.ers.usda.gov/topics/food-nutrition-assistance/food-security-in-the-us/key-statistics-graphics.aspx#.Uvu9A_ldUrU Reprinted with permission.

Food pantries and emergency kitchens serve as main providers of emergency food assistance (Coleman-Jensen et al., 2013). In 2012, 1.7% of food secure households used food pantries and 0.2% used emergency kitchens. In the same year, 25.4% of food insecure households used food pantries and 3.1% used emergency kitchens. Among the food pantry users, 18.3% was households with low food security, and 36.4% was households with very low food security. Among the households used emergency kitchen in 2012, 1.5% of low food secure households, and 5.7% of very low food secure households (Coleman-Jensen, Nord, & Singh, 2013b).

Healthy People 2020 is a science-based nationwide program, which was initiated by the United States federal government, targeting a 10-year period with the objective of improving the health of all Americans. Among its vast array of objectives, the promotion of healthful diets and healthy weight is designed to improve healthier food access. It also has a focus on increasing household food security and eliminating hunger. Reducing very low food security among households with children from 1.3% (2008) to 0.2% and reducing the household food insecurity from 14.6% (2008) to 6.0% are two objectives that have being initiated to combat food insecurity in the United States (Healthy People.gov, 2012).

Geographic Characteristics

Compared to other parts of the world, only a small portion of the U.S. population experiences food insecurity in their lifetime (LeBlanc et al., 2005). Compared to the Americans who live in urban regions, rural Americans experience a collective outcome of

economic factors, cultural and social differences, and educational insufficiencies, which create inequality in health care facilities (Stuff et al., 2004).

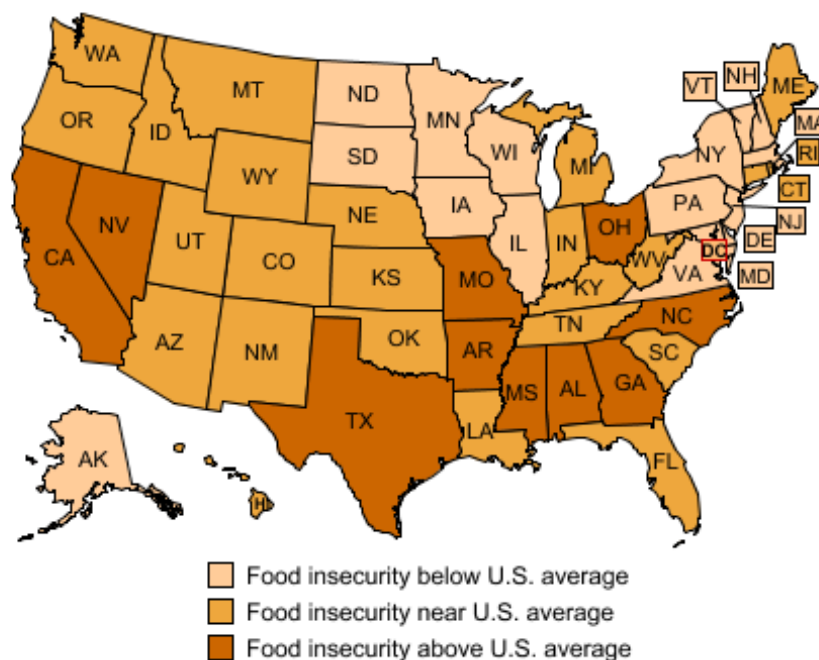
Food security differs in different geographic regions (Coleman-Jensen et al., 2013a). The Southern region had the highest food insecurity of 16%, followed by the West (14.4%), and the Midwest and Northeast (14.2% and 11.9% respectively). Food insecurity prevalence in Metropolitan areas was highest for households located in principal cities of metropolitan areas (16.9%). Households located in non-metropolitan areas had an intermediate food insecurity of 15.5%, and the lowest food insecurity of 12.7% was reported in suburbs and other metropolitan areas outside main cities (Coleman-Jensen et al., 2013a).

In 2012, the levels of food insecurity in ten states were significantly higher than the U.S. average food insecurity of 14.5%, and seventeen other States had significantly lower food insecurity. The remaining 24 states did not have significantly different food insecurity. Mississippi (20.9%) and Arkansas (17.9%) had the highest food insecurity followed by 18.4% in Texas. The lowest food insecurity was reported in North Dakota of 8.7%, and Vermont had 9.2% (Coleman-Jensen et al., 2013a). Figure 4 shows the food security prevalence at the state level in the United States during the period of 2010-2012.

Food insecurity can be a result of state-level characteristics (Bartfeld et al., 2006). Mainly the state level differences in food security can be due to the characteristics of the population, such as the income, employment, age, education, and structure of the family of their people. On the other hand, these differences can be because of the state's

economic status, the level of access to food, participation in food assistance programs, and state tax policies (Bartfeld et al., 2006).

Prevalence of food insecurity, average 2010-12



Source: Calculated by ERS based on Current Population Survey Food Security Supplemental data.

*Figure 4. State-level prevalence of food insecurity 2010-2012. From the U.S. Department of Agriculture (2013, September 4). *Food Security in the United States: Key Statistics & Graphics*. Retrieved February 6, 2014, from http://www.ers.usda.gov/topics/food-nutrition-assistance/food-security-in-the-us/key-statistics-graphics.aspx#.Uvu9A_ldUrU Reprinted with permission.*

The characteristics of the state population can be income lower than the federal poverty line (approximately up to 185% of the poverty line); education status, especially with less than high school education; ethnicity, such as households that are led by Black, Hispanic, and Native Americans; households renting the house rather than owning; living

in metropolitan areas, specifically in a central city; having three or more children; raising children by a single mother; households with adults having no employment; households without any elderly members or having disabled members; and households headed by a noncitizen (Bartfeld et al., 2006). On the other hand, the risk factors that are associated with state-level food insecurity are people getting low wages, high housing rentals, low participation in the National School Lunch program and food programs during the summer, increasing unemployment rate, and people moving in and out of the states for reasons such as jobs or homes, create instability among such households, and high employment rates (Bartfeld et al., 2006).

Adult and Women's Food Security

Primarily, women manage food and feeding requirements in the household (Olson, 2005; Quisumbing et al., 1995). It was reported that in 2012, higher food insecurity rates among households with children headed by a single woman was 35.4%, which was 11.8% higher than households headed by a single man. In the same year food insecurity for women who are living alone was 15.3% (Coleman-Jensen et al., 2013a). Women appear to adapt their food intake in order to secure the nutritional status of other family members, especially the children (McIntyre et al., 2003; Quisumbing et al., 1995). Olson, Miller, Swanson, and Strawderman (2005) found that food secure households had women with one or fewer chronic diseases (44.1%), compared to food insecure (54.2%) households. When there are not enough socially acceptable ways to obtain food then people tend to use various other coping mechanisms, such as withdrawing children from schools, selling other assets in order to buy food, larceny, and also risky behaviors such

as exchanging sex for money or for food. The problem is more profound when women have a low education standard with low income, which leads to a low purchasing power (Ivers & Cullen, 2011).

When compared to food secure women, the women who are food insecure consume significantly fewer meals (Dixon et al., 2001). Women who live in food insecure households tend to sacrifice their portion, especially their fruit and vegetable intakes. Such practices increase the risk to developing a poor health status (Olson, 2005). Kendall et al. (1996) studied a random group of women with children living at home in a rural county of New York State. Of the study group, 25% were living in food insecure households. As food insecurity worsened, fruit, salad, carrots, and vegetable consumption declined significantly, at the same time, the scores on eating disorder scale increased significantly. Food insecure women were more likely to fail to meet the national dietary recommendations for Vitamin C and several fruits and vegetable servings. Researchers were able to observe a significant difference in potassium and fiber intake and fruit consumption, among food secure group and food insecure group. A study conducted by Olson (2005) in New York State was able to show that when the household food insecurity increases, the frequency of fruit and vegetable consumption was significantly decreased, and also there was a significant reduction in scores indicative of disordered eating patterns among the women. When comparing the potassium and fiber intake among the food secure and food insecure women, it was a significant difference between the two groups. Also, food insecure women had a significantly lower consumption of vitamin C than the Recommended Dietary

Allowance, and also they consumed fewer than five fruits and vegetables per day. A study conducted by Kaiser, Baumrind, and Dumbauld, (2007) among women in California, revealed that there was 25.7% of food insecurity. The characteristics of groups that had highest food insecurity were Hispanic or Black race/ethnicity; Spanish-speaking; age less than 55 years; unmarried; low education; and when time spent in America is less than half of one's life. A more extensive discussion of produce intake related to food insecurity will be discussed in a subsequent section.

Studies conducted using nationally representative samples, have shown that among food insecure adults and older adults, there are poor nutrition outcomes due to intake of insufficient key nutrients (Bhattacharya, Currie, & Haider, 2004; Dixon et al., 2001). A study done by Stuff and colleagues (2004) in the Lower Mississippi Delta, found that adults who are food insecure are tend to have poor self-reported mental, physical and general health status. Dixon et al. (2001) discovered that food insecure adults who were between 20-59 years were more likely to have micronutrients below 50% of the dietary recommendations, and also the frequency of consumption of milk/milk products, fruits/fruit juices and vegetables were low compared to the adults who were food secure. On the other hand, studies have shown that the energy intake of food insecure adults did not differ from the food secure adults (Zizza, Duffy, & Gerrior, 2008). The reason for this is that they tend to eat more snacks, through which they make up the skipped meals or meal frequencies. A study conducted by Lee and Frongillo Jr, (2001) was able to show that the intake of energy, protein, carbohydrate, saturated fat, niacin, riboflavin, vitamins B₆ and B₁₂, magnesium, iron and zinc were significantly

lower among food-insecure elderly persons. In the same study, food-insecure elderly persons had a higher nutritional risk, and the likelihood of reporting fair or poor health status was 2.33 times greater. Rose and Oliveira (1997) analyzed a 24-hour diet recall data of a group of adult women and elderly. They uncovered that food sufficiency in adult women was significant and they consumed low amounts of eight nutrients, including energy, magnesium, and vitamins A, E, C, and B₆. Also, the elderly group had a probability of having low quantities of eight nutrients, including protein, calcium, and vitamins A and B₆.

Correlation between Food Insecurity and Poverty

Food is essential for the ideal physical, cognitive and mental development and functioning of the human body (Hamilton et al., 1997). If a person does not consume a sufficient amount food, that person could experience the response created by the body due to lack of food. This response, which is an uneasy or painful sensation caused by a lack of food, is known as hunger (Hamilton et al., 1997). Even though the prevalence of food insecurity differs with the demographic and economic characteristics, it has a strong relationship with income earning (Coleman-Jensen, Nord, Andrews, & Carlson, 2011; Nord et al., 2012; Rose, 1999; Quisumbing et al., 1995).

In 2012, 15.0% people and 11.8% families were in poverty. There was a 13.6% of poverty rate among males, and the poverty rate for females was 16.3% (DeNavas-Walt, Proctor, & Smith, 2013). This was not significantly different from the statistics in year 2011. In 2012, low-income households with incomes below 185% of the poverty line had 34.3% food insecurity. The prevalence of food insecurity among households

who had incomes below 100% and 130% of the poverty line were 40.9% and 38.2%, respectively. In 2012, the Federal poverty line was \$23,283 for a family of four (Coleman-Jensen et al., 2013). As stated by Grutzmacher and Gross (2011), in low-income families, obtaining food and the availability of food is controlled by limited resources.

When the cost for diet was reduced, below-income groups had a higher tendency of purchasing food that was high in fat and more energy-dense (Drewnowski & Specter, 2004). This change was more pronounced in low-income groups due to the inability to purchase recommended healthy food groups, such as lean meats, fish, fresh vegetables, and fruits, which are often more expensive. Furness, Simon, Wold, and Asarian-Anderson (2004) conducted a study in Los Angeles County to measure the prevalence and identify the predictors of food insecurity among households with incomes below 300% of the federal poverty level. They discovered that food insecurity prevalence was higher among the households with lowest income, with children, and who were homeless during the past five years.

Consequences of Food Insecurity

According to Hamelin and others (1999), outcomes of food security can be grouped into three areas: physical weakness, psychological distress, and sociofamilial disturbances. They have stated that the physical weakness consists of poor health, fatigue, or both, and these two conditions are related to lack of food. The psychological concerns are linked to insufficient access to food. This also involves feelings of stress and uneasiness that will make an individual act opposed to usual personal norms and

values, including obtaining food from a community food distribution centers, such as food pantry. The changes that occur in usual food consumption, in normal household activities, and also the disturbance in ways of obtaining food and managing fall under the category of sociofamilial disruptions (Hamelin et al., 1999).

Food insecurity has several consequences (DeRose et al., 1998). African-American women who utilize the food pantries constantly showed anxiety, violence, and stress, which had a strong relationship with severe food insecurity. Additionally, food-insecure households depict significant characteristics such as lower nutrient intakes (Weinreb et al., 2002), poor child development (Rose-Jacobs et al., 2008), and poor health (Lee et al., 2001). People who live in food insecure households are being forced into trade-offs, which increases their vulnerability (Brown & Gentilini, 2006). Some of these trade-offs are deciding between paying for housing (Meyers et al., 2005), heating (Frank et al., 2006), and medical care (Biros, Hoffman, & Resch, 2005). Brown, Shepard, Martin, and Orwat (2007) reported that according to 2007 estimations, the approximate cost of severe food insecurity is \$90 billion per year, and they anticipated that the actual cost of food insecurity could be higher. The cost for food insecurity is due to the elevation in medical cost, insufficient education, loss of productivity of workers, and cost for emergency food programs (Brown et al., 2007).

Stuff et al. (2004) conducted a study with rural and high-risk adults from the Lower Mississippi Delta, and it revealed that household food insecurity had a relationship with poorer self-reported health. A Canadian study uncovered that adults who experienced food insufficiency showed that there was a significantly higher possibility of

having poor health and poor functional health along with restricted activity.

Additionally, they had multiple chronic conditions, suffered from major depression and distress, and had poor social support (Vozoris & Tarasuk, 2003). Several studies have discovered that there is an association between food insecurity and diet-related chronic diseases (Huet, Rosol, & Egeland, 2012; Seligman, Laraia, & Kushel, 2010). It is believed that the relationship between food insecurity, poor nutrition, and poor physical and mental health is being created by several biological and stress mechanisms (Stuff et al., 2004). Adults who are food insecure and consume lower amounts of nutrients are more likely to be in poor or fair health, and are more likely to have problems with their daily activities (Lee et al., 2001; Ziliak, Gundersen, & Haist, 2008). Some of the outcomes, such as malnutrition, increase the susceptibility to diseases, increase disability, increase immune resistance to infections, and increase stays in health care facilities (Lee et al., 2001). Literature supports that food insecurity is associated with the development of weight gain, obesity, and insulin insensitivity (Stuff et al., 2004). Klesges et al. (2001) uncovered those women who are financially unable to obtain food, show greater levels of psychological depression than women who do not experience such a problem. Additionally, the inability to financially obtain food had a relationship with having a poorer quality of life and physical activity.

Chronic Disease

Chronic diseases have been one of the leading causes for higher mortality and disability rates in the world (WHO, n.d.-b). The chronic diseases that are accountable for the highest number of deaths are heart disease, stroke, cancer, chronic respiratory

diseases and diabetes (CDC, 2012a). Statistics have shown that the total number deaths from chronic diseases are double the number of all infectious diseases (including HIV/AIDS, tuberculosis and malaria), maternal and perinatal conditions, and nutritional deficiencies combined. The worldwide death toll in 2005 due to chronic disease was over 35 million people, which were 60% of the total estimated deaths in the world (WHO, 2005). Eighty percent of the total deaths from chronic diseases happen in low and middle income countries, and also 50% of them are in women (WHO, n.d.-a). According to estimates, if not given proper attention, this number of deaths can be increased by 17% between 2005 and 2015 (WHO, n.d.-b).

According to the CDC (2014), a chronic disease is a condition that prevails for longer durations and progresses at a slower pace. In the United States, most common chronic diseases are heart disease, stroke, cancer, diabetes, and arthritis, which are costly yet preventable (CDC, 2012a). Seven out of 10 deaths among Americans are due to chronic diseases. In 2005, 133 million Americans had at least one chronic disease (CDC, 2012a). The increase in the prevalence of chronic disease from 1960 to 2004 is 1.8% to 7%. In the U.S., out of total health cost more than 75% is due to chronic diseases (CDC, 2009). Additionally, the number of people living with chronic disease in America is higher than in Europe. The marked difference in lower health care cost may be due to healthier eating habits and lower poverty rates in Europe compared to the United States (Thorpe, Howard, & Galactionova, 2007). The four most common health behaviors are lack of physical activity, poor nutrition, tobacco use, and excessive alcohol consumption (CDC, 2012a). Based on the 2008 Physical Activity Guidelines for Americans, more

than one third of adults fail to meet the recommendations (Carlson et al., 2008). As the Behavioral Risk Factor Surveillance System reported in 2007, only 24% of adult Americans have eaten 5 or more servings of fruits and vegetable per day (CDC, n.d-c.).

Chronic Disease Risk and Poverty

Poverty exacerbates the problem, as when a person does not have sufficient access to resources, and participates in risky behavior, resulting in psychosocial stress (Murali & Oyebode, 2004). In the United States, many chronic diseases, such as diabetes, hypertension, hypercholesterolemia, stroke, heart disease, certain cancers, and arthritis, exist due to poor education and low income (Drewnowski & Specter, 2004; Drewnowski & Darmon, 2005). People who do not have adequate financial recourse tend to purchase low-cost, energy-dense food with added sugar and fat rather than lean meats, whole grains, and fresh vegetables and fruit, as they are usually more expensive to buy. Particular background provides a better explanation is to why there are very high rates of obesity and diabetes observed among minority populations and the poor labor force (Drewnowski & Darmon, 2005). Govil, Weidner, Merritt-Worden, and Ornish, (2009) were able to find out that the less educated and people with low socioeconomic status were more likely to be past smokers, lead a sedentary lifestyle, consume a high fat diet, be overweight and have depression than people with high socioeconomic standards. Women have a higher chance of being obese, particularly when they are poor. Further, poverty has an effect on women's physical activity, inadequate sleep, and skipping breakfast (Lee, Harris, & Gordon-Larsen, 2009).

There is scientific evidence that people who are earning low incomes, living in rural neighborhoods, and are minorities have very limited access to supermarkets, and also they do not consume sufficiently healthy diets. These people are more likely to eat fast food and food high in energy. These reasons are a concern, because the particular population is more susceptible to developing obesity (Larson, Story, & Nelson, 2009). Schoenborn, Adams, and Barnes (2002) observed that African American and Hispanic middle-aged adults who are less educated and low income earning reported the highest rate of obesity. Freeman (2006) stated that there are major barriers among the poor in preventing and controlling cancer problems in the United States. According to Freeman (2006), “Poor people face substantial barriers in seeking screening, diagnosis, and treatment of cancer, poor people experience more pain, suffering, and death due to cancer because of late diagnosis and treatment, poor people make sacrifices in order to obtain care and often do not seek care because they cannot afford it, poor people often indicate that the educational system related to health care is frequently insensitive and even irrelevant to them, poor people often become fatalistic and give up hope when in need of health care” (p. 139).

Appalachia

According to the Appalachian Regional Commission (ARC, n.d.), Appalachia consists of 399 counties and 13 states. Having 205,000 square miles, the region extends more than 1,000 miles alongside the spine of the Appalachian Mountains, from the southern portion of New York State through the northern part of Mississippi. The other states which are in the Appalachian region are portions of Pennsylvania, Maryland,

Ohio, Kentucky, Tennessee, Virginia, North Carolina, South Carolina, Georgia, Alabama and the entire state of West Virginia. The population of this region is over 25 million people. Appalachia is divided into subregions, which were revised in 2009 for research purposes (ARC, n.d.). The five subregions are north, north central, central, south central, and southern (see Figure 5).

The geography of Appalachia exists in a way that makes it isolated from the other surrounding regions (McLaughlin, Lichter, & Matthews, 1999). Friedell, Linville, and Hullet (2000) explained that 67% (266 of the 399 counties) of the Appalachian region was identified as rural. According to the Appalachian Regional Commission (n.d.) for the fiscal year 2014, there were 93 counties identified as distressed counties (ARC, n.d.). For the fiscal year 2014, there are seven Appalachian Ohio counties that are under the distressed category: Adams, Athens, Meigs, Morgan, Noble, Pike, and Vinton. The 3-year average unemployment rate, per capita market income, and poverty rate of each county is compared with national averages, and depending on the weighted averages, counties are categorized into distressed, at-risk, competitive, or attainment groups. The counties having a poverty rate and unemployment rates of at least 150% of the national rates, and having a per capita market income no more than two thirds of the national average, are categorized as distressed counties (ARC, n.d.).

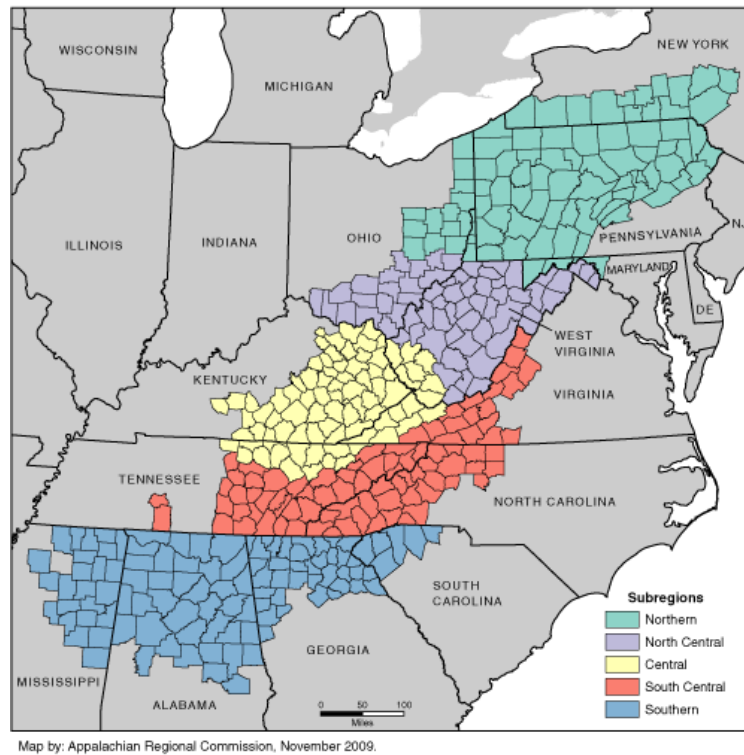


Figure 5. Subregions in Appalachia, U.S., 2009. From Subregions in Appalachia by Appalachian Regional Commission, 2009. Retrieved February 15, 2014, from http://www.arc.gov/assets/maps/related/Subregions_2009_Map.pdf Copyright 2013 by Appalachian Regional Commission. Reprinted with permission.

Food insecurity in Appalachia is probably greater than the national average. In 2006, in a sample of adults, Holben and Pheley (2006) found out that food security in Athens, Hocking, Meigs, Perry, Pike, and Vinton counties in Ohio was 27.2%. Among food insecurity with hunger households, 9.6% were food insecure with moderate hunger, and 10.5% were food insecure with severe hunger. Athens County in Ohio is one of the distressed counties (ARC, n.d.). Pheley, Holben, Graham, and Simpson, (2002) studied a group of people ($n = 1,006$) in the Athens county Ohio. The study uncovered that the group had 23% food insecurity.

In the Appalachian region, there are counties which have populations with poor economic status, a lower education status, are much older and have lower health status when compared to the national average (Friedell et al., 2000; see Figure 6).

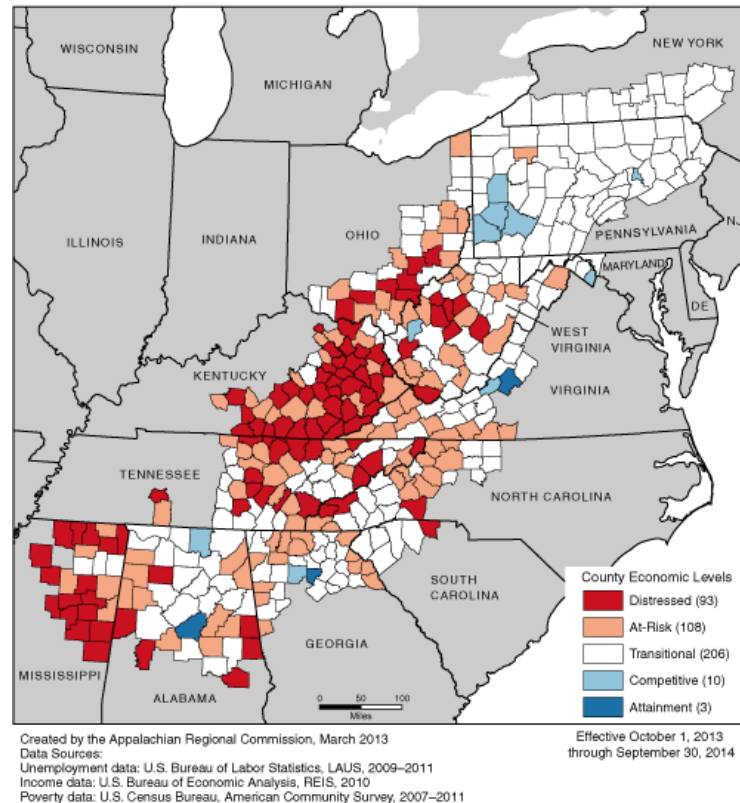


Figure 6. County economic status in Appalachia, FY 2014. From County Economic Status in Appalachia, FY 2014 by Appalachian Regional Commission, 2013. Retrieved February 15, 2014, from http://www.arc.gov/assets/maps/related/County-Economic-Status_FY2014_Map.pdf Copyright 2013 by Appalachian Regional Commission. Reprinted with permission.

Appalachian countries are categorized into one of five economic statuses: attainment, at-risk, transitional, competitive and distressed, depending on its status compared to the national ranking. Counties that fall in the attainment group are positioned as the best 10% of the nation's counties. On the contrary, distressed counties

are ranked as the worst 10% and they are the highly economically depressed counties (ARC, n.d.).

Compared to the national average, the per capita personal income was 82% in Appalachia. In all five Appalachian subregions, per capita income was significantly lower than the national average. Among the subregions, Northern and Southern Appalachia had a comparatively higher per capita income. In 2009, the lowest per capita income was reported in Central Appalachia, which was 68% of the national average (ACR, 2011; see Figure 7).

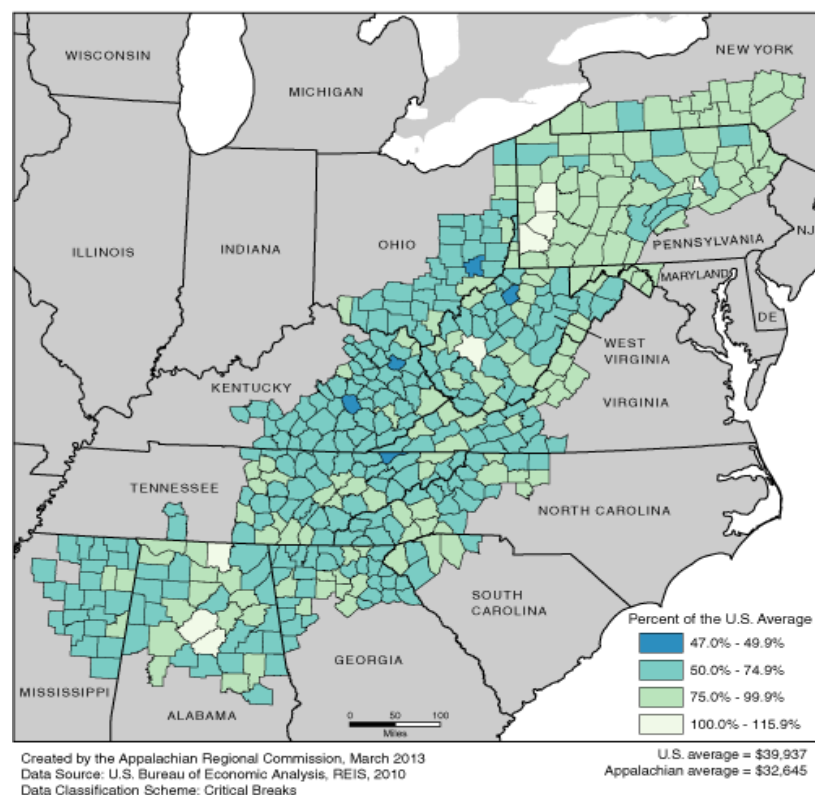


Figure 7. Relative per capita income rates in Appalachia, 2010. From Relative per Capita Income Rates in Appalachia 2010 by Appalachian Regional Commission, 2013.

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http://www.arc.gov/assets/maps/related/Per_Capita_Income_2010_Relative_Map.pdf

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In 2009, out of 32 counties in Appalachian Ohio, 14 counties were regarded as the poorest with a poverty rate of 13%, when compared to the 10% poverty rate in the other 18 counties (ACS, OCISS, 2010). During the 2007-2011 period, the poverty rate in the Appalachian region was 16.1% and the U.S. it was 14.3% (see Figure 8). During the same period, Appalachian Ohio had a poverty rate of 16.7% and in non-Appalachian Ohio it was 14.3% (Pollard & Jacobsen, 2013).

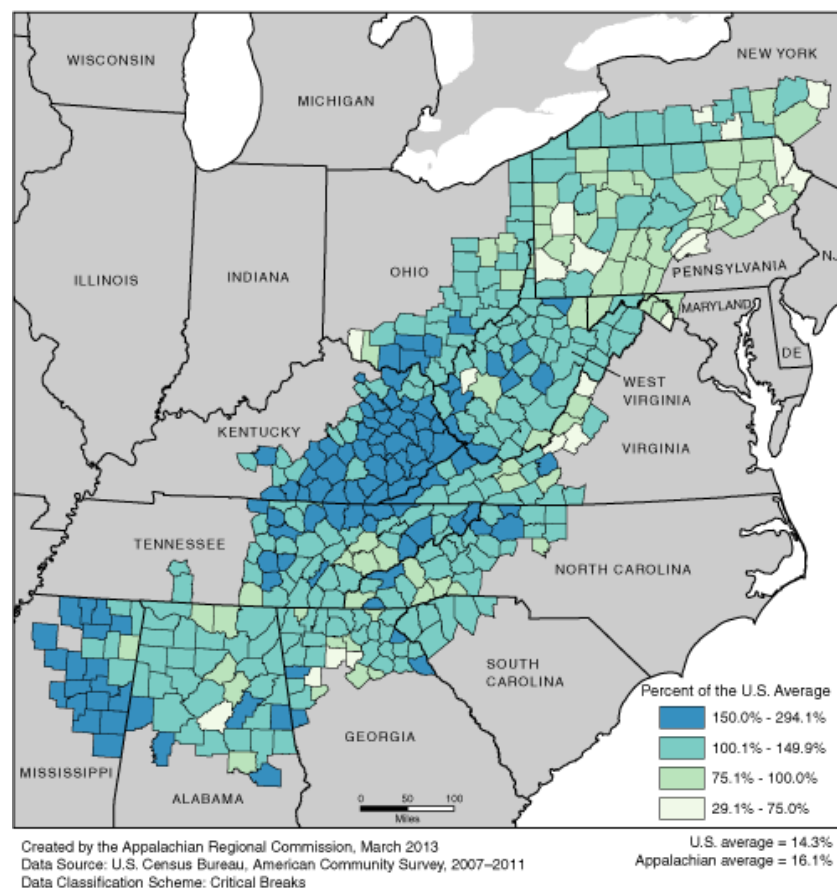


Figure 8. Relative poverty rates in Appalachia, 2007–2011(County Rates as a Percentage of the U.S. Average). From Relative Poverty Rates in Appalachia, 2007–2011 by Appalachian Regional Commission, 2013. Retrieved February 15, 2014, from http://www.arc.gov/assets/maps/related/Poverty_Rates_2007-2011_Relative_Map.pdf Copyright 2013 by Appalachian Regional Commission. Reprinted with permission.

According to the findings of 2008 Ohio Family Health Survey, in Appalachia the prevalence of poor health care quality was 5.51%, which was significant compared to other regions (metropolitan, 4.31%; rural, 3.28%; suburban, 2.21%). The proportion of unmet health needs in Appalachia was 5.51% and was also statistically significant (metropolitan, 15.2%; rural, 14.39%; suburban, 13.98%). Further the report concluded that in comparison with counties in Metropolitan areas, adults living in Ohio Appalachian counties had the probability of live in poverty, not having a high school diploma, being unemployed, and having Medicaid insurance or not having any insurance coverage. These adults were having low health status with probable characteristics of being smokers, being obese, having elevated blood pressure, having diabetes mellitus, and having a heart attack that calls for the need of having improved healthcare facilities for the Appalachian population.

Chronic Disease Risk in Appalachia

Rural Appalachia has been identified as a region where there is a high existence for risk factors related to cancer, such as inadequate physical activity, insufficient access to healthcare, and high usage of tobacco (Wewers, Katz, Fickle, & Paskett, 2006), as well as other chronic diseases. A study conducted in West Virginia revealed that the prevalence of obesity in the region is markedly high, due to lifestyle behaviors along with poor health status. During the 1994-1998 periods, rural Appalachia reported a death rate of 176.3/100,000 for all cancers, while all Appalachia had 173.1/100,000 (Huang et al., 2002). These rates were significantly higher than the national death rate (166.7/100,000) for the same period. Kelly, Shedlosky-Shoemaker, Porter, DeSimone, and Andrykowski,

(2010) suggested out that the people who live in rural Appalachia have a higher likelihood of cancer recurrence than people who live outside the region. Holben and Pheley (2006) conducted a study in rural counties in the northern Appalachian region of Ohio to assess the relationship of food security to clinical measurements of several chronic health risks. They were able to uncover that there was a high body mass index among individuals from food-insecure households, and this was prominent especially among women from food insecure households than their food-secure counterparts. Further study results showed that obesity was greater among individuals from food-insecure households, which was 48.1% compared to participants from food-secure households (35.1%). Another study conducted in the Appalachian state of West Virginia showed that obesity worsens as per capita income decreases (Amarasinghe, D'Souza, Brown, Oh, & Borisova, 2009).

Elnicki, Morris, and Shockcor (1995) stated that the tendency to screen for chronic disease among rural Appalachians was very low due to a lack of knowledge and related health care cost. Additionally, it was reported that among the study group, only 16% of the participants had blood pressure screening, 60% had tested for cholesterol level, 69% had mammography, 32% had done a physical examination, and 85% of them not had at least one preventative screening (Elnicki et al., 1995). The Community Outreach Program conducted by Appalachian Community Cancer Network has paid attention to educating Appalachians who are at risk about cancer. The goal of this program is to reduce the cancer burden in Kentucky, Ohio, Pennsylvania, Virginia, and

West Virginia. Also they carry out research and training programs in selected regions (ACCN, n.d.).

Cancer

Cancer is one of the most common chronic diseases in the world (WHO, 2014). In 2008, the number of deaths due to cancer was 7.6 million, which is 13% of all deaths (IARC, 2008). In 2008, globally, the estimated number of incidences for all cancers (excluding nonmelanoma skin cancer) was 12,662,554, and the mortalities were 7,564,802 (IARC, 2008). In 2002, the estimated distribution was 44.9% in Asia, 26% in Europe, 14.5% in North America, 7.1% in Central/South America, 6% in Africa and 1% in Oceania (Kamangar, Dores, & Anderson, 2006). Lung, stomach, liver, colon, and breast cancer are the leading cancers in the world (WHO, 2014). HPV is one of the most common viral infections and it is responsible for 20% of the cancer deaths in low-income and middle-income countries. Also, 30% of the cancer deaths can be prevented by controlling behavioral and dietary patterns of the society, high body mass index, low fruit and vegetable intake, lack of physical activity, tobacco use, and alcohol use (WHO, 2014). The approximate number of expected new cases and deaths in 2014 are over 16 million and 0.58 million, respectively (ACS, 2014a). In 2008, there was a global cost of \$895 billion for cancer (John & Ross, 2010).

Cancer causes serious social and economic problems all around the world (John & Ross, 2010). In 1971, President Richard Nixon initiated the “War against Cancer,” and since then there has been a number of accomplishments in cancer treatment and prevention (Freeman, 2008). According to the ACS (2012), cancer has become the

second leading cause of deaths in the United States. It causes one out of four deaths in the country. In 2007, the National Institutes of Health estimated that in the United States the annual total cost for cancer was \$201.5 billion. Also, the direct medical cost for cancer was \$77.4 billion and indirect cost due to loss of productivity was \$124 billion (ACS, 2013a). In order to address the chronic cancer issue there are programs such as the National Breast and Cervical Cancer Early Detection Program, the National Comprehensive Cancer Control Program, the National Program of Cancer Registries, and the Colorectal Cancer Control Program (CDC, 2013a).

There are a number of cancers that can be prevented by one or more life style changes such as refraining from smoking, increasing fruit and vegetable intake, using alcohol in moderate amounts, restricting caloric intake, regular exercise, minimizing meat consumption, protecting skin from direct exposure to sunlight, regular screening, and vaccinations (Anand et al., 2008).

As defined by the National Cancer Institute (2012), cancer is a group of diseases caused due to uncontrolled growth of abnormal cells that are able to invade other tissues. Hanahan and Weinberg (2000) have recorded that there are six common modifications that take place in the cell functions, which ultimately lead to the development of an invasive cancer. They proposed that every cancer: (a) has a self-supported signaling system that supports its growth; (b) is insensitive to growth inhibitors; (c) has the ability to avoid the programmed cell death; (d) has a high potential to replicate; (e) has a continuation of angiogenesis; and (f) has the ability to invade and metastasize the respective tissue. Further, they have suggested that cancers have the ability to reprogram

the energy metabolism and have the ability to evade the immune destruction and cause alterations in the genome.

The information about cancer incidence, mortality and prevalence provide different information about cancer status (Kamangar et al., 2006). Cancer incidence is the number of new cancer cases occurring in a specified population and in a given period of time (NCI, 2009). Cancer mortality is the number of deaths in a specified population and in a given period of time. Cancer incidence and mortality are expressed as the number of cancers/deaths per 100,000. Cancer prevalence is the number, including people living with cancer, who have been diagnosed and who have been diagnosed recently, at a given time (NCI, 2009). Age adjustment is done for the incidence or mortality rates. Incidence or mortality rate of a certain age group is being considered as a standard population, and the value is expressed as a proportion of the particular population. The possible effects occurring due to the age factor can be reduced when using age-adjusted rates (NCI, 2009).

Cervical Cancer

Among female cancers, cervical cancer has been identified as a preventable cancer that affects women (CDC, 2013b). Cervical cancer is a gynecologic cancer and the second most common cancer among women worldwide (Arbyn et al., 2011). According to 2008 estimates, the age-standardized cervical cancer incidence crude percentage in the world was 8.8%. Crude rates in developing regions and developed region were, 16.7% and 12.1%, respectively. Each year there are 500,000 new cases being diagnosed, 250,000 women die due to cervical cancer, and 80 of deaths are from

low- and middle-income countries (WHO, 2012). Figure 9 and Figure 10 demonstrate the world age-standardized prevalence and mortality rates for cervical cancer for 2012. The global cervical cancer incidence rates were highest in Central America, South America, the Caribbean, Sub-Saharan Africa, Southern Asia and Africa, Latin America, Asia, and India (ACS, 2008).

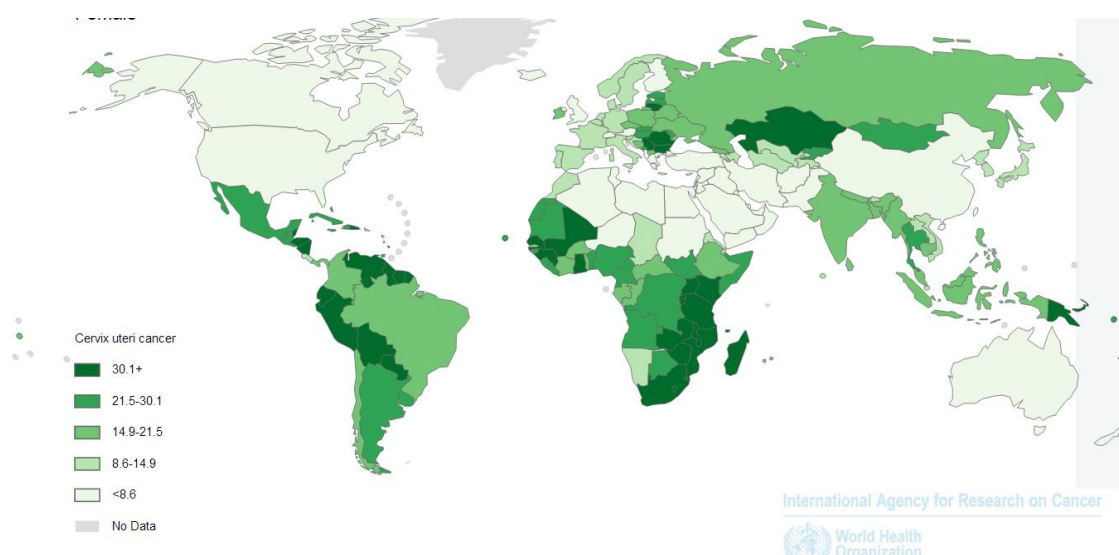


Figure 9. Estimated cervix uteri cancer prevalence, 2012. From “Cancer Incidence and Mortality Worldwide,” by J. Ferlay, I. Soerjomataram, M. Ervik, R. Dikshit, S. Eser, C. Mathers, . . . F. Bray, 2013. Available from the International Agency for Research on Cancer website: <http://globocan.iarc.fr>. Reprinted with permission of the author.

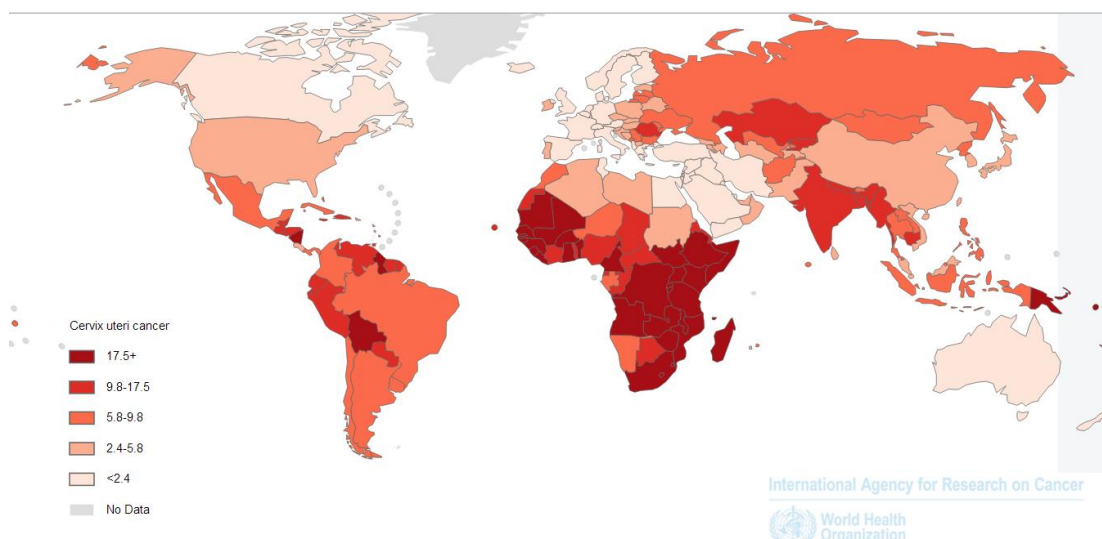


Figure 10. Estimated cervix uteri cancer mortality, 2012. From “Cancer Incidence and Mortality Worldwide,” by J. Ferlay, I. Soerjomataram, M. Ervik, R. Dikshit, S. Eser, C. Mathers, . . . F. Bray, 2013. Available from the International Agency for Research on Cancer website: <http://globocan.iarc.fr>. Reprinted with permission of the author.

The NCI defines cervical cancer as “Cancer that forms in tissues of the cervix (the passage that connects the uterus and vagina)” (NCI, 2009). Further, most of the cervical cancers occur between the endocervix columnar epithelium (see Figure 11) and the ectocervix squamous epithelium (Burd, 2003).

Progression from the original viral infection to the invasive cancer stage is at a very slow pace, and the time it takes to develop can be from years to decades. Thus, it provides ample time to detect the treatable pre-cancer stages before it develops into an invasive carcinoma (McLaughlin-Drubin & Münger, 2009). Table 5 summarizes cervical cancer related terms.

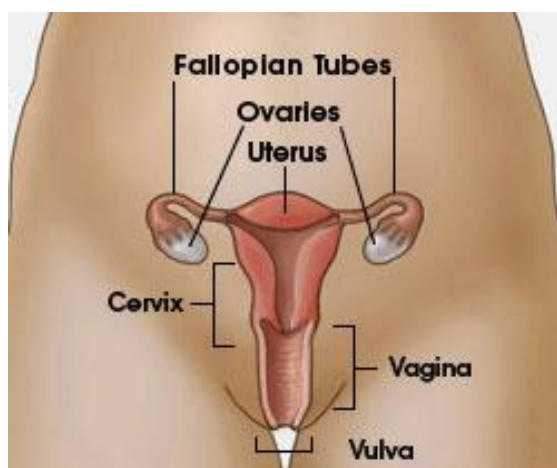


Figure 11. A cross-section of the cervix. From Centers for Disease Control and Prevention 2014. *Gynecologic Cancers, Cervical Cancer*. Retrieved January 17, 2014, from <http://www.cdc.gov/cancer/cervical/> Reprinted with permission of the author.

Table 5

Terminology Used in Cervical Cancer

Term	Definition
Cytologically normal women	–No abnormal cells are observed on the surface of their cervix upon cytology (WHO, 2010, p. 26).”
Cervical Intraepithelial Neoplasia (CIN) / Squamous Intraepithelial Lesions (SIL)	–SIL and CIN are two commonly used terms to describe precancerous lesions or the abnormal growth of squamous cells observed in the cervix. SIL is an abnormal result derived from cervical cytological screening or Pap smear testing. CIN is a histological diagnosis made upon analysis of cervical tissue obtained by biopsy or surgical excision (WHO, 2010 p. 26).”
Low-grade cervical lesions (LSIL/CIN1)	–Low-grade cervical lesions are defined by early changes in size, shape, and number of abnormal cells formed on the surface of the cervix and may be referred to as mild dysplasia, LSIL, or CIN1 (WHO, 2010, p. 26).”
High-grade cervical lesions (HSIL/ CIN2 / CIN3 / CIS)	High-grade cervical lesions are defined by a large number of precancerous cells on the surface of the cervix that are distinctly different from normal cells. They have the potential to become cancerous cells and invade deeper tissues of the cervix. These lesions may be referred to as moderate or severe dysplasia, HSIL, CIN2, CIN3, or cervical carcinoma in situ (CIS).

Table 5 (Continued)

Term	Definition
Carcinoma in situ (CIS)	Cancerous cells are confined to the cervix and have not spread to other parts of the body.
Invasive cervical cancer (ICC) / Cervical cancer	If the high-grade precancerous cells invade deeper tissues of the cervix or to other tissues or organs, then the disease is called invasive cervical cancer or cervical cancer.
Invasive squamous cell carcinoma	Invasive carcinoma composed of cells resembling those of squamous epithelium.
Adenocarcinoma	Invasive tumor with glandular and squamous elements intermingled.

Note. Adapted from “Human Papillomavirus and Related Cancers, Summary Report 2010,” by WHO/ICO Information Centre on HPV and Cervical Cancer (HPV Information Centre), 2010, p. 26. Retrieved February 6, 2014, from <http://www.fns.usda.gov/fsec/files/fsguide.pdf>

Cervical cancer is a slow-growing cancer, and the visible symptoms can appear when the tissue has been invaded by the true invasive cancer. The most common symptoms at the invasive cervical cancer stage are listed below (ACS, 2014b).

1. Abnormal bleeding in the vagina, such as after having sex, continuation of bleeding even after menopause, occurrence of periodical bleeding and spotting, and longer and unusually heavier and longer menstrual periods, continuation of the bleeding even after douching, or a pelvic exam.
2. Discharge occurring unusually from the vagina and may contain blood. This could occur even between periods or after menopause.
3. Pain felt during sex.

In the developed regions of the world, cervical cancer has taken 10th rank, and in North America, it is the 13th most common cancer among women (WHO, 2010). In the United States, cervical cancer is ranked as the 14th among the female cancers (NCI, 2010), and, in 2014, it is projected that there will be 12,360 new cases and 4,020 deaths (ACS, 2014c). The United States spends an annual direct cost of (approximately) \$1.55 billion for cervical cancer (Mariotto, Yabroff, Shao, Feuer, & Brown, 2011).

The cervical cancer burden differs between the race and ethnicity. According to the statistics during 2000-2004, the national rate for new cases diagnosed in the U.S. was 8.7 women out of every 100,000. During the same period, African Americans Hispanic women had a highest incidence rate, 13.8/100,000, followed by with 11.4/100,000 and whites with a rate of 8.5/100,000. The mortality rate for all races was 2.6/100,000. African American women showed the highest mortality with 4.9/100,000. The second highest mortality rate was reported for American Indian/Alaska Native (4.0/100,000), and a 3.3/100,000 mortality rate was seen among Hispanics/Latino women (NCI, 2008).

As Figure 12 shows, the incidence rates during 2008 in Arkansas, Delaware, District of Columbia, Florida, Illinois, Louisiana, Mississippi, North Dakota, Oklahoma, Texas, West Virginia, and Wyoming reported the highest incidence rates for cervical cancer; 8.8 to 10.7 per 100,000 women. During the same year, states that reported the lowest incidence rate (4.8 to 6.3 per 100,000) were Colorado, Connecticut, Idaho, Kansas, Maine, Massachusetts, Minnesota, Montana, Nebraska, New Hampshire, Utah, Virginia, and Wisconsin (CDC, 2012b).

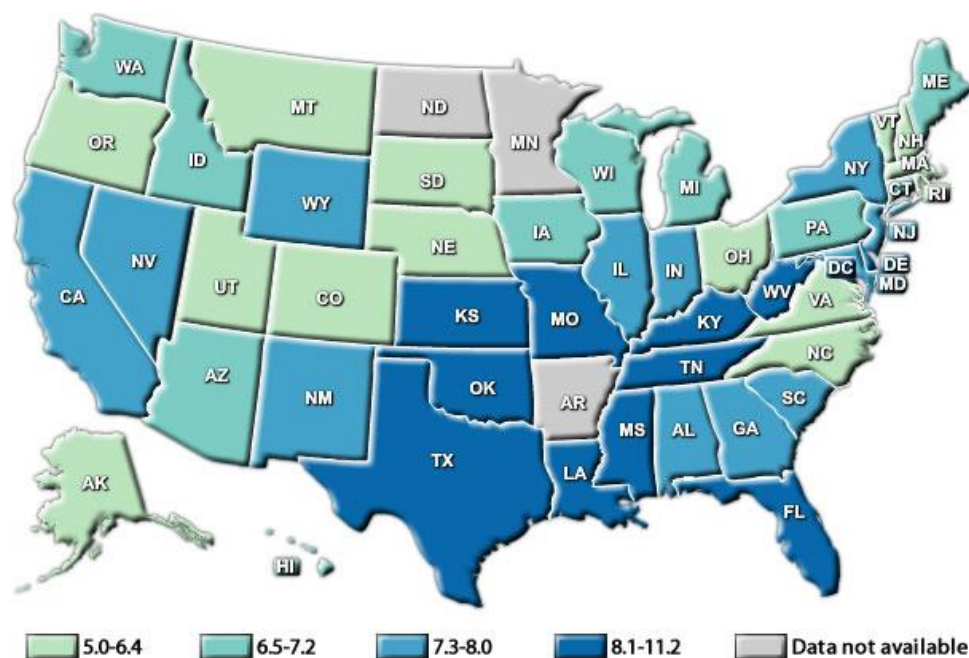


Figure 12. United States cervical cancer incidence rates by state, 2008. Rates are per 100,000 and are age-adjusted to the 2000 U.S. standard population. From Centers for Disease Prevention and Control, 2012. *Cervical Cancer Rates by Stat.* Retrieved February 15, 2014, from <http://www.cdc.gov/cancer/cervical/statistics/state.htm>. Reprinted with permission.

According to the information collected during 2008, Alabama, Arkansas, Louisiana, Mississippi, Oklahoma, South Carolina, Tennessee, and Texas had the highest cervical cancer death rates of 2.9 to 3.7/100,000 (see Figure 13). Comparatively, Arizona, Colorado, Connecticut, Indiana, Iowa, Kansas, Maine, Massachusetts, Michigan, Minnesota, Nebraska, and Wisconsin States had the lowest cervical cancer death rates of 1.3 to 2.0/100,000 (CDC, 2012b).

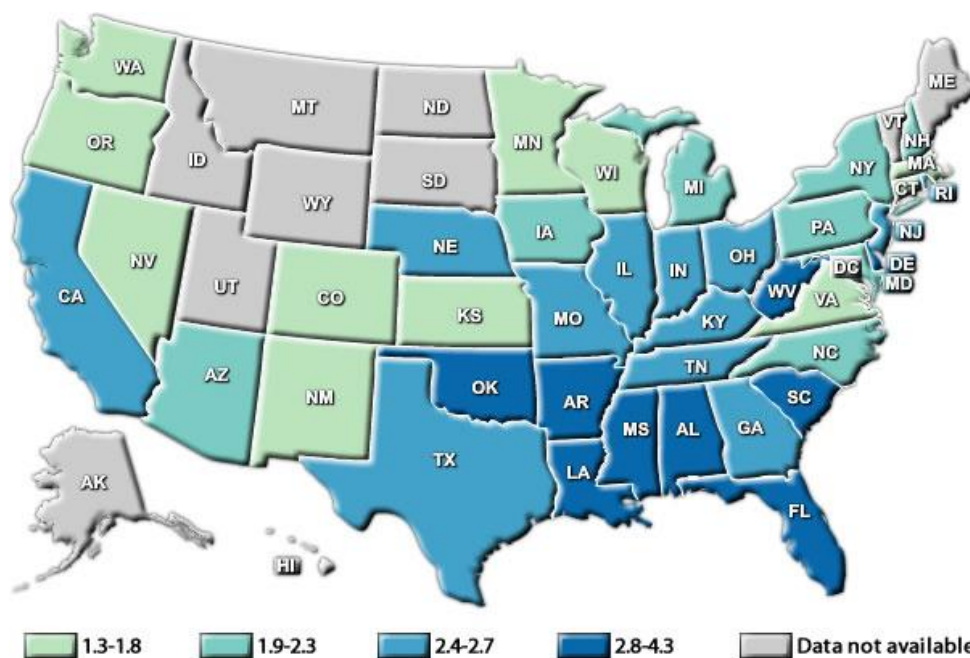


Figure 13. United States cervical cancer death rates by state, 2008. Rates are per 100,000 and are age-adjusted to the 2000 U.S. standard population. From Centers for Disease Prevention and Control, 2012. *Cervical Cancer Rates by State*. Retrieved February 15, 2014, from <http://www.cdc.gov/cancer/cervical/statistics/state.htm>. Reprinted with permission.

There is a loss due to the economic impact of the disease and it is calculated using several measurements. Disability-adjusted life years (DALYs) is one of the important measurements that are used to find out the status of the cancer mortality in society. The American Cancer Society (2010) stated that DALYs is “the sum of years of life lost by a patient due to premature death, as well as the years a patient lives with a disability resulting from a disease” (p. 7). For this measurement, the degree of illness and disability among cancer patients and long-term survivors are taken into consideration. DALYs consists of two other components; years of life lost (YLLs) and years lived with disability (YLDs). Table 6 provides a comparison of above-stated measurement in different regions and the world.

Table 6

Cervical Cancer-Estimated Disability-Adjusted Life Years, Years of Life Lost and Years Lived with Disability of United States (2008)

	DALY	YLLs	YLDs
United States of America	136,655	107,214	29,442
Northern America	153,658	120,320	33,338
World	8,738,004	7,788,282	949,722

Note. Adapted from “Human Papillomavirus and Related Diseases in United States of America. Summary Report 2014-01-31,” by L. Bruni, L. Barrionuevo-Rosas, B. Serrano, M. Brotons, R. Cosano, J. Muñoz, ... X. Castellsagué, 2014, ICO Information Centre on HPV and Cancer (HPV Information Centre), p. 30. Copyright 2014 by the ICO Information Centre on HPV and Cancer.

During the 1990's the U.S. government noticed the importance of addressing the concern of breast cancer and cervical cancer among women. As a result, in 1990, the Breast and Cervical Cancer Mortality Prevention Act was approved and established, which is the Public Law 101-354 (CDC, 2013d). Further, this led to the initiation of the Centers for Disease Control and Prevention's the National Breast and Cervical Cancer Early Detection Program (NBCCEDP), and it operates as a nationwide program. The target populations of this program are underserved, uninsured, and undernourished women, who are older, have a low incomes, and who belong to racial and ethnic minority groups. The program delivers breast and cervical cancer screening exams to these underserved women including pap tests, pelvic examinations, further diagnostic testing for women whose results are abnormal, and direction for treatments (CDC, 2013d).

Cervical Dysplasia

In the process of developing cervical cancer, a healthy cervix gets infected with HPV and progresses into mild dysplasia or CIN1 (Kiviat & Koutsky, 1993; Schiffman, Castle, Jeronimo, Rodriguez, & Wacholder, 2007). Identification of CIN2 in the cervix is a notification about the presence of productive HPV infection. CIN2 and CIN3 grades are regarded as true cervical cancer precursors, and, if untreated, will invade the cervix and grow into an invasive cervical cancer (Kiviat & Koutsky, 1993; Schiffman et al., 2007). Understanding and identification of each CIN stage at the right time is very important as it assists in treatment. Differentiating CIN1 from CIN2 and CIN3 is really important because the early detection of CIN means that treatment must commence before it is too late (Cox, Schiffman, & Solomon, 2003). CIN1 and genital warts can be caused by low-risk HPV types, mainly types 6 and 11 (Arends, Buckley, & Wells, 1998).

CIN is ~~a~~ histological diagnosis made upon analysis of cervical tissue obtained by biopsy or surgical excision (WHO, 2010 p.26).” It has been graded into 3 stages to recognize the phases of abnormality of the cells and also the extent of the cervical tissue involvement (NCI, 2008). In 1988, the Bethesda system (TBS) was developed at a National Cancer Institute workshop for the purpose of improving the standardization of cervical/vaginal cytological diagnoses reports provided by the cytology laboratories (Solomon, 1989). TBS standardization has been introduced to provide a clear definition to the pre-cancerous stages and to overcome the difficulties facing in CIN categorization (Solomon, 1989). According to the TBS, low-grade cervical lesions (LSIL) are defined

similar to CIN1 or mild dysplasia and high-grade cervical lesions (HSIL) are defined similar to a combination of CIN2 and CIN3, or CIS (see Table 5 and Figure 14).

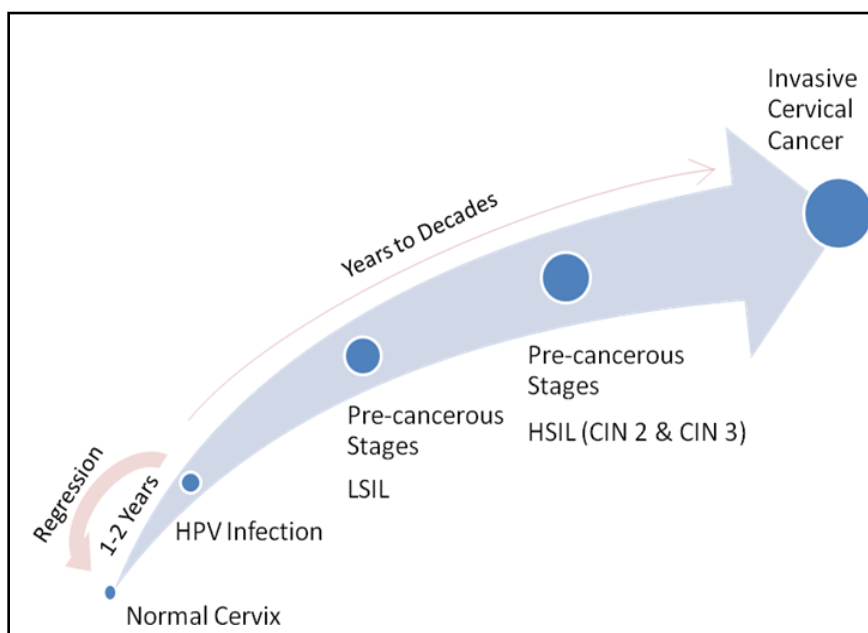


Figure 14. Progression of cervical cancer.

A Canadian study was able to reveal that mild and moderate dysplasia progressed to severe dysplasia or worsened within 2 years (Holowaty et al., 1999). Within these two years, 11% of mild dysplasia progressed to moderate dysplasia or worse. The rate of progression from mild to severe dysplasia was really low, which was 1% per year for 10 years. Moderate dysplasia progressed to severe dysplasia at a higher rate in the first 2 years and then, decreased for the next 8 years, and ultimately, the rate was 1.0 per 100 women in the tenth year. After a 10-year period more than half of mild or moderate dysplasia incidences remained at their initial stages without progressing into severe

lesions. In the same study, it was evidenced that more than moderate, mild dysplasia had a higher possibility to regress back to normal condition (Holowaty et al., 1999).

Human Papilloma Virus

Epidemiological studies have shown that genital HPV is the necessary cause for development of invasive cervical cancer (Bierkens et al., 2012), as well as a few other cancers such as anal, vaginal, vulvar and penile (Watson et al., 2008). A German scientist, Dr. Harald zur Hausen first discovered that human papilloma viruses cause cervical cancer (Dürst, Gissmann, Ikenberg, & zur Hausen 1983). These research studies were first conducted in the early 1970s (Di Domenico, Foppoli, Coccia, & Perluigi, 2011). In 2008, Dr. zur Hausen was awarded the Nobel Prize in Physiology or Medicine for his discovery (AACR, n.d.).

HPV is the most common sexually transmitted infection in the United States (CDC, 2013d). In the United States, the most common infections are sexually transmitted diseases (Weinstock, Berman, & Cates Jr, 2004). The currently infected population with HPV in the United States is approximately 79 million. Further, in each year, 14 million people are being added to this as newly infected (CDC, n.d.-b; Koutsky, Galloway, & Holmes, 1988). Almost half of the infections are in people between 15 and 25 years of age (Weinstock et al., 2004). Fleurence, Dixon, Milanova, and Beusterien, (2007) reported that the annual health care cost for HPV related disease conditions is in the range of \$2.25 to \$4.6 billion. Majority of sexually active men and women acquire genital HPV infection at some point in their lives (CDC, 2012c). The national health and nutrition examination survey, 2003–2006 conducted among women from 14-59 years of

age showed that the overall prevalence of HPV was 42.5%. Further, in the same study, they found that the prevalence was significantly varied by age, race or ethnicity, and number of sex partners (Hariri et al., 2011).

Papillomaviruses belong to family Papillomaviridae (de Villiers, Fauquet, Broker, Bernard, & zur Hausen, 2004). HPVs are nonenveloped and contain double-stranded circular DNA (Zheng & Baker, 2006). Most of the papillomaviruses are about 8 kb in size. The name for the virus has been given due to the fact that some of the strains cause warts or papilomas. These warts are tumors, which do not develop to a cancer (CDC, 2012b). This family has a higher degree of species specificity, and the existence have been found only in vertebrates. Another exclusive characteristic is that Papillomaviruses host site specificity, where they can only infect the squamous epithelial cells productively. As implied by the name, HPV only replicates in humans (Roden & Wu, 2006). There have been more than 100 different HPV types discovered (Stanley, 2008), and more than 30 types, which are transmitted through sexual contact, can infect the genital tract (CDC, 2010). HPV is primarily infected through skin contact mainly through sexual activities (Burd, 2003). HPV has the ability to withstand heat desiccation. Hence, other than sexual contact, HPV can be transmitted through prolong sharing of contaminated fomites such as clothes (Roden, Lowy, & Schiller, 1997). HPV infection and CIN lesions generally regress provided the absence of other risk factors, such as smoking and the continuous use of contraceptives (Moktar et al., 2011).

The Mechanism of the HPV Infection and Host Control of HPV Infection

The exception of the papillomavirus life cycle from all other viruses is that the infection only occurs in the epidermal or mucosal epithelial cells, and also that these layers are still able to proliferate, such as the basal layer cells (zur Hausen, 2002). Generally, in the mucosal epithelial cells, the viral genes are being suppressed. Even though the expression of these viral genes takes place to a limited extent due to the specific “early” viral genes such as E5, E6 and E7, these specific viral genes then enhance the proliferation of the infected cells and their lateral expansion (zur Hausen, 2002).

The immune system plays a major role in controlling the HPV infection (Ghaderi et al., 2000), and this can be clearly explained by looking at the increased persistence of the squamous intraepithelial lesions (SIL) in women who experience immunosuppression, such as HIV disease and who take immunosuppressive drugs (Petry et al., 2006). The involvement of a T-helper-cell (Fang et al., 2008), and the involvement of humeral immune response, which controls the pathogen activities through the act of antibodies and cellular immune response, is mediated by antigen-specific lymphocytes (Jenson, Kurman, & Lancaster, 1987). Thus, it is very important that HPVs have to escape from these defense mechanisms for the successive progression in the host (zur Hausen, 2002). There are two more protective mechanisms that are being used by the host. Host cells can inhibit the function of the viral oncoprotein, and also can disturb the transcription (zur Hausen, 2002). The current understanding is only on the action on E6 oncoprotein (Reznikoff et al., 1994). This particular inhibition can be done by either inactivated by

methylation, mutation or deletion (zur Hausen, 2002). Despite this, the expression of oncoprotein E7 has the ability to block this mechanism (Zerfass et al., 1995). Another concept is that blocking the transcription of HPV DNA which is known as cellular interference factor (CIF). Due to actions of macrophages and tumor necrosis factor, paracrine stimulation of cervical epithelial cells triggers CIF (zur Hausen, 2002). During the interruptions during malignant transformation this pathway does not function in cervical carcinoma cells (Rösl, Das, Lengert, Geletneky, & zur Hausen, 1997).

Even though the initial production of virions, which are the carriers of the viral genome, are at a slower pace, after the cells are infected with the virus and move to the upper layers, they start to differentiate (Narisawa-Saito & Kiyono, 2007). The newly released virions search for new host cells, and thus the proliferation expands to healthy tissues too. If this process continues for a longer period, which the immune system fails to clear out, after about 10 to 20 years there will be a higher risk to develop cervical cancer (Narisawa et al., 2007). The HPV genome is responsible to encode 8 proteins, which are E1, E2, E4, E5, E6, E7, L1 and L2 (Hamid, Brown, & Gaston, 2009; Zheng et al., 2006). Out of these proteins E6 and E7 provide the highest contribution for the HPV infections, which lead to invasive cervical cancer (Hamid et al., 2009; Klaes et al., 1999).

The task of E6 is to bind to the p53 tumor suppressor protein (Hamid et al., 2009). E6 utilizes the cellular ubiquitin ligase E6AP to bind p53, which then degrades the ability to respond the cell stress (Scheffner, Huibregtse, Vierstra, & Howley, 1993). The E6 promotes the degradation of p53, and this facilitates for dominant-acting oncoproteins, leading to oncogenesis (Scheffner, Werness, Huibregtse, Levine, & Howley, 1990).

Under such conditions, the immune system is unable to clear the foreign viral attack from the epithelial tissue (Di Domenico et al., 2011). Similarly, E7 is also binding to another tumor suppressor gene, which is pRb, p107, and p130 (Duensing & Münger, 2003). The release of E2F proteins convinces the premature cells to enter the S phase, which will interrupt the transcription of the cell. The final step of these reactions is that, in the absence of E2F protein activity and the presence of p53, the cell is intentionally driven to apoptosis (Hamid et al., 2009).

Low-Risk and High-Risk HPV Types

Munoz et al. (2003) have been able to classify the high-risk and low-risk HPV types. They found that there are 15 high-risk HPV types (16, 18, 31, 33, 35, 39, 45, 51, 52, 56, 58, 59, 68, 73, and 82) and 12 low-risk HPV types (6, 11, 40, 42, 43, 44, 54, 61, 70, 72, 81, and CP6108). Further, they discovered that 65% of individuals were infected with HPV type 16 and 18.

Low-risk HPV types are responsible for the development of genital warts, also known as condylomata acuminata (NCI, 2014). In the United States, approximately 1% of sexually active men and women are detected with genital warts at some point in their lives (Koutsky, 1997). The HPV type 6 and 11 are the most common low-risk strains and responsible of causing genital warts (Cox, 2006). Low-risk HPV types are mainly (90%) responsible for the development of CINI lesions and genital warts (Arends, Buckley, & Wells, 1998). The probability of low-risk HPV infection developing into an invasive cervical cancer is very minimal (NCI, 2012), but there could be some low-risk HPVs that are present in cervical carcinomas (Burd, 2003). Unlike CIN, the cell changes that takes

place in the cervix is only limited to the superficial layers of epithelium (Arends et al., 1998). A U.S. study, which collected data through privately insured health plans during the year 2000, showed that an average treatment for a person would visit a physician 3.1 times and spend \$436 (Insinga, Dasbach, & Myers, 2003). Uses of antiproliferative agents, destructive or excision therapies, and immune modulators, also known as therapeutic vaccines are the common treatments for genital warts (Lacey, Lowndes, & Shah, 2006).

There is a strong relationship between high-risk HPV types and occurrence of precancerous cervical lesions and invasive cancer (Wallin et al., 1999). The oncogenic potential of the high-risk types is dependent on the cooperative action of the two early viral gene products, E6 and E7, which bind and alter the activity of cell cycle regulatory proteins, and this same characteristic is being used to distinguish high-risk HPV types from other HPV (Zhang et al., 2007). Dürst and others, (1983) were able to isolate HPV type 16 (high-risk type) from a cervical cancer specimen. In a meta-analysis using 55 published studies from January 1989 to June 2004, Clifford and others (2005) uncovered the pattern for low-grade squamous intraepithelial lesions (LSIL) in different regions in the world. There was 80% HPV based LSIL detection in North America, and in other regions it was lower than 70%. Further, the same analysis showed that the most common HPV type in the LSIL is HPV-16 (26.3%) followed by HPV-31 (11.5%). High-risk HPV types are accountable for more than 90% of the cervical cancers and about 50% of them are due to the HPV type 16, whereas the HPV type 18 causes 10-20% of the problem (Munoz et al., 2003). E6 and E7 proteins that code the viral genome, are highly needed

for the viral cell transformations. They will interfere with the normal cell cycle by cooperating into the cell. Even though, the low-risk HPV types are not causing these effects, proteins from high-risk types are responsible for leading to pre-cancerous or cervical cancer development (Di Domenico et al., 2011).

Risk Factors

Even though detecting high-risk HPV infection in a woman's cervix epithelial tissue would necessarily slow the risk of developing cervical cancer, there is scientific evidence that it is required to have additional risk factors to trigger the persistence of the virus ultimately leading to an invasive cervical cancer (ACS 2014; Di Domenico et al., 2011). Primarily, the immune system clears off the infection by attacking the foreign bodies such as HPV (Di Domenico et al., 2011). The risk factors are responsible for the impairment of the immune system, which facilitates the successful growth of the virus (Calore, Pereira, & Cavaliere, 2001; Cubie, Seagar, Beattie, Monaghan, & Williams, 2000).

The age of sexually active women is one of the important risk factors of cervical cancer. In women, significant cell abnormalities occur at puberty and first pregnancy and after menopause the rate declines. Cervical cancer is a slow developing, and this is explained by the clear difference in the age of infection and the invasive carcinoma (Burd, 2003). Young women who are within the age group of 18-30, show a high occurrence of the HPV infection, whereas cervical cancer can be commonly found among women who are over 35 years (Burd, 2003). Further, Rodríguez et al. (2010) found out that the rate at which women get infected with new HPVs declines as they grow older.

At the same time, the possibility of these new infections progressing into CIN2 or CIN3 is minimal in older women. Thus, researchers concluded that use of vaccination and frequent HPV screening aiming to prevent or detect new cancer causing HPV at older age may not be very effective.

The duration of hormonal contraceptives use has a relationship with risk of developing cervical cancer. In a systematic review by Smith et al. (2003), stated that the relative risk of developing cervical cancer increased when compared to women who never used oral contraceptives to those who used them for less than 5 years, used them for 5 to 9 years and used them 10 years or more. The rated relative risks for HPV positive women were 0.9 (less than 5 years), 1.3 (5 to 9 years), and 2.5 (10 years or more) and 1.1, 1.6, and 2.2 were the risk were found among all women respectively. Von Knebel Doeberitz, Bauknecht, Bartsch, and zur Hausen (1991) uncovered that in HPV-positive types can create mutations in the p53 gene, which acts as a biological tumor suppresser and these mutations increases the risk of cervical cancer (Scheffner et al., 1993). With the presence of steroids, the expression of HPV-16 E6/E7 oncogenes increases, which leads lead to mutations in the p53 gene (Moodley, Moodley, Chetty, & Herrington, 2003).

The cigarette smoke condensate was used to study the cigarette smoke on cervical cancer development (Moktar et al., 2011). Researchers observed that expression of the p53 gene differ between HPV positive and HPV negative as result of cigarette smoke condensate induced DNA damage. The difference was that the p53 expression was only changed in the HPV positive cells. Also, other studies support that the DNA damage is

unable to activate p53 that acts on the expression of the E7 gene in HPV 16 (Moktar et al., 2011).

Cervical Cancer Preventive Measures

In order to detect the precancerous status there are two tests: the Pap test (or Pap smear) and the human papilloma virus (HPV) tests (ACS, 2013b). In the Pap test, a cell sample will be collected from the cervix and will be examined under a microscope. A small cell and mucus sample is scraped from the exocervix, which is the surface of the cervix that is next to the vagina. There are two ways that the samples can be examined under the microscope. One way is the conventional cytology where the sample is directly smeared to the glass microscope slide. The second method is the liquid-based cytology where the collected samples are stored in a special preservative liquid before putting it in a slide. There are advantages in this method, such as that the preservative will remove bacteria and yeast from some of the mucus and also it helps cells to spread evenly in the slide. Also the liquid will prevent the drying out and distortion of the sample. However, this method is comparatively expensive and can be disadvantageous as it detects the cells that are not precancerous causing unnecessary tests (ACS, 2013b).

The Pap test results can be stated as “normal” or “abnormal.” Even though the cell abnormality shows a risk of developing a cancer, not all the abnormal cell growths progress into a cancerous situation. Also the interpretation of Pap test results can be about the presence of high-risk HPV type. If the results are “negative” the interpretation is that woman is not infected with a high-risk HPV type. On the contrary, “positive” test result is an indication that the infection is being caused by at least one high-risk HPV

type. According to the revised Bethesda System (TBS) in 2001, the results of the Pap test can be ~~negative~~ for intraepithelial lesion or malignancy, epithelial cell abnormalities, and other malignant neoplasms” (ACS, 2013b). If the result is ~~negative~~ for intraepithelial lesion or malignancy,” it means that the sample does not contain any abnormal cells. The Bethesda System divides abnormal test results as squamous cell and glandular cell abnormalities. Further, it describes the squamous cell abnormalities depending on the severity. The categories are atypical squamous cells (ASC), consisting ASC-US and ASC-H; low-grade squamous intraepithelial lesions (LSILs); high-grade squamous intraepithelial lesions (HSILs); squamous cell carcinoma; atypical glandular cells (AGC); endocervical adenocarcinoma in situ (AIS); and adenocarcinoma (NCI, 2012) (see Table 4).

Another way of screening for cervical cancer is the test for HPV, mainly the high-risk types. The test involves a method similar to the Pap test, which also collects a cervix cell sample and looks for DNA or pieces of DNA of the virus cell sample. This test can be done as a combination with the Pap test. HPV DNA test is not considered as a replacement for the Pap test. The recommendation is that this test is not used in women who are under 30 years as there is a high chance that HPV infection may regress naturally. It is highly beneficial to screen women with a slightly abnormal Pap test result, so that further testing or treatments can be identified (ACS, 2013b). The American Cancer Society has recommended guidelines for cervical cancer early detection and they are as follow.

1. Women should begin the screening at the age of 21. Women who are 21 to 29 have to make sure that they get tested every 3 years, and as a follow up of an abnormal Pap test (ACS, 2013b).
2. Starting from age 30 years, women are advised to screen with a Pap test and HPV test every 5 years until they are 65 years. Additionally, women at this age group are more encouraged to get tested with Pap test every 3 years (ACS, 2013b).
3. Any women who have a suppressed immune system due to HIV infection, organ transplant or prolong use of steroids are considered at high risk. Thus, a regular screening is required for them under the recommendation of a healthcare professional (ACS, 2013b).
4. Women who are over the age of 65 years, had a regular screening for past 10 years, and no history of any pre-cancerous lesion (like CIN2 or CIN3) detected in the past 20 years, should discontinue screening. Continuation of screening for a minimum of 20 years is highly recommended for women who got detected with CIN2 or CIN3 from the time that the abnormal test results were discovered (ACS, 2013b).
5. Women who have had their uterus and cervix removed (hysterectomy) must stop Pap and HPV screening. This does not apply for women who had a hysterectomy as cervical cancer or pre-cancer treatment for cervical cancer and for those who had a hysterectomy without removal of the

cervix. They have to follow the above-mentioned guidelines (ACS, 2013b).

6. Women at any age should not do any of the screenings every year. Even though they have had the HPV vaccine still they need to follow the above guidelines (ACS, 2013b).

Another cervical cancer prevention method is the HPV vaccine. The first HPV vaccine was introduced in June 2006 under the commercial name GARDASIL™ (Merck and Co., Inc., New Jersey). GARDASIL™ is most effective for the 6, 11, 16, and 18 (NCI, 2012), which are responsible for 70% of cervical cancers and 90% of genital warts. This is approved by the FDA for the prevention of cervical cancer, and some vulvar and vaginal cancers in women and also for anal cancer and precancerous anal lesions prevention in both males and females who are from 9 to 26 years old. Another FDA approved vaccine is Cervarix. It is being produced by GlaxoSmithKline (GSK) for females ages 9 to 25. The effective range of this vaccine is for two HPV types: 16 and 18. The suggested mechanism for these two vaccines is that the HPV virus itself creates unique surface substances that can act like an antibody. These surface substances will react with another virus-like particle that is not infectious. With this reaction the virus-like particles attacks the cells that result in the stimulation of the immune system. The end result is the production of antibodies that can counteract the HPV infection. Neither of these vaccines provides complete prevention of any HPV infection, invasive cervical cancer or any other sexually transmitted disease (NCI, 2012).

HPV vaccines are not recommended for women who are over 26 as there is scientific evidence that these vaccines do not show any effective action. Also, this is not a replacement for the cervical cancer screening, and since vaccines do not target all the HPV types it is advised to continue Pap screening. The cost of the vaccine is \$130 per vaccine and for three doses (full series) it is \$390 (CDC, 2012c).

Barriers to Prevent Cervical Cancer

In the United States screening programs are in place to prevent and control cervical cancer risk (CDC, 2013b). Yet, there are major barriers which slow down the process, such as personal and cultural beliefs; barriers related to socioeconomic status; and institutional barriers. James and others (2009) reported that the 13.2% of women in the U.S. have had no pap test for the past three years. De Alba and Sweningson, (2006) found that Hispanic women are not sufficiently informed about cancer screening due to low English language proficiency. Another study revealed there are personal beliefs that act as barriers. In comparing the acculturation of both rural Hispanic women and rural non-Hispanic women, both had barriers such as the fear of finding cancer and other diseases, cost of treatments, time limitation, and transportation problems (Coronado, Thompson, Koepsell, Schwartz, & McLerran, 2004). Diagnosis of cervical cancer at a later stage has an association with being old and unmarried (Ferrante, Gonzalez, Roetzheim, Pal, & Woodard, 2000). Hiatt and others (2001) studied women from the San Francisco Bay Area and found out that having a Pap test within the past 3 years was low among non-English speaking Latino and Chinese women. Asian American and Pacific Islander women were reluctant to take cervical cancer preventive measures due to low

income and not having enough care (Kagawa-Singer, Pourat, 2000). Also, lack of insurance among Latino women was one of the independent predictors for not getting a Pap test every three years (Rodríguez, Ward, & Pérez-Stable, 2005). Women who do not do regular testing for cervical cancer risk depicted that insufficient insurance status was a profound indicator (Ferrante et al., 2000; Kagawa-Singer & Pourat, 2000). Inadequate access leads to differences in the use of cervical cancer preventive care. Detection at a pre-cancerous stage is more likely among Medicare women who are under the health maintenance organizations care than women who are under the fee-for-service (Kirsner et al., 2005). Another study uncovered that African American women living in high poverty areas had a 1.2 times of likelihood of not having a Pap smear in the two years (Datta et al., 2006).

Cervical Cancer, Poverty, and Produce Intake

Poverty is one of the risk factors for cervical cancer (Benard, Coughlin, Thompson, & Richardson, 2007). Low frequency of screening has been observed among women who earn low incomes (Hall et al., 2002). Leyden et al. (2005) found that women who have low education standards and reside in a high poverty neighborhood were more likely to not have a Pap test. Another study showed that women who are under 200% of the poverty line were not able to meet the cervical cancer screening objectives for the year 2000 (National Cancer Institute Cancer Screening Consortium for Underserved Women, 1995). A meta-analysis documented that out of 13 cancers studied, 11 showed significant protective effects from fruit and vegetable diets, including cervix, ovary, and endometrium cancers (Block, Patterson, & Subar, 1992). Other risk factors of cervical

cancer, such as cigarette smoking, use of oral contraceptives for a period of time, socioeconomic status, age, and ethnicity, can have a complex correlation with nutritional status. Especially, high cervical cancer, rates have been reported among African American women, Hispanic women, women with low educational standards, and low-income earning women (Potischman & Brinton, 1996).

Herrero et al. (1991) found that vitamin C, β -carotene, and other carotenoids showed an association with reduced cervical cancer risk. This outcome supports the findings of Potischman and others, (1991), which is that β -carotene or foods rich in β -carotene will negatively affect the increased risk of cervical cancer. Verreault, Chu, Mandelson, and Shy (2006) conducted a study using women who had cervical cancer, to find the association with vitamins A, C and E and of folic acid, to the risk of invasive cervical cancer. They suggested that foods high in Vitamin E and C have the ability to reduce the risk of invasive cervical carcinoma. Liu et al. (1993) studied the relationship of nutritional factors with cervical dysplasia by adjusting for other risk factors; age, race, age at first sexual relationship, cigarette smoking, parity, number of sexual partners, continuous use of oral contraceptive use, and HPV type 16 infection. Researchers evidenced that there is a significant enhancement ($P = 0.05$) in the cervical dysplasia and low intake of vitamin A. In the same study, it was uncovered that inadequate intake of Vitamin C, riboflavin, and folate were inversely proportionate to increased risk of cervical dysplasia. A case-control study conducted with women who had cervical dysplasia showed that the effect of risk factors for cervical dysplasia, especially HPV type 16, can be enhanced due to low red blood cell folate levels (Piyathilake, Macaluso,

Brill, Heimburger, & Partridge, 2007). Yeo and others (2000) conducted a case-control research study with the participation of American Indian women showing that lower intake of Vitamin A has a positive association with CIN1, and also the presence of low serum Vitamin E content may have the ability to increase the risk of CIN1 or CIN3.

Individuals who earn a low income are more likely to have less access to fresh fruits and vegetables, and they are less likely to eat fresh fruits and vegetables (Rose et al., 2010). Tomita and others (2010) found an association of low income, produce intake and the risk of cervical cancer. The study was conducted in São Paulo, Brazil, with the participation of women diagnosed with CIN 1,2,3 and invasive cervical cancer. Researchers measured the total serum carotene and tocopherols levels along with the produce intake, and then compared these with the stage of pre-cancerous or cervical cancer. The total fruit and juice consumption was lowest among the women with CIN3 followed by invasive cervical cancer. The total vegetable intake was highest among the CIN2 group and then the control group. The lowest vegetable intake was seen in invasive cervical cancer group followed by the CIN1 group. The control group consumed the highest amount of dark green and deep yellow vegetables and fruits (28.2 g/day), while CIN3 group (16.2g/day) consumed the lowest amount. Out of the entire participation, 43% of women were earning less than \$50 per month. With increase in the serum lycopene concentration there was a negative impact to CIN1, CIN3 and cancer. It was evidenced that as the dietary intake of dark green and deep yellow vegetables/fruit and serum α - and γ -tocopherols increases, led to nearly 50% reduction in the CIN3.

Cervical Cancer in Rural Appalachia

During the period 2003-2007, the average annual number of new invasive cancer cases and age-adjusted incidence rates in Ohio was 8.0/100,000, and, similarly, the national rate was 8.1/100,000 (OCISS, 2010). During the same period, the average annual number of new invasive cancer cases and age-adjusted incidence rates in Ohio and the U.S. was 2.4/100,000. Hopenhayn, Bush, Christian, and Shelton, (2005) reported the cervical cancer incidence rates in the Appalachian Kentucky, West Virginia, and Pennsylvania. The incidence rate for Kentucky, West Virginia, and Pennsylvania were 13.4, 13.9, and 10.2/100,000 for a year, respectively. In the same study they found that rural status, education standards, and ethnicity were stronger predictors of invasive cervical cancer, but Appalachian status was a weaker predictor. Data obtained from Surveillance, Epidemiology, and End Results Program (SEER), which was collected from Northern, Central, and Southern Appalachian counties between 2001 and 2003, showed that Central Appalachia had the highest cervical cancer incidence rate of 11.2/100,000 compared to the other two Appalachian regions, and was 35% higher than the national rate (Wingo et al., 2008). Out of 345 Appalachian Kentucky women, 34% have never or rarely obtained their Pap test. Also, this has been due to the belief about presence of visible cervical cancer symptoms, and insufficient means of attaining accessible medical care (Hatcher, Studts, Dignan, Turner, & Schoenberg, 2011).

A study conducted using Appalachian women has shown that for cervical cancer screening, cost acts as a barrier, and also the understanding that these women had about the Pap test cost was limited and inaccurate (McAlearney et al., 2010). A study

conducted by the National Cancer Institute (National Cancer Institute Cancer Screening Consortium for Underserved Women, 1995) in six different states to evaluate and compare the cervical cancer screening objectives for the year 2000 in selected underserved women, observed that 82% to 95% of women had at least one pap test done, and 55% to 74% had a pap test in the past three years. Another study was done to compare the breast and cervical cancer screening rates in selected underserved populations with objectives for the year 2000. They studied low-income and minority women, Hispanic women, and residing in rural West Virginia and Wisconsin and found out that women, 80 years old or over, with low-education status, without health insurance, living in Appalachian West Virginia, and Hispanic women from urban Texas region, did not meet the cervical cancer screening objectives (National Cancer Institute Cancer Screening Consortium for Underserved Women, 1995). Elnicki and colleagues (1995) were able to uncover that among the rural Appalachians; only 22% had the Pap test. Participants reported that due to insufficient knowledge and information and cost of testing, they tended omit these preventative tests.

During the 1994-1998 period, Kentucky, Ohio, and West Virginia had significantly higher cervical cancer death rates for their Appalachian regions when compared to the national rate (Huang et al., 2002). Among these three states Kentucky was found with the highest cervical cancer rate of 3.8/100,000 (Huang et al., 2002). During 2003-2007, in Ohio, 46% of women diagnosed invasive cervical cancer at a later stage. Among the distressed counties in Ohio Appalachia, Hocking, Perry, and Pike reported higher percentages for diagnose at late for cervical cancer and Athens and Megis

were among the counties with high percentages (American Cancer Society & Ohio Cancer Incidence Surveillance System [ACS & OCISS], 2010).

According to the 2008 Ohio Behavioral Risk Factor Surveillance the percentage of those women 18 years and above in Ohio, who reported having a Pap test during the past 3 years was 82%. Since 1992 this percentage has remained relatively constant (ACS & OCISS, 2010). Other researchers were able observe that screening was low among older women and women who had less education (Hall et al., 2002).

In 1992, after analyzing the findings of higher rates for specific cancers such as breast, colorectal and cervical in Appalachia, the importance of having a dedicated cancer control program was being identified by the National Cancer Institute. This led to the initiation of the Appalachia Leadership Initiative on Cancer (ALIC) project, which has the intention to “achieve reductions in cancer incidence and mortality, increases in cancer survival, and increases in the diagnosis of cancers at earlier stages within the Appalachian region” (NCI, 1992). Further, through many organized programs such as Northern Appalachia Leadership Initiative on Cancer, North Central Appalachia Leadership Initiative on Cancer, Central Highlands Appalachia Leadership Initiative on Cancer, and Southern Appalachia Leadership Initiative on Cancer through which research has been conducted in different parts of the region.

Antioxidants and Cervical Cancer

Prolonged existence of HPV is not necessarily the only factor needed for the development of invasive cervical cancer. One of the most important co-factors that facilitate the viral expansion is oxidative stress (Di Domenico et al., 2011). Further,

oxidative stress is increased by several risk factors that are associated with cervical cancer development, such as tobacco smoking and chronic inflammation (Moktar et al., 2011). Beevi, Rasheed, and Geetha (2007) studied the effect of oxidative and nitrosative stress which happens as lipid peroxidation and nitric oxide (NO) level increase. They evidenced that oxidative and nitrosative stresses possess the ability to negatively change the antioxidant defense system and the development of cervical cancer. Reactive oxygen species (ROS) creates adverse structural alterations in DNA, especially mutations in base pairs, rearrangements, deletions, insertions and amplification of the sequence (Cerutti, 1994). Also, ROS can alter protein and gene activity that responds to stress conditions (Wiseman & Halliwell, 1996). Particularly, studies have reported that ROS is one of the main factors for cancer growth in humans (Ames, 1989).

Oxidative stress arises when ROS production increases and that diminishes the ability of antioxidant activity in cells. Reactive oxygen species are being produced regularly in aerobic cell mitochondria. Reactive oxygen species is a byproduct of incomplete mitochondrial oxidative phosphorylation, where molecular O_2 to H_2O is reduced to oxygen free radicals and H_2O_2 (Murphy, 2009). At lower levels ROS acts beneficially to humans by assisting in cell proliferation and their survival. The problem is that when ROS levels increase, the cellular macromolecular damage to lipids, proteins, DNA and nucleic acids, this results in adverse outcomes causing detrimental health effects. The free-radical initiated reactions continue to attack the adjacent cells and ultimately cause cell death. Particularly, ROS can make the changes in DNA bases and especially can injure to tumor-suppressor genes (Cerutti, 1994; Jackson, 1994). Cancer

development will be decided depending on the antioxidant defense, the ability to repair damaged DNA, and the efficiency of removing the oxidized products, especially oxidized nucleosides, before they get into the genetic material such as DNA (Wiseman & Halliwell, 1996).

Oxidative stress can be increased due to inflammation, and there is scientific evidence that there is a relationship between chronic inflammation and cancer development (Balkwill & Mantovani, 2001). Gonçalves et al. (2005) were able to demonstrate that low-grade cervical lesions or high-grade cervical lesions caused by HPV infections have a likelihood of increasing the erythrocyte TBARS (Erythrocytes thiobarbituric acid reactive substances) levels and decrease the vitamin C content which can lead to oxidative stress in women with cervical cancer or CIN. Even though the mechanism of creating cancer through infection has not been fully understood, there are three mechanisms that have been suggested: the infectious agent is directly acting on host cell genetic material (Parsonnet, 1999); the immunosuppression is due to the infection; or the infection is producing more ROS (Ohshima, Tatemichi, & Sawa, 2003). Additionally, mechanical and chemical factors and irradiation (UV, ionizing irradiation) can increase the oxidative stress (Darr & Fridovich, 1994; Ohshima et al., 2003).

Scientific evidence of the negative relationship between produce consumption that is high in antioxidants and risk of cancer goes back to the 1970's. Bjelke (1975) conducted a 5-year longitudinal study and suggested that Vitamin A or closely related active compounds may possess the ability of modifying the expression of factors that aggravate the carcinogens. Also, even for cancer control, natural antioxidants,

specifically dietary polyphenol (Thomasset et al., 2006) has been scientifically found to be potentially effective for cervical cancer prevention. These include vitamin B₁₂, folate, vitamin E, vitamin C, β -carotene, lycopene (Myung, Ju, Kim, & Kim, 2011), curcumin found in turmeric, resveratrol found in grapes, and also epigallocatechin-3-gallate from green tea (Di Domenico et al., 2011). These compounds possess abilities, to block the carcinogenesis effect and inhibit tumor growth. Antioxidants inhibit tumor growth through the use of nonscavenging mechanisms which program the cancer cells to kill themselves (apoptosis), interfere with cell cycle, inhibit DNA synthesis, and cause changes in the signal transduction pathways (D'Archivio et al., 2008).

A number of studies have shown the protective effects of antioxidants on cervical cancer. The tasks of folate in the cell environment are mainly for DNA synthesis, DNA repair, and also DNA methylation. Science evidence suggests that at low folate levels, HPV is more easily incorporated into the host cells gene (Alberg et al., 2000). Vitamin B₁₂ has an association with folate intake. Collectively, these two compounds are engaged in conversion of homocysteine, even though they show a negative association with homocysteine levels (Myung et al., 2011). Homocysteine has been identified as a marker for low levels of vitamin B₁₂, further at extremely higher levels homocysteine shows a relationship with an increase of cervical cancer (Alberg et al., 2000). Vitamin E or α -tocopherol acts as a chain breaking antioxidant. Lipid peroxidation that creates free radicals, involves a chain reaction: initiation, propagation, and termination. Vitamin E has the ability to interrupt propagation reaction and break the chain of reactions (Burton & Traber, 1990). Vitamin C is believed to oxidize compounds that are harmful to human

health. Target substances are compounds that carry unpaired radicals such as superoxide, hydroxyl radical, peroxy radicals; compounds that are reactive yet non-radicals nitrosamine, nitrous acid, hypochlorous acid; compounds those react with above-mentioned radicals or non-radicals and also react with vitamin C, such as the reaction with α -tocopheroxyl radical. With the involvement of vitamin C this substance is broken back in to α -tocopherol (Padayatty et al., 2003). In a literature review by Giuliano (2000) stated the importance of more epidemiologic studies to understand stages which nutrients can contribute effectively to reduce risk of cervical carcinogenesis and as an independent factor from other risk factors for cervical cancer. In addition, review also mentioned that studies have to design to look at proper evaluation of HPV, nutrient markers, and other biomarkers along with in-depth understanding of the mechanism of nutrient actions in relation to HPV infection, persistence, and progression to considerable cervical lesions.

Produce Intake in the United States

There is ample scientific evidence that higher consumption of fruits and vegetables has a positive relationship with a decreased risk of chronic diseases such as cardiovascular disease, cancer and diabetes (He, Nowson, & MacGregor, 2006; Genkinger, Platz, Hoffman, Comstock, & Helzlsouer, 2004; Ziegler et al., 1986). “Dietary Guidelines for Americans” provides scientific, evidence-based nutrition information to assist healthy life style activities, which are related to chronic diseases risk reduction (CDC, 2013c). These guidelines have being designed for people who are older than 2 years. The first publication was issued in 1980 and the latest was issued in 2010 (CDC, 2013c). In their publications released in 1980 and 1985, a basic mention was

given about the importance of fruit and vegetable intake in the section “Eat a Variety of Foods” and did not provide any recommendation for the amount of intake (USDA & U.S. Department of Health Education and Welfare, 1980; USDA & USDHHS, 1985). In the 1990 edition, it was recommended that people consume 3-5 servings of vegetables and 2-4 servings of fruits per day (USDA & USDHHS, 1990). In the 2000 edition, a separate section on fruits and vegetables; “Choose a Variety of Fruits and Vegetables Daily” was included (USDA & USDHHS, 2000). The last update has been done in 2010. According to the Dietary Guidelines for Americans 2010, a person needs to eat 2-4 servings of fruits and 3-5 servings of vegetables (USDA & USDHHS, 2010). According to the ChooseMyPlate.gov (n.d.), foods are in the fruit group are any fruit, which is in either fresh, canned, frozen, or dried, and may be whole, cut-up, or pureed or 100% fruit juice. Also, vegetables that are raw or cooked, fresh, frozen, canned, dehydrated, whole, cut-up, mashed or 100% vegetable juice count as a member of the vegetable Group.

The 1999-2000 National Health and Nutrition Examination Survey, which was a 24-hour recall study of 8,070 participants, showed that only 40% of Americans were able to consume an average of five or more ½-cup servings of fruits and vegetables per day (Guenther, Dodd, Reedy, & Krebs-Smith, 2006). Serdula and others (1996) uncovered the association between consumption of fruits and vegetables and lifestyle behaviors. They found that people who were heavy smokers, heavy drinkers, practicing a sedentary lifestyle, and who had never tested their blood cholesterol demonstrated the lowest fruit and vegetable intake. Another study was conducted to look at the trend of produce intake from 1994 to 2005, and its results showed that the intake was relatively stable along this

period (Blanck, Gillespie, Kimmons, Seymour, & Serdula, 2008). Further, Casagrande, Wang, Anderson, and Gary (2007) reported similar findings. Researchers were able to obtain a trend between 1988 and 2002 that Americans did not show any increase in fruit intake, and there was small decrease in vegetable consumption (Casagrande et al., 2007). The State Indicator Report on Fruits and Vegetables in 2009 reported that the national average of fruit consumption of two servings or more was 32.8%, and in the State of Ohio it was 28.6%. There was a national average of 25.2% for consumption of three servings of vegetables or more, and in Ohio it was 27.4%. These data were obtained through a 6-item frequency screener conducted by the 2007 Behavioral Risk Factor Surveillance System (CDC, n.d.-a).

Most low-income families spend their income on food at home. According to the Bureau of Labor (2008), low-income families who are at the bottom 20% of the income distribution, spend two thirds of household food expenditure on food at home, and the portion spent on fresh fruits and fresh vegetables was 5.8% and 5.4% respectively (13.4% was spent on cereals and breads; 23.4% on meat, poultry, fish, and eggs; 10.9% on dairy products; 3.2% on processed fruit and 2.8% on processed vegetables, and 35.0% on other food at home). Low-income families tend to purchase foods that are dense in energy, less nutritious containing refined carbohydrates, added fats, and added sugars (Darmon & Drewnowski, 2008).

The probability of having access to quality food in the right quantities can be limited for those who earn low income (Hendrickson, Smith, & Eikenberry, 2006). A study conducted in Québec City, Canada, showed that the disparities in physical access to

fresh fruits and vegetable may be an issue for low produce intake. Further, this might be a problem in rural regions where the number of supermarkets is fewer than urban areas (Pouliot & Hamelin, 2009). Morland, Wing, and Diez Roux (2002) suggested that when comparing African-Americans who have access to one or more supermarkets have a higher probability of meeting the fruit and vegetable recommendations than their counterparts who did not have the same accessibility. Furthermore, for every additional supermarket, their produce intake improved by 32%. In the same study, an 11% increase in produce intake was observed among the white American group with the presence of one or more supermarkets. Additionally, the findings of Rose and Richards (2004) support that the produce intake of households participating in the Food Stamps Program is high when they live close to a supermarket. The study results showed a difference of 62g/day of fruit intake comparing households that lived 1 mile closer to the food store than households who lived five miles away. Haynes-Maslow, Parsons, Wheeler, and Leone (2013) conducted a study involving low-income participants who lived in North Carolina. The study objectives were to evaluate perceived barriers at community-level to produce intake in low-income populations. Most of the participants were African-American females and majority of the group had a high school education or less. The study results showed that high cost, insufficient transportation, low quality, having not many options to choose from, changes in the food environment, and changing societal norms were main barriers to increase their produce consumption. Parents were unable to provide their children adequate amounts of fruits and vegetables due to high cost. Due to the same reason, women preferred canned and frozen fruits and vegetables over fresh

produces. Particularly those who did not own a vehicle and elderly participants reported transportation as a barrier to purchase fruits and vegetables. Among the study group, most of them reported that they preferred high-quality fruits and vegetables, yet the availability of high-quality produces was lacking in the area. Also, having a limited selection was one other factor that was reported by the participants. They also responded that rapidly changing food environment have made them to purchase more fast food because of the convenience, although most of them admitted that fast food is unhealthy. Interestingly, participants seemed to identify the shifts in societal norms as a perceived barrier to produce consumption. Few of the norms that they mentioned were women being sole bread winners in the family, children having more choice, and preference for convenient food over home cooked meals. Although cost can be the major reason for low-income households to limit their produce intake, other factors mentioned in this study could possibly act as barriers to reduce their fresh fruit and vegetable intake. Designing educational programs aiming to increase produce intake addressing these barriers would give more promising results.

Produce Intake in Appalachia

A cross sectional study was conducted in Athens County in Appalachian Ohio by Kropf, Holben, Holcomb, and Anderson, (2007) who observed the difference between women who were participating in Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) and WIC/Farmers' Market Nutrition Program. They evidenced that 26.8% of the participants were living in a food secure household. Among the rest of the participants who were living in food insecure households, 20.6% were

living in households at risk for food insecurity, 32.9% of them were under low food security and 19.7% were experiencing very low food security. There was no food security difference between (WIC) and WIC/Farmers' Market Nutrition Program participants. Women who participated in WIC/Farmers' Market Nutrition Program had a higher educational status, consumed more vegetables, and showed they attained more rewards due to participating in the program. A greater diet quality was also reported.

The Amish population living in the Appalachian regions report a low cancer risk compared to the non-Amish population. Non-Amish samples tend to have lower vegetable servings per day than the Amish group. Among females the daily serving of the Amish group was 2.1 compared to the non-Amish group. Further, Amish women had lower percentage of energy from saturated fat (12%) than the non-Amish women (16.3%) (Carter et al., 2011). The average fruit consumption among the rural Appalachians was 1.24 ± 0.96 per day, and the daily average vegetable consumption is 1.97 ± 0.91 servings. Another study reported that among a 54 groups of school children in rural Appalachia with a higher poverty rate, the fruit and vegetable consumption was low, and they consumed high amounts of fatty and sugary foods (Crooks, 2000).

Produce Intake and Food Security

In a study conducted with participating women in New York County, Kendall et al. (1996) found out that when food insecurity increases, there is a significant increase in disordered eating patterns and also a significant reduction in the rate of household fruit and vegetable consumption. Adult women who were living in food insecure households showed that they had significantly low levels of energy, magnesium, vitamin A, E, C and

B₆ (Rose & Oliveira 1997). Seefeldt, (2010) reported that in food insecure households, selective shopping practices excluded certain foods such as milk, cereal, fruits, and meat from their shopping list as the food prices go up. Another study conducted using adults from food insufficient families revealed that they had a lower frequency of milk or milk product, fruit or fruit juice and vegetable intake (Dixon et al., 2001). A study conducted in the Navajo reservation with the participation of 42 women who have at least one child less than 18 years old, found food security among the group was 19%, and there was a high food insecurity rate. Among the participants, 23.8% were living marginally food secure, 28.6% women had low food security, and 28.6% experienced a very low food security. There were number of factors which were related to food insecurity such as lower vegetable intake, low willingness to exchange current choices for fruit and vegetable consumption, increased barriers to consuming fruits and vegetables, and a perceived low-quality diet (Ray, Holben, & Holcomb Jr, 2012).

A group of children (n = 6,513) were analyzed for demographic status, socioeconomic status and fruit and vegetable consumption (Lorson, Melgar-Quinonez, & Taylor, 2009). Households above 350% of the poverty line showed the highest fruit juice intake compared to the children who were living in the range of 130% and 350% of the poverty line. The highest intake of total cups of fruit from juice was reported among the children living in marginally food secure households, but this was not significant when compared to the food secure households. Compared to children who are living in the food secure households, food insecure households consumed more french fries, which stood as their total vegetable consumption. Also the lowest average total fruit and

vegetable intake was reported by the children and adolescents living in food insecure without hunger households, even though it was not significant compared to other food security groups (Lorson et al., 2009). A study conducted with Inuit households revealed that food insecure households consumed fewer amounts of fruits and vegetables (Huet et al., 2012). Grutzmacher and Gross (2011) examined a group of elementary students and their parents in Maryland. They were able to find out that both parents and children who were living in food insecure households consumed low amounts of fruits and vegetables.

Townsend, Kaiser, Allen, Joy, and Murphy (2003) used the 13-item Tool to Assess Psychosocial Indicators of Fruit and Vegetable Intake to examine the sensitivity of the tool with limited-resource communities by using serum carotenoids, few selected micronutrients, servings of fruit/vegetable, and behaviors of fruit/vegetable. This survey measures perceived benefits, perceived control, self-efficacy, readiness to eat more fruit and, and perceived diet quality. Table 7 illustrates the definitions of constructs and domains of the tool.

Table 7

Definitions of Psychosocial Constructs Related to Produce Intake Behaviors

Construct or domain	Definition (Townsend and Kaiser, 2005)	Number of items
Perceived benefits	Outcome expectations provide motivation for eating fruits and vegetables (p. 172)	2
Perceived control	The items asked who is in charge of the food shopping and food preparation and referred to the perception of having control over the behaviors (p. 172)	2
Self-efficacy	Items assessing the confidence a participant feels in performing specific fruit and vegetable behaviors in a variety of circumstances (p. 172)	6
Readiness to eat more fruit or vegetables	Items referred to increasing the current intakes of fruit and vegetables compared to the amount eaten in the past (p. 176)	2
Perceived diet quality	The item asked about the perception of their own diet quality	1
Predisposing domain	Perceived benefit construct score + perceived control (p. 172)	
Enabling domain	Self-efficacy construct score (p. 172)	
Change in intention domain	Readiness to eat more fruit construct score + readiness to eat more vegetables construct score + perceived diet quality construct score (p. 172)	
Change in all domains	Change in predisposing + change in enabling + change in intention (p. 172)	

The biopsychosocial framework (see Figure 15) that has been developed by Townsend and Kaiser (2005) depicts the interaction between physiological, behavioral, dietary and biological aspects. The physiological constructs are considered as mediators

of changes in behaviors and changes occur in these constructs would lead to modifications in behaviors related to fruit and vegetable intake.

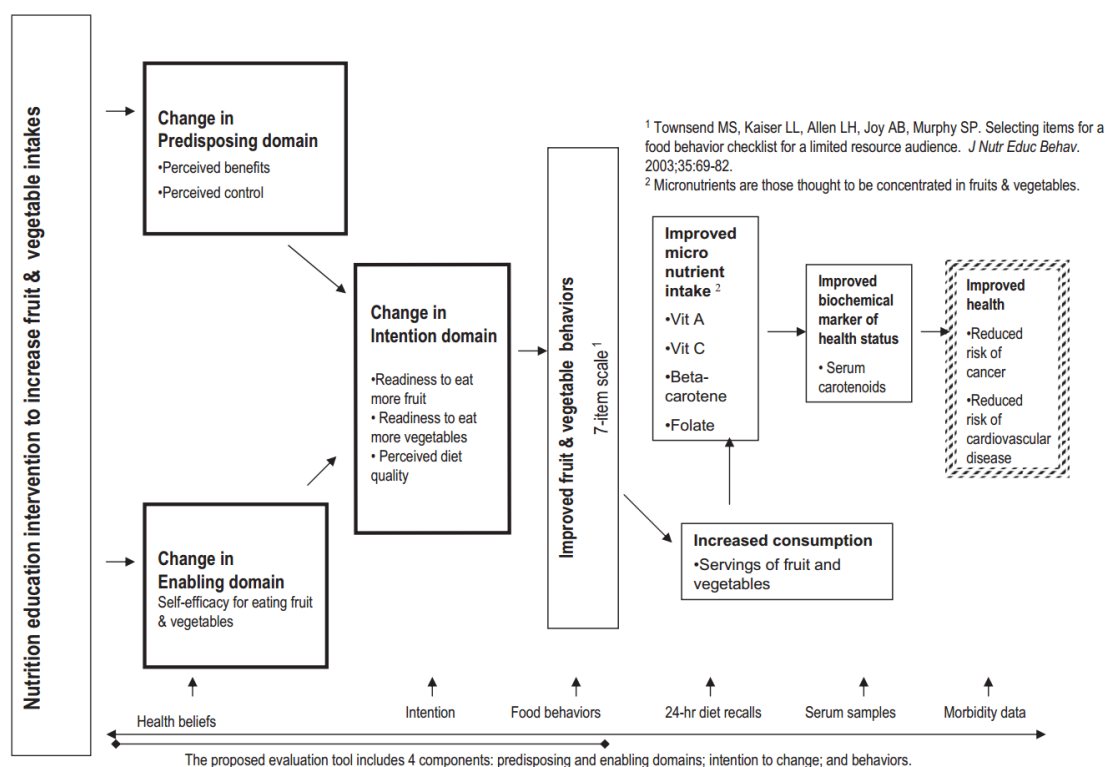


Figure. Biopsychosocial framework for estimation of sensitivity of evaluation tool for US Department of Agriculture education programs for increasing fruit and vegetable consumption.

Figure 15. Biopsychosocial framework for estimation of sensitivity of evaluation tool for increasing fruit and vegetable consumption. From "Development of a Tool to Assess Psychosocial Indicators of Fruit and Vegetable Intake for 2 Federal Programs," by M. S. Townsend & L. L. Kaiser, 2005, *Journal of Nutrition Education and Behavior*, 37(4), p. 172. Copyright 2005 by Journal of Nutrition Education and Behavior. Reprinted with permission.

Summary

As stated in the literature review, food insecurity could lead to a number of mentally and physically adverse health outcomes. Further, there are geographical differences for household food security even within the same country. Women who live

in food insecure households tend to consume lower amounts of fruits and vegetables than the national recommendations. Low produce intake has been identified as a modifiable risk factor that can increase the risk of chronic diseases, particularly cancer risk.

According to previous scientific findings, low produce intake can be associated with increased risk of cervical cancer. Specifically, a study revealed the positive relationship between low fruit and vegetable consumption and risk of cervical cancer among low-income women (Tomita et al., 2010). Similar research work is required to understand the underlining risk factors for high incidence and mortality rates among the women who live in the rural Appalachian region. The present study examined the differences between food security, cervical health, and produce intake among women live in rural Appalachia.

Chapter 3: Methodology

No studies have been conducted in the rural Appalachian region to investigate whether high incidence and mortality rates of cervical dysplasia have an association with food insecurity and /or consumption of dietary produce. This study examined: (a) differences in HPV status by food security status; (b) differences in risky sexual behaviors by food security status; (c) differences in produce intake/behaviors by food security status; (d) differences in produce intake/behaviors by HPV status; and (e) the association of produce intake/behaviors and food security, adjusted for demographic confounders including the HPV status among women in rural Appalachia and attending a clinic for gynecological care.

Research Design

A cross-sectional survey was conducted. Institutional Review Board (IRB) approval was obtained from the Ohio University Institutional Review Board for the study prior to the collection of any data (see Appendix C).

Study Population

One hundred and fifty six participants were recruited from an Obstetrics/ Gynecology clinic in Athens County, Ohio. Females who were English speaking and writing, 21 years and older, and attending the clinic in Athens County for cervical screening/testing (includes Pap test, HPV test, and/or colposcopy) were considered as eligible participants for the study. Women who have had a hysterectomy were excluded from the study.

Sampling Procedure

Data collection took place between March 2013 and July 2013. Patients attending the clinic were informed about the study through signage (see Appendix D) at the clinic or by the clinic research staff. Signs were posted where women were waiting to see the provider. The signage provided information about participation benefits and contact details about the study. If any of the patients was interested in participating in the study, the clinic staff guided them.

If a woman agreed to participate, she was given a packet including (a) information about the study, rationale, and contact details of the project staff if she had any questions about the study (including a name, phone number, and email address); (b) an informed consent (see Appendix E) about the study including the authorization forms to obtain permission for the project staff to view results of their cervical screening/testing; and (c) a survey questionnaire (see Appendix F). Patients were informed that they had the right to leave the study at any time, and they could choose not to complete any section of the study.

The participant was asked to insert the completed consent forms and survey questionnaires into an envelope to protect the confidentiality of the participant. This envelope was deposited into an earmarked box at the clinical site. After completing the survey, each participant was given a \$15 gift card.

In keeping with cervical cancer screening guidelines, Pap test, HPV test and/or colposcopy results from within three years before or after the completion of the consent

form or the questionnaire were obtained from the clinic. No additional medical information was obtained.

Research Instrument and Scoring

The questionnaire consisted of several sections, including demographic information, risky sexual behaviors, produce intake and behaviors, and food security.

In the demographic information section, participants answered demographic questions, including age, race, marital status, education, occupation type, current living arrangement, annual income, and health insurance.

Household adult food security information was collected using the U.S. household 18-item Food Security Survey module (Bickel et al., 2000). Only the 10 adult household food security items were included in the survey. The survey was scored using the method of Bickel et al. (2000). Zero affirmative responses were categorized as high food security, 1-2 affirmative responses were categorized as marginal food security, 3-5 affirmative responses were categorized as low food security, and 6-10 affirmative responses were categorized as very low food security (see Appendix G).

The clinical data of the participants were obtained from O'Bleness Clinic. They were categorized into two different methods.

Method 1:

1. Positive [For 21-29 years; ASCUS HPV positive, LSIL, CIN and for 30 years and above; positive HPV (even if negative pap), LSIL, CIN]
2. Negative (For 21-29 years; all negative results, including ASCUS but HPV negative and for 30 years and above; negative pap, negative HPV)

Method 2 (Massad et al., 2013):

1. Age 21-29: negative (all negative results, including ASCUS but HPV negative)
2. Age 21-29: positive (ASCUS HPV positive, LSIL, and CIN)
3. Age 30 and over: negative (negative pap, negative HPV)
4. Age 30 and over: positive (positive HPV (even if negative pap), LSIL, CIN)

The Community Awareness Resources and Education (CARE) Risky Sexual Behavior Index questionnaire, developed and validated by Reiter et al. (2009) for cervical cancer research, was utilized to obtain the information about the sexual relationships and behaviors of the participants. The questionnaire was scored using standard procedures (Reiter et al., 2009). Scores were used to categorize the level of risky behavior of the participant. A score of 0-5 was considered as low-risk; 6-10 was medium-risk and higher than 11 was high-risk (see Appendix H).

The 13-item Tool to Assess Psychosocial Indicators of Fruit and Vegetable Intake in Low-Income Communities (Townsend & Kaiser 2005; see Table 7 and Appendix I), was used to obtain the information about produce intake behaviors. The scaling system developed by Townsend and Kaiser (2005) was used for scoring (see Table 8).

Table 8

Scoring for Psychosocial Constructs Related to Produce Intake Behaviors

Construct or domain	Scoring range
Perceived benefits	0-1
Perceived control	0-1
Self-efficacy	0-1
Readiness to eat more fruit or vegetables	0-1
Perceived diet quality	0-1
Predisposing domain	0-2
Enabling domain	0-1
Change in intention domain	0-3
Change in all domains	0-6

A 7-item Food Behavior Checklist, part of the “Current 16-Item Food Behavior Checklist for Use with Some Low-Income Clientele” (Townsend, Kaiser, Allen, Joy, & Murphy, 2003), was also included. The food behavior scale score was calculated by the sum of the item score developed by Townsend et al. (2003) (see Appendix J).

Research Questions and Statistical Analysis

The self-reported data and clinical data were entered electronically into a spreadsheet format, and statistical analyses were conducted using SPSS version 16 (SPSS: An IBM Company, Chicago, IL) software. Prior to entry into SPSS, a sequential number was assigned for each woman. Any data which were missing or non-applicable were considered as missing data. In order to find the statistical significance, two tail tests

were conducted. Type I error was taken into account, and the level of significance was considered at $\alpha = .05$ ($p < .05$).

To describe the sample, descriptive analysis was conducted. In order to find out the measures of the central tendency for continuous variables, means were computed. The standard deviation of the sample and a confidence interval (CI) of 95% were calculated. When analyzing the categorical variables, frequencies and percentages were recorded along with the 95% CI. The data obtained from the sample were used to infer the parametric data that measures the population. The specific research questions and respective statistical analysis test for this study are listed in Table 9.

For statistical analysis purposes, a dichotomous variable for adult food security status was created. The fully food secure group consisted of only women with high food security (women with a household scale score of “zero”), those without any indication of food insecurity. The not fully food security group consisted of women with any indication of food insecurity (women who were categorized into marginal, low, or very low food secure groups). However, this is a departure from typical food security categorization, people with marginal food security are also considered as food secure.

Further, HPV dichotomous variable was used in the statistical analysis. The HPV dichotomous categorization was based on HPV positivity and HPV negativity of the clinical data.

Table 9

Research Questions and Statistical Analysis Tests

Does HPV differ between women who live in food secure households and food insecure households in rural Appalachia and attending a clinic for gynecological care?	Chi-Square test
Do risky sexual behaviors differ between women who live in food secure households and food insecure households in rural Appalachia and attending a clinic for gynecological care?	Wilcoxon-Mann-Whitney U test
Does produce intake differ between women who live in food secure households and food insecure households in rural Appalachia and attending a clinic for gynecological care?	Wilcoxon-Mann-Whitney U test
Do produce intake behaviors differ between women who live in food secure households and food insecure households in rural Appalachia and attending a clinic for gynecological care?	Wilcoxon-Mann-Whitney U test
Does produce intake differ between positive HPV women and negative HPV women in rural Appalachia and attending a clinic for gynecological care?	Wilcoxon-Mann-Whitney U test
Does produce intake behaviors differ between positive HPV women and negative HPV women in rural Appalachia and attending a clinic for gynecological care?	Wilcoxon-Mann-Whitney U test
What is the association of produce intake behaviors and food insecurity, adjusted for demographic confounders including the HPV status among women in rural Appalachia?	Univariate General Linear Model (GLM)

Chapter 4: Results

Characteristics of the Participants

Participants ($n = 153$) were 29 ± 8 years and primarily White/Non-Hispanic ($n = 144$, 94.1%). The demographic characteristics of our participants are summarized in Table 10.

Table 10

Demographic Characteristics of the Study Participants

Characteristic	Frequency (n)	Percentage (%)
Race ($n = 148$)		
American Indian or Native Alaskan Asian	1	0.7
Native Black or African American	2	1.3
Hispanic	1	0.7
White	144	94.1
Education ($n = 152$)		
Less than high school	4	2.6
High school graduate	16	10.5
Some college or higher	132	86.8
Health insurance ($n = 142$)		
No health insurance coverage/self-pay	2	1.4
Medicaid or Medicare only	25	17.5
Private insurance only	115	81.0
Marital Status ($n = 151$)		
Married	81	53.6
Single/never married	61	40.4
Divorced	8	5.3
Separated	1	0.7

Table 10 (Continued)

Characteristic	Frequency (n)	Percentage (%)
Employment (n = 146)		
Working full-time	79	51.6
Working part-time	23	15.0
Unemployed	13	8.5
Student (full/part-time)	16	10.5
Social security disability	4	2.6
Annual income (n = 151)		
\$0-\$10,000	37	24.5
\$10,001-\$20,000	23	15.2
\$20,001-\$30,000	17	11.3
\$30,001-\$40,000	20	13.2
Over \$40,000	47	31.1
County (n = 145)		
Distressed	125	86.2
Non- distressed	20	13.8
Employment (n = 146)		
Yes	79	82.9
No	25	17.1

Household Adult Food Security Status

Out of 153 women, 113 (75.3%) were living in food secure households, and 37 (24.7%) were living in food insecure households. The household adult food security status of the survey participants is summarized in Table 11.

Table 11

Household Adult Food Security Status of the Study Participants (n = 150)

Level of food security	Household food security category	Frequency (n)	Percentage (%)
High food security	Fully food secure	113	75.3
Marginal food security	Not fully food secure	16	10.7
Low food security	Not fully food secure	15	10.0
Very low food security	Not fully food secure	6	4.0

HPV Clinical Data

Table 12 summarizes HPV clinical data of the study participants.

Table 12

HPV Clinical Data of the Study Participants (n = 152)

Category	Frequency (n)	Percentage (%)
Negative HPV	139	91.4
Age 21-29	84	55.3
Age 30 and over	55	36.2
Positive HPV	13	8.6
Age 21-29	6	3.9
Age 30 and over	7	4.6

Of women who had positive HPV results, 3 reported having LSIL, and 7 had positive results for ASCUS. Thirty women (19.7%) said that they were informed by their doctor for having Trichomonas vaginal infections, Venereal warts, condylomas or

papilloma virus infections (HPV), Chlamydia, or/and Genital herpes. Only 38 women (25%) of the participants mentioned receiving the HPV vaccine (brand name Gardasil or Cervarix). Fifty women (32.9%) said that they had had abnormal Pap test results in the past.

Risky Sexual Behavior

Risky sexual behavior status of women who participated in the study is summarized in Table 13.

Table 13

Risky Sexual Behavior Status of the Study Participants (n = 138)

Risky sexual behavior category	Frequency (n)	Percentage (%)
Low	49	35.5
Medium	28	20.3
High	61	44.2

Produce Intake

Table 14 summarizes the produce intake of the study participants.

Table 14

Produce Intake of the Study Participants

Indicator	n	Mean	SD
Daily vegetables servings	152	2.1	1.1
Daily fruit servings	150	2.0	1.0
Daily total fruit and vegetable servings	152	4.1	1.9

Table 15 provides data on the proportion who met the daily recommendation for fruit, vegetable and total produce intake. Tables 16 and 17 summarize the proportion that met the daily vegetable and fruit recommendations by food security status.

Table 15

Proportions of the Study Participants Meeting Recommended Daily Produce Intake

Indicator	Met recommended daily intake n (%)	
	Yes	No
Daily vegetables servings ^a (n = 152)	101 (66.4)	51 (33.6)
Daily fruit servings ^b (n = 149)	99 (66.4)	101 (33.6)

^a ≥ 2 servings (ChooseMyPlate.gov, n.d.).

^b ≥ 1.5 servings (ChooseMyPlate.gov, n.d.).

Table 16

Proportions of the Study Participants Meeting Recommended Daily Vegetable Intake by Household Adult Food Security Status

	Fully food secure (n = 113)	Not fully food secure (n = 37)	p-value ^a
Met the daily recommendation	25	74	0.817
Did not meet the daily recommendation	12	39	

^aChi-squared test.

Table 17

Proportions of the Participants Meeting Recommended Daily Fruit Intake by Household Adult Food Security Status

	Fully food secure (n = 111)	Not fully food secure (n = 36)	p-value ^a
Met the daily recommendation	25	72	0.614
Did not meet the daily recommendation	11	39	

^aChi-squared test.

Tables 18 and 19 summarize the proportion that met the daily vegetable and fruit recommendations by food security status.

Table 18

Proportions of the Participants Meeting Recommended Daily Vegetable Intake by HPV Status

	HPV positive (n = 13)	HPV negative (n = 138)	p-value ^a
Met the daily recommendation	9	91	0.811
Did not meet the daily recommendation	4	47	

^aChi-squared test.

Table 19

Proportions of the Participants Meeting Recommended Daily Fruit Intake by HPV Status

	HPV positive (n = 13)	HPV negative (n = 135)	p-value ^a
Met the daily recommendation	11	87	0.142
Did not meet the daily recommendation	2	48	

^aChi-squared test.

Produce Intake Related Behaviors

Table 20 summarizes the psychosocial indicators related to fruit and vegetable intake of the women who participated in the study, and Table 21 provides a detailed description of psychosocial indicators related to fruit and vegetable intake.

Table 20

Produce Intake Related Behaviors of the Study Participants

Construct/Domain	n	Mean	SD
Perceived benefit score	150	0.9	0.2
Perceived control score	149	0.8	0.2
Self-efficacy score ^a	149	0.9	0.1
Perceived diet quality score	149	0.5	0.2
Readiness to eat more vegetables score	151	0.7	0.2
Readiness to eat more fruits score	149	0.7	0.2
Enabling domain score ^a	149	0.9	0.1
Predisposing domain score	149	1.7	0.3
Change in intention domain score	146	1.9	0.6
Change in all domains score	144	4.5	0.8
7-item fruit and vegetable scale score	151	15.5	4.0

^aScoring of self-efficacy score = scoring enabling domain score.

Table 21

A Detailed Description of Produce Intake Related Behaviors of the Participants

Indicator	Frequency (n)	Percentage (%)
Perceived Diet Quality (n = 149)		
Poor	4	2.7
Fair	34	22.8
Good	57	38.3
Very good	48	32.2
Excellent	6	4.0
Perceived Benefit (n = 150)		
0.25	1	0.7
0.5	17	11.3
0.75	29	19.3
1	103	68.7
Perceived Control (n = 149)		
0	2	1.3
0.25	3	2.0
0.5	46	30.9
0.75	24	16.1
1	74	49.7
Self-efficacy		
0.25 - 0.74	14	9.4
0.75 - 0.99	43	28.9
1	92	61.7
Readiness to eat more vegetables (n = 149)		
Pre-contemplation	4	2.6
Contemplation	13	8.6
Preparation	19	12.6
Action	78	51.7
Maintenance	37	24.5
Readiness to eat more fruits (n = 149)		
Pre-contemplation	6	4.0
Contemplation	9	6.0
Preparation	19	12.8
Action	74	49.7
Maintenance	41	27.5

Difference in HPV Prevalence by Household Adult Food Security Status

There was no significant difference in HPV prevalence between fully food secure and not fully food secure participants. Table 22 summarizes the HPV prevalence by household adult food security.

Table 22

HPV Prevalence by Household Adult Food Security Status

	Fully food secure	Not fully food secure	p-value ^a
Negative HPV	31	105	0.207
Positive HPV	5	8	

^aChi-squared test.

Difference in Risky Behavior Score by Household Adult Food Security Status

Risky behavior scores differed between fully food secure (mean score 61.65) and not fully food secure (mean score 89.32) participants ($p < 0.001$).

Difference in Produce Intake by Household Adult Food Security

Produce intake did not differ by food security status. Table 23 summarizes the produce intake by household adult food security.

Table 23

Differences of Produce Intake of the Study Participants by Household Adult Food Security

Indicator	Fully food secure (n = 37)	Not fully food secure (n = 113)	p-value ^a
Daily vegetables servings	2.0 ± 1.0	2.1 ± 1.2	0.846
Daily fruit servings	2.1 ± 1.0	2.0 ± 1.0	0.452
Daily total produce servings	4.2 ± 1.8	4.1 ± 2.0	0.721

^aWilcoxon-Mann-Whitney U test.

Differences in Produce Intake Related Behaviors by Household Adult Food Security

A statistically significant difference was observed between food security groups for perceived diet quality ($p = 0.014$). Fully food secure women perceived that their diet was healthier as they had higher mean rank score for perceived diet quality (78.68) than not fully food secure women (59.57). Self-efficacy and enabling domain scores approached significance ($p = 0.064$). Statistical analysis results are provided in Table 24.

Table 24

Differences of Produce Intake Related Behaviors by Household Adult Food Security

Construct/ Domain	Fully food secure (n = 37)	Not fully food secure (n = 113)	p-value ^a
Perceived benefit score	0.9 ± 0.2	0.9 ± 0.2	0.478
Perceived control score	0.8 ± 0.3	0.8 ± 0.2	0.086
Self-efficacy score	0.9 ± 0.1	0.9 ± 0.1	0.064

Table 24 (Continued)

Construct/Domain	Fully food secure (n = 37)	Not fully food secure (n = 113)	p-value ^a
Perceived diet quality score	0.6 ± 0.2	0.4 ± 0.2	0.014
Readiness to eat more vegetables score	0.7 ± 0.2	0.7 ± 0.2	0.459
Readiness to eat more fruits score	0.7 ± 0.2	0.7 ± 0.2	0.515
Enabling domain score	0.9 ± 0.1	0.9 ± 0.1	0.064
Predisposing domain score	1.6 ± 0.3	1.7 ± 0.3	0.254
Change in intention domain score	2.0 ± 0.6	1.8 ± 0.6	0.198
Change in all domains score	4.6 ± 0.7	4.4 ± 0.8	0.245
7-item fruit and vegetable scale score	15.2 ± 3.7	15.6 ± 4.2	0.897

^aWilcoxon-Mann-Whitney U test.

Difference in Produce Intake by HPV Status

Produce intake did not differ by HPV status. Table 25 summarizes the data.

Table 25

Difference in Produce Intake by HPV Status

Indicator	HPV positive group	HPV negative group	p-value ^a
Daily vegetables servings	2.3 ± 1.4	2.1 ± 1.1	0.846
Daily fruit servings	2.3 ± 0.8	2.0 ± 1.0	0.452
Daily total produce servings	4.6 ± 1.6	4.1 ± 2.0	0.721

^aWilcoxon-Mann-Whitney U test.

Difference in Produce Intake Related Behaviors by HPV Status

Produce intake behaviors and perceived diet quality did not differ by HPV status as shown in Table 26.

Table 26

Produce Intake Related Behaviors by HPV Status

Construct/Domain	HPV positive group	HPV negative group	p-value ^a
Perceived benefit score	0.9 ± 0.2	0.9 ± 0.2	0.480
Perceived control score	0.8 ± 0.2	0.8 ± 0.3	0.520
Self-efficacy score	0.9 ± 0.1	0.9 ± 0.1	0.907
Perceived diet quality score	0.6 ± 0.2	0.5 ± 0.2	0.077
Readiness to eat more vegetables score	0.8 ± 0.2	0.7 ± 0.2	0.362
Readiness to eat more fruits score	0.8 ± 0.1	0.7 ± 0.3	0.158
Enabling domain score	0.9 ± 0.1	0.9 ± 0.1	0.907
Predisposing domain score	1.7 ± 0.2	1.7 ± 0.3	0.455
Change in intention domain score	2.2 ± 0.4	2.0 ± 0.6	0.066
Change in all domains score	5.0 ± 0.4	4.5 ± 0.8	0.052
7-item fruit and vegetable scale score	15.8 ± 3.1	15.5 ± 4.2	0.761

^aWilcoxon-Mann-Whitney U test.

Relationship of Household Adult Food Security Scale Score and Adjusted Results of General Linear Model

A Univariate General Linear Model (GLM) analysis was conducted to examine the relationship of food security scale score and perceived diet quality, self-efficacy, perceived benefit, perceived control, readiness to eat more fruits and vegetables, daily vegetable servings, daily fruit servings, daily total produce servings, HPV status, education, insurance, smoking, and income. The adjusted results of Univariate GLM analysis are provided in Table 27.

According to the results of the GLM analysis, while controlling for all other variables in the Table 27, the following variables significantly predicted household adult food security scale score: health insurance ($p < 0.001$); education ($p = 0.004$); smoking status ($p = 0.006$); and perceived diet quality ($p = 0.019$).

Table 27

Relationship of Household Adult Food Security Scale and Adjusted Results of Univariate General Linear Model

Parameter	Beta coefficient	SD	p	95% CI	
				Lower Bound	Upper Bound
Intercept	3.836	1.335	.005	1.187	6.485
Health insurance (private insurance vs. no insurance/Medicaid/Medicare)	1.474	.372	<.001	.736	2.213
Smoking status (smokers vs. non-smokers)	-1.064	.379	.006	-1.816	-.312
Education (beyond high school vs. high school or less)	-1.443	.486	.004	-2.407	-.479
HPV status (positive vs. negative)	.056	.494	.909	-.924	1.037
Readiness to eat more fruits score (maintenance stage vs. earlier stages)	.017	.396	.966	-.768	.803
Readiness to eat more vegetables score (maintenance stage vs. earlier stages)	-.808	.420	.057	-1.640	.025
Income	-.106	.082	.199	-.269	.057
Risky sexual behavior score	.001	.014	.946	-.027	.029
Perceived benefit score	-.955	.839	.258	-2.620	.709
Perceived control score	.887	.506	.083	-.116	1.890
Self-efficacy score	-1.050	1.087	.336	-3.207	1.106
Daily vegetable servings	-.288	.530	.587	-1.339	.762
Daily fruit servings	-.196	.456	.668	-1.101	.709
Daily total produce servings	.302	.474	.526	-.638	1.241
Perceived diet quality score	-1.779	.748	.019	-3.264	-.295

Chapter 5: Discussion, Conclusion, and Recommendations

Overall, this study showed that participants facing food insecurity had higher risky sexual behavior scores compared to their food secure counterparts. Poor perceived diet quality was apparent among food insecure women.

Characteristics of Participants

Demographic characteristics. Collectively, participants were 29 ± 8 years and primarily White/Non-Hispanic, had some college or higher education, were married and working fulltime. Most of them were living in distressed counties and were non-smokers. The majority of the participants had private insurance and had an annual income of over \$40,000.

Being in an underprivileged geographical area, the majority of rural Appalachian residents are more likely to be White/Non-Hispanic, to have a low proportion with a high school diploma or higher qualification, to be under the poverty line, and to be uninsured, compared to non-Appalachian regions. According to 2007-2011 American Community Survey of the U. S. Census Bureau, the percentage of White/Non-Hispanic alone, in Ohio Appalachia was 91.9%, and in non-Appalachian Ohio it was 79.1% (Pollard & Jacobsen, 2013). As reported in the same survey, in Appalachian Ohio, the proportion that had a high school diploma or more was 84.7% compared to 88.5% in non-Appalachian Ohio (Pollard & Jacobsen, 2013). Additionally, the percentage of persons below the poverty line in Appalachian Ohio was 16.7%, compared to 14.3% in non-Appalachian Ohio and in the U.S. (In 2011, the recorded poverty line for a family of two adults and two children was \$22,811; Pollard & Jacobsen, 2013). According to the findings of a 2008 Ohio

Family Health Survey (Frazier, 2009), in Appalachia, the percentage of uninsured persons was 21.9%, which was significant compared to other regions (Metropolitan 17.4%; rural, 17.0%; and suburban, 12.3%). In the same year, 12.7% of Appalachians got enrolled for Medicaid (Metropolitan, 10.1%; rural, 8.1%; and suburban, 6.1%).

Food security. According to USDA guidelines, 85.9% of participants were living in food secure households, and 14.1% were living in food insecure households. This value was lower than the 2012 estimates of food insecurity in the U.S. In “Household Food Security in the United States in 2012” Coleman-Jensen and colleagues (2013) reported that food security in U.S. households in 2012 was 85.5%, and 14.5% were food insecure. In the same report they recorded that food insecurity (low or very low food security) in the state of Ohio was 16.1%. Compared to national data, a lesser proportion of the present study group had experienced food insecurity. Considering any indication of food insecurity, our study sample had 75.3% high household food security (fully food secure), and 24.7% had marginal, low or very low household food security (not fully food secure). While it would be worth to compare our data to estimates for Appalachia, there are no available data for household food security in the Appalachian region.

While our study results regarding food insecurity was comparable to national estimates, several other studies conducted in the Appalachian region reported high household food insecurity compared to national statistics. Particularly, women who live in low-income households and rural areas may have a higher tendency to experience food insecurity (Gorimani & Holben, 1999). Holben and Pheley (2006) uncovered that among 1,879 participants from Athens, Hocking, Meigs, Perry, Pike, and Vinton counties in

Ohio, 72.8% were living in food secure households, and 27.2% were from food insecure households. A group of 170 women from households receiving WIC benefits alone and 65 women those from households receiving both WIC and Farmers' Market Nutrition Program benefits were studied by Walker and others (2007). Among this particular group, 47.4% experienced food security and 52.6% experienced food insecurity (26.8%, food security; 20.6%, marginal food insecurity; 32.9%, low food security; and 19.7%, very low food security). Another research study conducted in Athens County, Ohio, analyzed data from 297 adults who were living in households with children enrolled in the Head Start program. The data was collected using a survey instrument including the 18-question U.S. Household Food Security Survey Module (Holben, McClincy, Holcomb, Dean, & Walker, 2004). Among this convenience sample, 152 (51.2%) were from food secure households, and 145 (48.8%) were living in food insecure households. Additionally, the number of households who had experienced very low food security in the previous 12 months was 90 (30.3%). There were 41 households who had experienced food very low food security in children.

In 2004, a telephone interview was conducted to collect data regarding household food security and the health status of older ($n = 91$) adults participating in the Commodity Supplemental Food Program (CSFP) in Athens County, Ohio (Holben, Barnett, & Holcomb, 2007). Of 91 participants, 50.5% were living in food secure households, while the remaining 49.5% lived in food insecure households. The portion that was living in households characterized by low food security and very low food security was 39.6% and

9.9%, respectively. Further, the study revealed that low household food security led to poorer health scores.

Several of the previous studies were conducted in samples with lower incomes and who qualified for food assistance programs, so it was not unexpected that our sample was more food secure. In the present study, we only used 10 questions from the same survey module that were related to adult food security, whereas most of the above mentioned studies used 18 questions including child food security questions. The reason we omitted child food security question was that we were only studying women's food security, and also participants might have been reluctant to reveal true information about child food security due to personal and legal issues.

HPV status. Although cervical cancer is a prevailing problem in rural Appalachia, our study group reported fewer HPV cases than expected. According the National Health and Nutrition Examination Survey data, the overall HPV prevalence among females aged 14 to 59 years was 26.8% (Dunne et al., 2007). According to Hariri and others (2011), during 2003-2006, the HPV prevalence among White/Non-Hispanic women was 39.2%. Further, CARE project revealed that prevalence of any HPV type among Appalachian women was 43.1%, which is five-fold higher than reported by our study participants (Reiter et al., 2013).

Fewer numbers of younger females in rural Appalachia reported to have received the HPV vaccine due to being insufficiently informed about cervical cancer, prioritizing other responsibilities over health care, cost, and being uninsured (Mills, Head, & Vanderpool, 2013). A study by Reiter et al. (2013), as a part of the part of the

Community Awareness, Resources, and Education (CARE) Project, was focused on studying the factors causing abnormal cervical cytology among women living in Appalachian Ohio. That study was designed to find the prevalence of HPV types in females who are aged between 18 and 26 years, living in an Appalachian region, and having no history of HPV vaccination. They discovered that 85.5% had a Pap test in the three years before the study. Approximately 44% mentioned having a history of at least one abnormal Pap test, which is more than the rate our study sample reported (32.9%). However, the percentage that were told by a doctor that they had venereal warts, condylomas, or papillomavirus infections was only 11.5%, and thus lower than the present study results (19.7%). In the same study, according to the clinical data, there was a 43.1% of prevalence for HPV of any type. However, the above number was almost five times higher compared to the present study results. The prevalence for high-risk HPV types (33.5%) was higher than the lower risk types (23.4%), and 12.5% of women were diagnosed for vaccine-preventable HPV types. Further, out of 278 women who had abnormal Pap test results, 51.4% had ASC-US, 40.3% had LSIL, 5.4% had HSIL, 2.5% had AGC, and 0.4% had squamous cell carcinoma. The higher rate of HPV infection in the Reiter study (2013), compared to our study, may be due to the sampling strategy. Our study was conducted in a gynecology office and that the Reiter sample (2013) was gathered from 17 health clinics in Ohio Appalachian region.

Risky sexual behavior. Less than half (44.2%) of participants were in the category of high-risk sexual behavior. However, there was a low occurrence of HPV infection. According to Reiter and others (2013), Appalachian women who are positive

HPV are more likely to perform risky sexual behaviors. The rate of abnormal Pap tests (32.9%) may be a better proxy for risky behavior than HPV infection in our case.

There is a long latency period between initial HPV infection and the appearance of cervical cancer. In addition, HPV activity does not have the ability to thrive into a malignant form independently unless factors such as age, risky sexual behaviors, lower income status, education level, or poor nutrition provide additional support. There are reports that suggest lower income, age at first intercourse, and having multiple sexual partners are factors that elevate the risk of cervical neoplasia (Amburgey et al., 1993; Hildesheim et al., 1993; Kjellberg et al., 2000; Muñoz et al., 2002; Plummer et al., 2003; Schiffman et al., 1993; Tomita et al., 2010; Wheeler et al., 1993). A study designed to examine women in Portland, Oregon, for the risk factors related to HPV infection (Bauer et al., 1993) uncovered that apart from risky sexual behaviors, lower levels of education and low income were associated with an increased prevalence of HPV. Lazcano-Ponce and others (2001) observed that women with low socioeconomic status were at the risk of having multiple HPV infections compared to women who reported to have medium socioeconomic status. Another study found that among the women who had been given referrals for treatments and repeat Pap tests, women of low socioeconomic status showed an irregularity in meeting the referrals (Laedtke & Dignan, 1992). Such situations can be influenced by the ability of having and maintaining medical insurance due to their economical conditions. Liddon, Leichliter, and Markowitz, (2012) found that women or girls who are insured are more likely to get the HPV vaccine, irrespective of their age. The ability to maintain health insurance could also be accompanied by the status of their

income. Because our sample was drawn from a “regular” clinic requiring insurance or regular payment, rather than a “free” screening site, our results are not unexpected.

Produce intake and produce intake related behaviors. Two thirds of the study participants met the recommendations for both fruit (1.5 to 2 cups/day) and vegetable (2 to 2.5 cups/day) consumption (choosemyplate.gov, n.d.). Similarly, according to the study group responses, most of them were in the action and maintenance stage for readiness for eating fruit and readiness to eat more vegetables. At this stage, participants show a commitment, and they have made a great deal of effort to make changes. These behaviors have been comfortably established and less likely to regress back to old actions.

Perceived benefit, perceived control, and self-efficacy means were high among the women, but not the perceived diet quality score. In our study, means for change in the predisposing domain and change in the enabling domain were higher, meaning that our participants believe that they can improve their produce intake behaviors. However, the mean score for the change in intention domain that measures the intention for a particular behavior reported to be low.

Overall, our study participants showed positive attitudes and confidence towards changing their produce intake behaviors. Personal beliefs on their ability to initiate and execute actions that can produce desirable effects to enhance their health are vital. It has been recorded that self-efficacy may promote the transition related to improve fruit and vegetable consumption (Wiedemann et al., 2009). Further, evidence is present to support

that there is a strong and consistence relationship between self-efficacy and produce intake (Luszczynska, Tryburcy, & Schwarzer, 2007; Van Duyn et al., 2001).

Household Adult Food Security and HPV Prevalence

The present study was the first study to look at food security and HPV status of women who live in rural Appalachia. No differences were found in food security by HPV status. The small sample size may have been the reason for this finding.

Household Adult Food Security and Risky Sexual Behavior

To our knowledge, no studies have examined food insecurity and risky sexual behavior in rural Appalachia or America in a similar sample. Our finding of risky sexual behaviors among not fully food secure women indicated that they may be at increased risk for poor cervical health.

Other studies have explored food insecurity and risky sexual behavior among HIV affected populations. A study conducted in San Francisco revealed that food insecurity is a risk factor connected to having unprotected sex among homeless and marginally-housed HIV-infected people (Vogenthaler et al., 2013). Weiser and colleagues (2007) were reported that, among women in Botswana and Swaziland, food insufficiency was associated with elevated risky sexual behaviors that also put them at risk of transmitting HIV.

Household Adult Food Security and Produce Intake and Related Behaviors

In this study, higher perceived diet quality was observed among fully food secure women. Other studies from our region support that food insecurity is associated with poorer perceived diet quality (Carter et al., 2011; Crooks, 2000; Kropf et al., 2007).

Food security has been a known factor that is associated with unhealthy dietary behaviors. Studies have shown that food security has an association with better fruit and vegetable intake (Grutzmacher & Gross, 2011; Kendall et al., 1996; Kirkpatrick & Tarasuk, 2008). In thesis research conducted to examine food security and produce intake and behaviors among distressed women with children who live in Appalachian Ohio, researchers reported that when the adult food security worsens, the amount of fruit consumption also declines (Hazen, 2009). Vardel (2010) studied access to fresh produce by low-income households that obtain food from a rural food pantry in Appalachian Ohio along with a produce intervention program to improve participants' produce intake and food security status. At the initial stage, the whole group showed 62.3% food insecurity, and this was more than four-fold higher, compared to the national level in 2009 (14.7%) (Nord et al., 2009). There was an improvement in food security status due to the intervention program. The post-intervention food insecurity was 50.8%, still almost three-and-a-half times higher than the U.S. national food insecurity statistics.

As illustrated above, when a household experiences food insecurity, it may lead to lower fruit and vegetable consumption, specifically below the recommended values. Drewnowski and Specter (2004), reported that food insecurity was associated with poverty that leads to poor produce intake. This, food insecure households tend to have lower food expenditures, leading to low fruit and vegetable consumption, and lower-quality diets. Because of resource constraints, these households have a higher tendency to have diets with high-fat and energy-dense foods. Due to the high cost of lean meats, fish, fresh vegetables, and fruit, people living in low-income households choose more

affordable, high-energy dense diets, compromising food quality. A recent study was conducted among low-income people who live in two counties in North Carolina to examine the perceived barriers to adequate produce intake (Haynes-Maslow et al., 2013). The majority of the participants were African-American females with high school education or less. The study results indicated that the primary barriers to produce intake are cost, transportation, quality, variety, changing food environment, and changing societal norms. The participants showed a preference to have more fruits and vegetables. Further, it was revealed that the participants were not able to provide fruit and vegetables due to resource constraints. However, they mentioned that tended to but more canned and frozen fruits and vegetable due to their affordability. Our study did not measure fresh versus other produce items, where may be an avenue for further research.

Women tend to compromise their needs to provide for other family members in the household. In households characterized by low food security, women tend to consume low amounts of energy and other nutrients, such as Vitamin A, folate, iron, and magnesium, leading them to be nutrient deficient (Tarasuk & Beaton 1999). Tarasuk (2001) reported that women who reported to live in households experiencing food insecurity with severe or moderate hunger over the past 30 days were more likely to have lower intakes of vegetables and fruit compared to their counterparts. Another study revealed that from the time of receiving the main income, low-income women's energy and produce intake declined with time over the month (Tarasuk, McIntyre, & Li, 2007).

Adults who live in food-insecure households tend to cut down their produce intake in order to provide their children with sufficient fruits and vegetables and other

nutrients (Rose, 1999). A similar observation was made by Kirkpatrick and colleagues (2008) in a study group between ages of 1 to 70 years living in food-insecure households. Nutrient inadequacy and poor quality diet, including fewer servings of fruits and vegetables, were to be seen among adults and adolescents, compared to children. Kendall et al. (1996) studied women with children living in a rural county of New York State for their food insecurity status and produce intake. The study results indicated that the produce intake of the participants declined with poor food security status. A group of adult women with children living on a Navajo reservation was studied by Ray and colleagues (2012). Women who were living in food insecure households consumed low amounts of vegetables. In a study carried out in Atlantic, Canada by McIntyre and others (2003) examined whether low-income single mothers would compromise their own diets to provide for their children. The results indicated that food consumption of children was consistently adequate, while mothers reported to be deficient in energy and other nutrients.

Kropf and others (2007) recruited women from the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) and WIC/Farmers' Market Nutrition Program participating households, to observe their household food security status, education level, produce intake and behaviors, including perceived diet quality. Similar to our study, food insecurity of participants was associated with poorer diet quality. Among women with children living on a Navajo reservation, food security was statistically significantly related to their perceived diet quality; specifically, food insecure

households showed a lower perceived diet quality compared to food secure households (Ray et al., 2012).

Vardell, (2010) has reported that several poor produce intake related behaviors, including diet quality, self-efficacy, servings of fruits and vegetables, 7-item behavior checklist score, and other related fruit and vegetable psychosocial indicators, were associated with household food insecurity among low-income households that obtain food from rural food pantries in Appalachian, Ohio. In a study conducted with the involvement of low-income patients with diabetes, Lyles and others 2013 observed lower self-efficacy and fruit and vegetable consumption among the patients who were food insecure, compared to their food secure counterparts. As stated by Townsend and Kaiser (2007), self-efficacy is used to measure the confidence in executing certain actions related to fruit and vegetable intake in different situations. Havas and others (1998) found that when self-efficacy increased by 1, standard deviation increased by 0.76 serving consumption. Measuring self-efficacy of a population is highly important for health promotion programs that aim to improve produce intake. According to Luszczynska and others (2007), verbal advice and positive emotion can lead to improvements in self-efficacy to achieve changes in behavior.

HPV Status and Produce Intake and Related Behaviors

Genital HPV is known as the most common sexually transmitted infection, and there is no known treatment for the virus itself (CDC, 2013e). It has been documented that even though HPV infection is the main causative agent of cervical cancer, it may not be sufficient to induce the cancer (Domenico et al., 2012; Kim et al., 2003; Kolanjiappan,

Manoharan, & Kayalvizhi, 2002). Among other factors that correlate with cervical cancer, oxidative stress is a prominent factor that further promotes the HPV-initiated carcinogenesis (Domenico et al., 2012; Jiang, Xiao, Khan, & Xue, 2013; Kim et al., 2003; Looi, Dali, Ali, Ngah, & Yusof, 2008). Conversely, antioxidants work as a mediator to curtail the reactions that are initiated due to oxidative stress. Hence, antioxidants are known for their potential therapeutic use as chemopreventive agents. Accordingly, a diet rich in fruits and vegetables is a source that is rich in antioxidants. Even though most of the HPV infections regress back to normal, uncontrolled persistent high-risk HPV types could develop into cervical neoplasia stages that ultimately reach invasive carcinoma. For that matter, the role of antioxidants may have a vital role in controlling the infection and clearing it in a shorter period.

No indicators of produce intake/behaviors differed by HPV status. Similar findings were noted by Sedjo et al. (2003) about HPV persistence or cervical dysplasia and dietary nutrients. That study was conducted in a small number of low-income Hispanic women participants (n = 91). Research by Goodman, McDuffie, Hernandez, Wilkens, and Selhub (2000) reported no or little association of plasma concentrations of folate, homocysteine, or vitamin B₁₂ with the estimated risk of precancerous lesions other than the promising risk reduction in cervical dysplasia with increased plasma cysteine levels.

Several other studies have discovered statistically significant associations between HPV and produce intake, particularly serum micronutrients. Chih, Lee, Colville, Binns, and Xu (2013) reviewed earlier publications related to dietary intake and risk reduction of

HPV related CIN. They concluded that the consumption of a diet that is high in vitamins and minerals, specifically fruits and vegetables, would have a protective effect on the progression of transient and persistent HPV infections to high-grade CIN 2, 3, and invasive carcinoma. As study by Giuliano and others (2003) looked at the relationship between dietary intake and HPV infection (persistence of specific types of HPV) among women who live in Brazil. The study was conducted for a 12-month period, and the women were given a questionnaire about the dietary intake of 15 food items, including the frequency of consumption in the past 5 years (Giuliano et al., 2003). The study also examined the relationship between several selected fruits and vegetable intake and serum carotenoids concentrations. Serum carotenoids concentration data and self-reported citrus fruits and carrots intake data showed a strong association. Further, Giuliano and others (2003) observed that consumption of several dietary carotenoids may be able to reduce the risk of persistent HPV infection. Sedjo et al. (2002), reported that women who had a higher intake of vegetables showed a 54% reduction in the risk of persistent HPV infection. In a case control study conducted with women who had squamous cell carcinoma of the cervix, Ghosh and others (2008) uncovered that total fruit and vegetable intake was associated with reducing the risk of cervical cancer by 50%. Goodman and others (2007) studied a cohort of women for a longer period to examine the association of serum micronutrients concentrations with the clearance of HPV infection. Total carotenoids amounts showed an association with a significant decrease in the clearance time of type-specific HPV infection. They also observed that women who had higher concentrations of α -tocopherol and total-tocopherol levels showed a shorter clearance

time when compared to women with lower levels. In the same study, a corresponding risk reduction was observed in cervical cancer with higher amounts of serum micronutrients.

Research by Flatley and others (2009) discovered that folate may act as a factor that changes the activity of high-risk HPV infections that have an ultimate result on reducing the risk of cervical carcinoma. Apart from having low intake of fruits and vegetables, women who are smokers are at a higher risk, since this combination elevates the risk of progression from general HPV viral infection to an invasive cancer state. A recent study published by Tomita, Roteli-Martins, Villa, Franco, and Cardoso (2011) was able to show that women with CIN who are current smokers are more likely to have low amounts of dark green and deep yellow vegetables and fruits.

Even though few studies that have focused on HPV infection status and fruit and vegetable intake, many other studies have found a relationship of serum micronutrient levels to increased risk of cervical carcinoma (Feng et al., 2011; García-Closas, Castellsagué, Bosch, & González, 2005; Gariglio, Gutiérrez, Cortés, & Vázquez, 2009; Kim et al., 2010; Myung et al., 2011; Yeo et al., 2000; Zhang, Dai, Zhang, & Wang, 2012).

Predictors of Household Adult Food Security Scale Score

According to the adjusted GLM results, health insurance, smoking status, education attainment, and perceived diet quality, are significant predictors of household adult food security scale score. Women, who had education attainment of more than high school level, did not have private insurance, smoked cigarettes, and lower perceived diet

quality scores had significantly higher household adult food security scale score, with lower self-reported food security. There are previous studies to support the idea that people who live in food insecure households are more likely to be smokers (Armour, Pitts, & Lee, 2008; Gooding, Walls, & Richmond, 2011; Kruger et al., 2012) and have poor perceived diet quality (Hazen, Holben, Holcomb, & Struble, 2008; Kropf et al., 2007; Vardell, 2010), and to lack health insurance coverage (Alaimo, Briefel, Frongillo Jr, & Olson, 1998). Previous studies have observed that food insecure populations tend to have lower school attainment levels (Gooding et al., 2011).

Conclusion and Recommendations

Overall, this study showed that participants facing food insecurity had higher risky sexual behavior scores, compared to their food secure counterparts. Poor perceived diet quality was apparent among food insecure women.

However, there were several limitations that we experienced during the study. Because this has been the first study to examine food security, cervical health, and produce intake in the Appalachian region, the research was executed as a pilot study in a small convenience sample. We were able to recruit participants from only one clinic for cervical testing and screening. If we were to collect data using clinics in other areas of the Appalachian region, results may have yielded different outcomes. Since the study was a cross-sectional design, we were not able to assess the activity of the virus with time and the relationship to produce intake.

In order to avoid disturbances to the clinic's daily routine, we recruited our participants through convenience sampling. This may have been a factor that influenced

the study results. Further, we considered self-reported data, other than the HPV status, obtained from the clinic. While this is acceptable for the constructs measured, participants may have been biased towards certain questions due to personal and legal reasons. However, because we used validated questionnaires, the results are probably accurate. Additionally, 25% of the women had the HPV vaccine, which may explain the food security and HPV results.

Food security status may be under- or overstated, due to the nature of the survey. However, the validated survey has been found to accurately reflect food security status.

Although no difference was found in food security by HPV status, using more women participants may have yielded different results. Our data show that food insecurity may promote riskier sexual behaviors and could be further examined by a study with a larger sample size. Future studies should be carried out to examine whether there are any influences from dietary intake and habits of food insecure women on high-risk and low-risk HPV types. There have been studies published that HPV types with different risk levels have different clearance times. In addition, examining the cohort effect of food insecure women who have HPV infection will provide more meaningful insight to the situation. Further, an educational component could be included to provide these women with information on how to improve produce intake while managing their income for other expenses as well. The productivity of such programs can be monitored along with the HPV infection status of women periodically. A study could be designed with the involvement of a multidisciplinary research team to understand ways that the produce intake can be improved among women with poor cervical health and higher food

insecurity, including measuring its effectiveness to control the cancer problem, compared to other measures. These finding could be used for numerous interventions that focus on the transfer of knowledge through nutrition education aimed at preventing or controlling many diet-related chronic disease problems, especially among rural Appalachian women. These types of interventions might help to shrink the cervical cancer issue in rural Appalachia along with improving food security and healthy dietary behaviors that will benefit many other chronic disease conditions.

Chronic physical and mental conditions appear to lead to increased household food insecurity conditions, irrespective of household sociodemographic characteristics (Tarasuk et al., 2013). Thus, women with a higher risk for cervical cancer are likely to experience household food insecurity. Accordingly, further studies should explore the relationship of cervical cancer and food security.

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Appendix A: U.S. Household Food Security Survey Module

Optional USDA Food Sufficiency Question/Screeners

HH1. Which of these statements best describes the food eaten in your household in the last 12 months: —enough of the kinds of food (I/we) want to eat; —enough, but not always the kinds of food (I/we) want; —sometimes not enough to eat; or, —often not enough to eat?

- | | |
|--|--|
| <input type="checkbox"/> [1] Enough of the kinds of food we want to eat | <input type="checkbox"/> [3] Sometimes not enough to eat |
| <input type="checkbox"/> [2] Enough but not always the kinds of food we want | <input type="checkbox"/> [4] Often not enough to eat |
| | <input type="checkbox"/> [5] DK or Refused |

Household Stage 1: Questions HH2-HH4

HH2. —(I/We) worried whether (my/our) food would run out before (I/we) got money to buy more.” Was that often true, sometimes true, or never true for (you/your household) in the last 12 months?

- | | |
|---|--|
| <input type="checkbox"/> [] Often true | <input type="checkbox"/> [] Never true |
| <input type="checkbox"/> [] Sometimes true | <input type="checkbox"/> [] DK or Refused |

HH3. —The food that (I/we) bought just didn’t last, and (I/we) didn’t have money to get more.” Was that often, sometimes, or never true for (you/your household) in the last 12 months?

- | | |
|---|--|
| <input type="checkbox"/> [] Often true | <input type="checkbox"/> [] Never true |
| <input type="checkbox"/> [] Sometimes true | <input type="checkbox"/> [] DK or Refused |

HH4. —(I/we) couldn’t afford to eat balanced meals.” Was that often, sometimes, or never true for (you/your household) in the last 12 months?

- | | |
|---|--|
| <input type="checkbox"/> [] Often true | <input type="checkbox"/> [] Never true |
| <input type="checkbox"/> [] Sometimes true | <input type="checkbox"/> [] DK or Refused |

Household Stage 2: (Affirmative response to one or more of Questions HH2-HH4OR, response [3] or [4] to question HH1- continue to Adult Stage 2)

Adult Stage 2: Questions AD1-AD4

AD1. In the last 12 months, since last (name of current month), did (you/you or other adults in your household) ever cut the size of your meals or skip meals because there wasn't enough money for food? ☐ [] Yes

- ☐ [] No (Skip AD1a)
☐ [] DK (Skip AD1a)

AD1a. [IF YES ABOVE, ASK] How often did this happen—almost every month, some months but not every month, or in only 1 or 2 months? ☐ [] Almost every month

- ☐ [] Some months but not every month
☐ [] Only 1 or 2 months
☐ [] DK

AD2. In the last 12 months, did you ever eat less than you felt you should because there wasn't enough money for food?

☐ Yes ☐ No ☐ DK

AD3. In the last 12 months, were you every hungry but didn't eat because there wasn't enough money for food?

☐ Yes ☐ No ☐ DK

AD4. In the last 12 months, did you lose weight because there wasn't enough money for food?

☐ Yes ☐ No ☐ DK

Household Stage 3 If affirmative response to one or more of questions AD1- AD4 - continue to Adult Stage 3)

Adult Stage 3: Questions AD5-AD5a

AD5. In the last 12 months, did (you/you or other adults in your household) ever not eat for a whole day because there wasn't enough money for food?

☐ Yes ☐ No (Skip AD5a) ☐ DK (Skip AD5a)

AD5a. [IF YES ABOVE, ASK] How often did this happen—almost every month, some months but not every month, or in only 1 or 2 months?

☐ Almost every month ☐ Only 1 or 2 months
☐ Some months but not every month ☐ DK

Child Stage 1: Questions CH1-CH3 (Transitions and questions CH1 and CH2 are administered only to all households with children under age 18 if not skip to End of Food Security Module.

CH1. ~~(I/we)~~ relied on only a few kinds of low-cost food to feed (my/our) child/the children) because (I was/we were) running out of money to buy food.” Was that often, sometimes, or never true for (you/your household) in the last 12 months?

☐ Often true ☐ Never true
☐ Sometimes true ☐ DK or Refused

CH2. ~~(I/We)~~ couldn't feed (my/our) child/the children) a balanced meal, because (I/we) couldn't afford that.” Was that often, sometimes, or never true for (you/your household) in the last 12 months?

☐ Often true ☐ Never true
☐ Sometimes true ☐ DK or Refused

CH3. "(My/Our child was/The children were) not eating enough because (I/we) just couldn't afford enough food." Was that often, sometimes, or never true for (you/your household) in the last 12 months?

☐ Often true

☐ Never true

☐ Sometimes true

☐ DK or Refused

Child Stage 2: Questions CH4-CH7 (If affirmative to one or more of questions CH1-CH3, then continue to Child Stage 2)

CH4. In the last 12 months, since (current month) of last year, did you ever cut the size of (your child's/any of the children's) meals because there wasn't enough money for food?

☐ Yes

☐ No

☐ DK

CH5. In the last 12 months, did (CHILD'S NAME/any of the children) ever skip meals because there wasn't enough money for food?

☐ Yes

☐ No (Skip CH5a)

☐ DK (Skip CH5a)

CH5a. [IF YES ABOVE ASK] How often did this happen—almost every month, some months but not every month, or in only 1 or 2 months?

☐ Almost every month

☐ Only 1 or 2 months

☐ Some months but not every month

☐ DK

CH6. In the last 12 months, (was your child/were the children) ever hungry but you just couldn't afford more food?

☐ Yes

☐ No

☐ DK

CH7. In the last 12 months, did (your child/any of the children) ever not eat for a whole day because there wasn't enough money for food?

☐ Yes

☐ No

☐ DK

Appendix B: U.S. Measurement of Household Food Security Status

Number of affirmatives		1998 food security scale score	Food security status and code	
Households with children	Households without children		2000 label	2006 label
0	0	0	Food secure / 0	High food security / 0
1	1	1.0		Marginal food security / 1
2	2	1.2		
		1.8		
		2.2		
3		2.4	Food insecure without hunger / 1	Low food security / 2
4	3	3.0		
		3.0		
5		3.4		
	4	3.7		
6		3.9		
7		4.3		
	5	4.4		
8		4.7	Food insecure with hunger (moderate) / 2	Very low food security / 3
	6	5.0		
9		5.1		
10		5.5		
	7	5.7		
11		5.9		
12		6.3		
	8	6.4		
13		6.6	Food insecure with hunger (severe) / 3	
14		7.0		
	9	7.2		
15		7.4		
	10	7.9		
16		8.0		
17		8.7		
18		9.3		

Note. Adapted from “Guide to measuring household food security” by G. Bickel, M. Nord, C. Price, W. Hamilton and J. Cook, 2000, Office of Analysis, Nutrition, and Evaluation, Food and Nutrition Services, USDA, p. 34. Retrieved November 23, 2012, from <http://www.fns.usda.gov/FSEC/FILES/FSGuide.pdf> & “Household food security in the United States, 2006,” by M. Nord, M. Andrews, and S. Carlson, 2007, U. S. Department of Agriculture, Food and Nutrition Service, Alexandria, VA, p. 50. Retrieved November 23, 2012 from http://www.ers.usda.gov/media/215286/err49_1_.pdf

Appendix C: Institutional Review Board (IRB) Approval Letter



OHIO
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12F029

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The following research study has been approved by the Institutional Review Board at Ohio University for the period listed below.

Project: Women's Health and Nutrition Survey - A Pilot Study

Researcher(s): David H Holben
Jane T Balbo
Jody Jerome

Advisor:
(if applicable)

Department: Nutrition; School of Applied Health Sciences & Wellness

Anne Loucks

Anne Loucks, Ph.D., Chair
Biomedical Institutional Review Board

9/6/2012

Approval Date

9/5/2013

Expiration Date

This approval is valid until expiration date listed above. If you wish to continue beyond expiration date, you must submit a periodic review application and obtain approval prior to continuation.

The approval remains in effect provided the study is conducted exactly as described in your application for review. Any additions or modifications to the project must be approved by the IRB (as an amendment) prior to implementation.

Adverse events must be reported to the IRB promptly, within 5 working days of the occurrence.

Appendix D: Flyer Used for Participant Recruitment

Women's Health and Nutrition Study!



If you are:

- A woman
- Age 21-65 years
- Want to help us learn how health and nutrition might affect Pap smears
- Have not had a hysterectomy

Please ask our clinic staff for a survey packet!

For questions or more information, please contact the study team:

womenshealthnutritionstudy@gmail.com

Appendix E: Consent Form for Participant Recruitment

APPROVED

SEP - 6 2012

Ohio University Consent Form

Title of Research: Women's Health and Nutrition Survey in Appalachian Ohio

Researchers: David Holben, PhD; Jane Balbo, DO; Jody Gerome, DO; Amy Smith, OMS-2; Sumali Hewage, BS.

OHIO UNIVERSITY
INSTITUTIONAL REVIEW BOARD

You are being asked to participate in research. For you to be able to decide whether you want to participate in this project, you should understand what the project is about, as well as the possible risks and benefits, in order to make an informed decision. This process is known as informed consent. This form describes the purpose, procedures, possible benefits, and risks. It also explains how your personal information will be used and protected. Once you have read this form and your questions about the study are answered, you will be asked to sign it. This will allow your participation in this study. You should receive a copy of this document to take with you. Regardless of your decision to participate or not, the medical care that you receive at your clinic will not be affected.

Explanation of Study

Rates of cervical cancer are higher in southeast Ohio than in other parts of Ohio.

Pap smears look for cervical cancer or pre-cancer (also called "cervical dysplasia"). We know that abnormal Pap smears have been associated with health, nutrition, or certain other lifestyle behaviors. This study is being done to look at those factors that can affect women's health and nutrition.

If you agree to participate, you will be asked to fill out some forms. The first form asks some basic information about you, such as your age. A second survey will ask you health questions that are commonly asked by health care providers at gynecologic visits. The third form is a survey about the foods you eat.

If you agree to participate, you are giving us permission to look at the results of your recent Pap smears and/or colposcopy.

If you agree to participate, we also may call you in the future to invite you to participate in a related study, and you may say no (see "Information about you" survey).

You should not participate in this study if you are younger than 21, older than 65, have had a hysterectomy, or you are unwilling to participate.

Your participation in the study will last up to 10 minutes.

Risks and Discomforts

There are no anticipated risks of participating in this study, other than protecting your private medical information. Every effort will be made to protect your private medical information in the following ways: (1) the data will only be examined in one of our healthcare facilities (Campus Care, River Rose OB/Gyn, OU-HCOM Free Clinic, or OU-HCOM Community Health Services Mobile Health Van), (2) only members of the investigating team will be reviewing your information, and (3) your information will be kept in a locked cabinet and a password protected computer, and will be destroyed 24 months after the study ends.

Benefits

After you complete the survey, you will receive \$15 for your participation. This study is important to science/society because it will help us get more information about women's health related to behaviors and nutrition.

You may not benefit personally by participating in this study.

Confidentiality and Records

Your study information will be kept confidential within the limits of the law by the following:

Your surveys will not have your name on them, only a unique number. These surveys will be kept in a locked filing cabinet in one of the researchers' offices.

A master list that contains each participant's name, date of birth, and unique number will be kept in a separate locked filing cabinet in one of the researchers' offices, along with this consent form.

Additionally, while every effort will be made to keep your study-related information confidential, there may be circumstances where this information must be shared with:

- * Federal agencies, for example the Office of Human Research Protections, whose responsibility is to protect human subjects in research;
- * Representatives of Ohio University (OU), including the Institutional Review Board, a committee that oversees the research at OU;

Compensation

After completing the survey, \$15 compensation will be provided. We will collect your name and address and your signature when you receive your compensation.

Contact Information

If you have any questions regarding this study, please contact ***Dr. David Holben at 740-593-2875.***

If you have any questions regarding your rights as a research participant, please contact Jo Ellen Sherow, Director of Research Compliance, Ohio University, (740)593-0664.

By signing below, you are agreeing that:

- you have read this consent form (or it has been read to you) and have been given the opportunity to ask questions and have them answered
- you have been informed of potential risks and they have been explained to your satisfaction.
- you understand Ohio University has no funds set aside for any injuries you might receive as a result of participating in this study
- you are 21 years of age or older
- your participation in this research is completely voluntary
- you may leave the study at any time. If you decide to stop participating in the study, there will be no penalty to you and you will not lose any benefits to which you are otherwise entitled.

Signature_____ Date_____

Printed Name_____

Version Date: ***[8/30/12]***

Appendix F: Survey

Food and Nutrition Survey

Completion of this survey is completely voluntary and may cease at any time. No one will be able to identify you in any report resulting from this survey.

This survey should be taken by the individual attending the clinic today. This study is being done in order gain a deeper understanding of food access and women's health in our area. The survey will take about 10minutes to complete. In no way will your answers affect you or your family's access to the clinic. Thank you very much for your time and assistance.

***If you have questions related to this interview please contact, per your consent form:**

David H. Holben, PhD, RD, LD (researcher) at 740-593-2875

or

Jo Ellen Sherow (Director of Research Compliance) at 740-593-0664.

Tell Us About You.

How old are you? _____

What is your race? (Circle all that apply)

American Indian or Native Alaskan	Asian Native	Black or African American	Hispanic	Hawaiian or Other Pacific Islander	White
Other (Please specify.)					

What is your current marital status? (Circle one answer)

Married	Widowed	Divorced	Separated	Single/Never Married
If not married, do you have a live-in partner? Yes No				

Including you, how many people live in your household?

_____ adults
 _____ children 18 yrs & younger

What is your highest level of education completed?

(Check one box only)

Less than High School	
High School Graduate – high school DIPLOMA or the equivalent (GED)	
Some College or Higher	

What is your occupation type?	
(Check one box only)	
Working full-time (35 or more hours per week)	
Working part-time (fewer than 35 hours per week)	
Unemployed	
Student (either full or part-time)	
Social Security Disability	
Applying for Social Security	
Retired	
Other (Please explain)	

What is your current employment status?	
(Circle one answer)	
Unskilled labor/ never employed/ Other	Professional/ skilled labor

Which of the following best describes your current living arrangement?	
(Check one box only)	
I live with immediate family members (parents, brothers, sisters)	
I live with my partner/significant other/spouse	
I live with relatives (cousins, aunt or uncle, etc.)	
I live with a friend (or friends)	
I live alone	

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What figure is closest to your current annual income?					
(Circle one answer)					
\$0-\$10,000	\$10,001-\$20,000	\$20,001-\$30,000	\$30,001-\$40,000	Over \$40,000	Prefer not to answer
Do you currently have health insurance?					
(Circle one answer)					
No coverage/ self-pay		Medicaid or Medicare only		Private insurance only (job/ school/ purchased)	

What county do you live in? _____
--

Do you belong to a church / religion? (Circle one answer)	Yes	No
--	-----	----

Do you smoke cigarettes/ tobacco?	Yes	No
The age you started smoking / using tobacco	_____ years	
Average cigarettes smoked per day/ average use of tobacco per day	_____ cigarettes/ tobacco	

In general my health is excellent, very good, good, fair, or poor. (Circle one answer)				
Excellent	Very Good	Good	Fair	Poor

Tell Us About Your Sexual Behaviors.

How old were you the first time you had sexual intercourse ("gone all the way," "made love")?	Years	Don't know	Refuse

What is the number of male partners (age 18 years or YOUNGER) with whom you have had sexual intercourse?	Number	Don't know	Refuse

What is the number of male partners (OVER 18 years of age) with whom you have had sexual intercourse?	_____
--	-------

Have you ever had sexual intercourse for money? (Circle one.)	Yes	No
To the best of your knowledge, have any of your male sexual partners had sex with men? (Circle one.)	Yes	No

To the best of your knowledge, have any of your male sexual partners used intra-venous (IV) drugs? (shoot-up, tie, ping-n-wing, bang, back jack) (Circle one.)	Yes	No
--	-----	----

Did you and your partner(s)/husband(s) use condoms when you were less than 18 years old? (Circle only one.)			
Yes, regularly	Yes, sometimes	Never	No partner

Did you and your partner(s)/husband(s) use condoms when you were 18 years old or older? (Circle only one.)			
Yes, regularly	Yes, sometimes	Never	No partner

Have any of your present or previous sexual partners been treated for sexually transmitted diseases (STDs)? (These include diseases for which your partner had to also be treated such as "clap, drip, gotten burned, green pus". This does not include yeast infections.) (Circle one.)	Yes	No
--	-----	----

Have you used any of these methods of birth control?			
	Yes	No	Don't Know
Birth pills			
NuvaRing			
Birth control patch			
Depoprovera			
Birth control implant (Implanon/ Nexplanon/ Norplant)			
IUD/ Intra Urine Device			
Condoms			
Sponge			
Diaphragm			
Cervical cap			
Spermicide			
Natural family planning/ rhythm method			
I have never had intercourse/ sex before			

Did a doctor ever tell you that you had one of the following conditions? Please select all that apply, (if in doubt select "Don't know").		
	Yes	Don't Know
Trichomonas vaginal infections		
Venereal warts, condylomas or papilloma virus infections (HPV)		
Chlamydia		
Genital herpes		
Syphilis		
Gonorrhea		
HIV		

Have you received HPV vaccine (brand name Gardasil or Cervarix)? (Circle only one.)		
Yes	No	Don't Know or Refuse

Have you received an abnormal pap test results? (Circle only one.)		
Yes	No	Don't Know or Refuse

May we call you in the future about another study related fruits and vegetables? (Circle only one.)	
Yes	No

Tell Us About Your Food and Nutrition Habits and Behaviors.

I feel that I am helping my body by eating more fruits and vegetables. (Circle one answer)	Agree (Yes)	Agree or Disagree (Maybe)	Disagree (No)
I may develop health problems if I do not eat fruit and vegetables. (Circle one answer)	Agree (Yes)	Agree or Disagree (Maybe)	Disagree (No)
I feel that I can eat fruit or vegetables as snacks. (Circle one answer)	Agree (Yes)	Agree or Disagree (Maybe)	Disagree (No)
I feel that I can buy more vegetables the next time I shop. (Circle one answer)	Agree (Yes)	Agree or Disagree (Maybe)	Disagree (No)
I feel that I can plan meals or snack with more fruit during the next week. (Circle one answer)	Agree (Yes)	Agree or Disagree (Maybe)	Disagree (No)
I feel that I can eat two or more servings of vegetables at dinner. (Circle one answer)	Agree (Yes)	Agree or Disagree (Maybe)	Disagree (No)
I feel that I can plan meals with more vegetables during the next week. (Circle one answer)	Agree (Yes)	Agree or Disagree (Maybe)	Disagree (No)
I feel that I can add extra vegetables to casseroles and stews. (Circle one answer)	Agree (Yes)	Agree or Disagree (Maybe)	Disagree (No)
In your household who is in charge of what foods to buy? (Circle one answer)	I Am	Shared Decision	Other Person
In your household who is in charge of how to prepare the food? (Circle one answer)	I Am	Shared Decision	Other Person

How would you best describe your diet? (Circle one answer)				
Excellent	Very Good	Good	Fair	Poor

Which one statement best fits you?	
	(Check one box only.)
I am not thinking about eating more fruit.	
I am thinking about eating more fruit...planning to start within six months.	
I am definitely planning to eat more fruit in the next month.	
I am trying to eat more fruit now.	
I am already eating 3 or more servings of fruit a day	

Which one statement best fits you?	
	(Check one box only.)
I am not thinking about eating more vegetables.	
I am thinking about eating more vegetables...planning to start within six months.	
I am definitely planning to eat more vegetables in the next month.	
I am trying to eat more vegetables now.	
I am already eating 3 or more servings of vegetables a day.	

Do you eat more than one kind of fruit daily? (Circle only one.)			
Never	Sometimes	Often	Always

Do you eat more than 1 kind of vegetable in a day? (Circle only one.)			
Never	Sometimes	Often	Always

During the past week, did you have citrus fruit (such as orange or grapefruit) or citrus juice?		
(Circle one.)	Yes	No

How many servings of vegetables do you eat each day?	Number _____
---	--------------

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Do you eat 2 or more servings of vegetables at your main meal? Sometimes, often, always, or never?			
(Circle one.)			
Sometimes	Often	Always	Never

Do you eat fruit or vegetables as snacks?	Yes	No
(Circle one.)		
How many servings of fruits do you eat each day?	Number _____	

Over the past five years, has your daily produce intake changed? (Circle only one.)			
No, it is the same as it is now.	Yes, it has decreased.	Yes, it has increased.	Don't know.
If you answered yes , please answer the following questions about your produce intake over the past five years.			
Over the past five years, how many servings of vegetables have you eaten, on average, each day?	Number _____		
Over the past five years, how many servings of fruit have you eaten, on average, each day?	Number _____		

Which one statement best fits you?	
(Check one box only.)	
I am not thinking about gardening to grow vegetables for my household.	
I am thinking about gardening to grow vegetables for my household. ...planning to start within six months	
I am definitely planning to garden to grow vegetables for my household in the next month.	
I am trying to garden to grow vegetables for my household.	
I am already gardening to grow vegetables for my household.	

Which one statement best fits you?			
(Check one box only.)			
I am not thinking about gardening to grow fruits for my household.			
I am thinking about gardening to grow fruits for my household. ...planning to start within six months			
I am definitely planning to garden to grow fruits for my household in the next month.			
I am trying to garden to grow fruits for my household.			
I am already gardening to grow fruits for my household.			
Which of these statements best describes the food eaten in your household in the last 12 months?			
(Check one box only.)			
Enough of the kinds of food I/we want to eat			
Enough but not always the kinds of food I/we want			
Sometimes not enough to eat			
Often not enough			
Don't Know or Refused			
Here are some reasons why people don't always have enough to eat. For each one, please tell me if that is a reason why YOU don't always have enough to eat.	Yes	No	Don't Know
Not enough money for food			
Not enough time for shopping or cooking			
Too hard to get to the store			
On a diet			
No working stove available			
Not able to cook or eat because of health problems			

Here are some reasons why people don't always have the quality or variety of food they want. For each one, please tell me if that is a reason why YOU don't always have the kinds of food you want to eat.	Yes	No	Don't Know
Not enough money for food			
Kinds of food (I/we) want not available			
Not enough time for shopping or cooking			
Too hard to get to the store			
On a special diet			

In the past 12 months, (I/we) worried whether (my/our) food would run out before (I/we) got money to buy more.			
(Circle only one.)			
Often true	Sometimes true	Never true	Don't Know or Prefer Not to Answer

In the past 12 months, the food that (I/we) bought just didn't last, and (I/we) didn't have money to get more.			
(Circle only one.)			
Often true	Sometimes true	Never true	Don't Know or Prefer Not to Answer

In the past 12 months, (I/we) couldn't afford to eat balanced meals.			
(Circle only one.)			
Often true	Sometimes true	Never true	Don't Know or Prefer Not to Answer

In the past 12 months, did (you/you or other adults in your household) ever cut the size of your meals or skip meals because there wasn't enough money for food? (Check one box only)				
Yes. Almost every month	Yes. Some months but not every month	Yes. Only 1 or 2 months	No	Don't Know or Prefer Not to Answer

In the past 12 months, did you (personally) ever eat less than you felt you should because there wasn't enough money to buy food? (Check one box only)		
Yes	No	Don't Know or Prefer Not to Answer

In the past 12 months, were you (personally) ever hungry but didn't eat because you couldn't afford enough food? (Check one box only)		
Yes	No	Don't Know or Prefer Not to Answer

In the past 12 months, did you (personally) lose weight because you didn't have enough money for food? (Check one box only)		
Yes	No	Don't Know or Prefer Not to Answer

In the past 12 months, did (you/you or other adults in your household) ever not eat for a whole day because there wasn't enough money for food? (Check one box only)				
Yes. Almost every month	Yes. Some months but not every month	Yes. Only 1 or 2 months	No	Don't Know or Prefer Not to Answer

Thank you for participating in our survey!

**Appendix G: Food Security Scale Values and Status Levels Corresponding to
Number of Affirmative Responses**

Households without children (out of 10)	1998 food security scale score	Code	Food security category	Food security dichotomous category
0	0	0	High food security	Food secure
1	1.2	1	Marginal food security	
2	2.2			
3	3.0	2	Low food security	Food insecure
4	3.7			
5	4.4			
6	5.0	3	Very low food security	
7	5.7			
8	6.4			
9	7.2			
10	7.9			

Note. Adapted from a) –Guide to Measuring Household Food Security,” by G. Bickel, M. Nord, C. Price, W. Hamilton and J. Cook, 2000, Office of Analysis, Nutrition, and Evaluation, Food and Nutrition Services, U.S. Department of Agriculture, p. 11-12. Retrieved February 6, 2014, from <http://www.fns.usda.gov/fsec/files/fsguide.pdf>; b) –Definitions of Food Security”. Retrieved February 6, 2014, from USDA website: <http://www.ers.usda.gov/topics/food-nutrition-assistance/food-security-in-the-us/definitions-of-food-security.aspx>

Appendix H: CARE Risky Sexual Behavior Index, 2009 Scale Scoring

Question	Answer options		Scoring
Age at first sexual intercourse	Less than 18 years of age	18 Years of age or older	Less than 18 years of age = 5 18 Years of age or older = 0
Number of sexual partners during lifetime	5 or more	4 or fewer	5 or more = 5 4 or fewer = 0
Any male sexual partners with history of sex with other men	Yes	No	Yes = 1 No = 0
Any male sexual partners with history of intravenous drug use	Yes	No	Yes = 1 No = 0
Any male sexual partners with history of sexually transmitted infection	Yes	No	Yes = 1 No = 0
History of sexual intercourse in exchange for money	Yes	No	Yes = 1 No = 0
Condom use frequency	Inconsistent use	Consistent use	Inconsistent use = 1 Consistent use = 0
Ever been diagnosed with a sexually transmitted infection	Yes	No	Yes = 1 No = 0

(Scores can range from 0 to 35; just sum responses using the above rules)

Note. Adapted from "Measuring Cervical Cancer Risk: Development and Validation of the CARE Risky Sexual Behavior Index," by P. L. Reiter, M. L. Katz, A. K. Ferketich, M. T. Ruffin IV, & E. D. Paskett, 2009, *Cancer Causes Control*, P.1869. doi 10.1007/s10552-009-9380-5

Appendix I: 13-Item Tool to Assess Psychosocial Indicators of Produce Intake

Perceived Benefits				
Question	Answer options			Scoring
“I feel that I am helping my body by eating more fruits and vegetables.”	Agree (Yes)	Agree or Disagree (Maybe)	Disagree (No)	Sum of item scores/# of items Agree (Yes) = 1 Agree or Disagree (Maybe) = .5 Disagree (No) = 0
“I may develop health problems if I do not eat fruit and vegetables.”	Agree (Yes)	Agree or Disagree (Maybe)	Disagree (No)	

Perceived Control				
Question	Answer options			Scoring
“I am in your household who is in charge of what foods to buy?”	I Am	Shared Decision	Other Person	Sum of item scores I Am = .5 Shared Decision = .25 Other Person = 0
“I am in your household who is in charge of how to prepare the food?”	I Am	Shared Decision	Other Person	

Predisposing Domain = Perceived Benefit Construct Score + Perceived Control Construct Score (Townsend and Kaiser, 2005).

Perceived Diet Quality						
Question	Answer Options					Scoring
“How would you best describe your diet?”	Excellent	Very Good	Good	Fair	Poor	Excellent = 1 Very Good = .75 Good = .50 Fair = .25 Poor = 0

Note. Adapted from “Development of a Tool to Assess Psychosocial Indicators of Fruit and Vegetable Intake for 2 Federal Programs” by M. S. Townsend & L. L. Kaiser, 2005, *Journal of Nutrition Education and Behavior*, 37(4), p.173-175.

Self-Efficacy				
Question	Answer options			Scoring
—feel that I can eat fruit or vegetables as snacks.”	Agree (Yes)	Agree or Disagree (Maybe)	Disagree (No)	Sum of item scores/# of items Agree (Yes) = 1 Agree or Disagree (May be) = 5 Disagree (No) = 0
—Ifeel that I can buy more vegetables the next time I shop.”	Agree (Yes)	Agree or Disagree (Maybe)	Disagree (No)	
—feel that I can plan meals or snack with more fruit during next week.”	Agree (Yes)	Agree or Disagree (Maybe)	Disagree (No)	
—feel that I can eat two or more servings of vegetables at dinner.”	Agree (Yes)	Agree or Disagree (Maybe)	Disagree (No)	
—feel that I can plan meals with more vegetables during the next week.”	Agree (Yes)	Agree or Disagree (Maybe)	Disagree (No)	
—feel that I can add extra vegetables to casseroles and stews.”	Agree (Yes)	Agree or Disagree (Maybe)	Disagree (No)	

Enabling Domain = Self-efficacy Construct Score (Townsend and Kaiser, 2005)

Note. Adapted from “Development of a Tool to Assess Psychosocial Indicators of Fruit and Vegetable Intake for 2 Federal Programs” by M. S. Townsend & L. L. Kaiser, 2005, *Journal of Nutrition Education and Behavior*, 37(4), p.173-175.

Readiness to Eat more Fruit and Vegetables	
Which statement best fits you?	Scoring
“I am not thinking about eating more fruit.”	Pre-contemplation = 0
“I am thinking about eating more fruit...planning to start within six months.”	Contemplation = .25
“I am definitely planning to eat more fruit in the next month.”	Preparation/Planning = .50
“I am trying to eat more fruit now.”	Action = .75
“I am already eating 3 or more servings of fruit a day.”	Maintenance = 1
Readiness to Eat more Fruit and Vegetables	
Which statement best fits you?	Scoring
“I am not thinking about eating more vegetables.”	Pre-contemplation = 0
“I am thinking about eating more vegetables...planning to start within six months.”	Contemplation = .25
“I am definitely planning to eat more vegetables in the next month.”	Preparation/Planning = .50
“I am trying to eat more vegetables now.”	Action = .75
“I am already eating 3 or more servings of vegetables a day.”	Maintenance = 1

Change in Intention Domain = Readiness to Eat More Fruit Construct Score + Readiness to Eat More Vegetables Construct Score + Perceived Diet Quality Construct Score (Townsend and Kaiser, 2005)

Change in All Domains = Change in Predisposing + Change in Enabling + Change in Intention (Townsend and Kaiser, 2005)

Note. Adapted from “Development of a Tool to Assess Psychosocial Indicators of Fruit and Vegetable Intake for 2 Federal Programs” by M. S. Townsend & L. L. Kaiser, 2005, *Journal of Nutrition Education and Behavior*, 37(4), p.173-175.

Appendix J: 7-Item Fruit and Vegetable Scale

Question	Answer options				Scoring
–Do you eat more than one kind of fruit daily?”	Never	Sometimes	Often	Always	Never = 1 Sometimes = 2 Often = 3 Always = 4
–Do you eat more than 1 kind of vegetable in a day?”	Never	Sometimes	Often	Always	Never = 1 Sometimes = 2 Often = 3 Always = 4
–Do you eat 2 or more servings of vegetables at your main meal?”	Never	Sometimes	Often	Always	Never = 1 Sometimes = 2 Often = 3 Always = 4

Question	Answer Options		Scoring
–During the past week, did you have citrus fruit (such as an orange or grapefruit) or citrus juice?”	Yes	No	Yes = 2 No = 1
–Did you eat fruit or vegetables as snacks?”	Yes	No	

Question	Answer Options	Scoring
–How many servings of vegetables do you eat each day?”	Number	Number of vegetables + Number of Fruit
–How many servings of fruit do you eat each day?”	Number	

7-Item Fruit and Vegetable Scale Score = Sum of item scores (Townsend et al., 2003)

Note. Adapted from “Selecting Items for a Food Behavior Checklist for a Limited-Resource Audience” by M. S. Townsend, L. L. Kaiser, L. H. Allen, A. B. Joy, & S. P. Murphy, 2003, *Journal of Nutrition Education and Behavior*, 35(2), p.173-175.



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