Nutrition, Physical Activity, Excess Weight/Obesity and Cancer Risk

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Obesity, defined as body mass index (BMI) ≥ 30kg/m^2, is a risk factor for several diseases, including cardiovascular disease and cancer. In 2010, an estimated 36% of the population was obese. [1] While obesity, particularly as it relates to poor nutrition and inadequate physical activity, has been associated with type 2 diabetes for many years, less is known about the relationship between obesity and the risk of developing or dying from cancer. [2]

The National Cancer Institute, a research article that reviewed meta-analyses and large studies and recent findings from the American Institute for Cancer Research (AICR) found that excess weight/obesity, eating an unhealthy diet and/or lack of physical activity are associated with an increased risk of developing breast, colon, endometrial, esophageal, gallbladder, kidney, liver, ovarian, pancreatic and advanced prostate cancers. The percentage of these cancers that may be attributed to obesity ranges from 17% to 40%.[3–6]

This review explores the association of nutrition, physical activity and excess weight/obesity to the most common cancers in Kentucky, providing a valuable resource for Kentucky Cancer Consortium member organizations regarding the growing body of health research in this area. In addition, this review provides justification for including nutrition, physical activity and excess weight/obesity prevention in the Cancer Action Plan.

The literature review we conducted included published articles found in PubMed, a search engine providing free access to the National Library of Medicine's database of indexed citations on life sciences and biomedical topics. Key words used to identify relevant articles included: obesity,

cancer or neoplasm, risk and Kentucky. The search was restricted to articles published about human subjects within the last 10 years in the U.S. with available abstracts and/or free full texts. Abstracts were reviewed and articles were excluded if their focus was not cancer risk associated with obesity. Additional articles were found by reviewing the references in the selected articles and through communication with national organizations.

Kentucky Cancer and Obesity Rates

In 2012, Kentucky ranked 9th highest in the nation for adult prevalence of obesity, with 67% of adults classified as overweight or obese. Since 2008, the adult obesity rate has remained above 30% (**Figure 1**). [7] Similar to the adult population, more than 35% of Kentucky children and young adults have been overweight and obese every year since 2003 (**Figure 2**). [8]

In Kentucky, the 10 most commonly diagnosed cancers include prostate, lung and bronchus, female breast, colon, melanoma of the skin, corpus uteri, urinary bladder, kidney and renal, pancreas and thyroid. (**Table 1**). [9]

Based on the literature on nutrition, physical activity, obesity and cancer, five of the most commonly diagnosed cancers in Kentucky may be linked to these risk factors including: female breast, colon, kidney, pancreatic and advanced prostate cancers. [3–6]

Breast cancer

Breast cancer is the most commonly diagnosed cancer in women and the second most common cause of cancer death among women in the U.S. [10,11] Several factors that have been associated with an increased risk of developing breast cancer include lack of physical activity, use of alcohol and poor diet. Several underlying physiologic mechanisms have been considered to explain the biological link between obesity and breast cancer:

Obesity is associated with increased estrogen production in fat tissue and estrogens may initiate cellular changes. [12,13] Moreover, poor nutrition and lack of physical activity together have an impact on obesity and increased amounts of insulin, which may increase risk. [12]

Inflammation may also explain breast cancer's relationship with obesity. In overweight and obese women, low-grade inflammation occurs in fat tissue, including the breast. This inflammation triggers the release of an enzyme regulating estrogen production, thus playing a role in cancer development. [14]

Female breast cancer risk has previously differed according to menopausal status. Increased body weight has been associated with increased risk for postmenopausal breast cancer, while premenopausal overweight and obese women seemed to have a reduced risk. Obesity has been linked to 30-50% of the increased risk for postmenopausal breast cancer. [13] Recent research shows that there is an increased mortality risk in younger women as well. A review of 70 trials showed that premenopausal women with estrogen receptor positive breast cancer have 34% higher mortality, as compared to their leaner counterparts.[15]

Poor nutrition, lack of physical activity and excess weight/obesity have also been associated with poor cancer survival.[16] One study found an increased relative risk of breast cancer death to be significantly associated with an increased BMI (p for trend <0.001). The percentage risk increase in women with a BMI of 25.0-29.9 was 34%, whereas it was 112% for women with a BMI ≥ 40.[17]

Colon and rectum

Several studies have associated poor nutrition, lack of physical activity and excess weight/obesity with an increased risk of colorectal cancer, with a 50-100% increased risk among men and a 20-50% increase among women.[13]

Similar to breast cancer, poor nutrition and lack of physical activity increase the risk for excess weight/obesity, which may lead to production of high levels of circulating insulin and insulin resistance, thereby increasing the risk of colorectal cancer and worsening its prognosis.[12]

From 1976-2004, there was an increase in the proportion of colorectal cancers in men attributed to obesity: 4.9% from 1976-1980, 7.2% from 1988-1994 and 11.8% from 2001-2004. The same trend is observed in women although with less magnitude.[18]

Poor nutrition, lack of physical activity and excess weight/obesity have a negative impact on colon cancer survival. In a large U.S. adult cohort study, mortality rates increased with increasing BMI in both male and female colon cancer patients. [17] The overall increased risk of colorectal cancer death was 84% for males and 46% for females, with risk increasing as BMI increases. The Million Women Study found a 61% increased risk of colon cancer death with increasing BMI in premenopausal, but not in postmenopausal women.[19]

Prostate

Based on global scientific research looking at nutrition, physical activity, excess weight and obesity (included 104 studies), there is now strong evidence that excess weight/obesity increases the risk of advanced prostate cancer.[20] New studies have found that increased height in a man is linked to an increased risk for prostate cancer.[20] Consuming beta-carotene does not show to have a considerable effect on prostate cancer risk. [20] Several other dietary-related considerations have limited evidence of increased prostate cancer risk including: increased consumption of dairy products, diets high in calcium, low Vitamin E and low plasma (blood) selenium. As a matter of fact, the conclusions related to diets high in calcium and selenium have been downgraded from "strong" to "limited" evidence.[20] Previous studies tended classify all prostate cancers in the same risk category related to excess weight and obesity; however, the latest research recognizes that

this risk is primarily related to *advanced* prostate cancers, which explains why some evidence has changed from "strong" to "limited".[20]

Summary and Recommendations

As more is understood about the link between cancer and excess weight/obesity, it is becoming increasingly important to take immediate action to improve nutrition, increase physical activity, prevent excess weight/obesity and reduce the risk of cancer incidence and mortality. Ways we can do include:

- Monitor the latest evidence in order to continue to understand the nutrition, physical activity and excess weight/obesity and cancer link.
- Educate Consortium members, partners and others on the nutrition, physical activity, excess weight/obesity and cancer link.
- Encourage Consortium members and partners to educate their networks on the nutrition, physical activity and excess weight/obesity and cancer link.
- Implement, evaluate and revise Cancer Action Plan strategies related to nutrition, physical activity and excess weight/obesity.
- Partner with other health promotion and chronic disease prevention-related organizations to collaboratively focus on improved nutrition, increased physical activity and excess weight/obesity-reduction cross-cutting strategies, particularly policy, systems and environmental changes.

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Table 1: Invasive Cancer Incidence Rates in Kentucky - Both Genders, All Races, 2007-2011

Site	Population at Risk	Total Cases	Crude Rate	Age-adjusted Rate
Prostate (males only)	10,610,469	14,453	136.2	128.8
Lung and Bronchus	21,580,203	23,659	109.6	98.5
Breast*	21,580,203	15,557	72.1	65.1
Colon & Rectum*	21,580,203	12,429	57.6	52.6
Melanoma of the Skin	21,580,203	5,495	25.5	23.8
Corpus Uteri (females only)	10,969,734	3,040	27.7	23.3
Urinary Bladder	21,580,203	5,333	24.7	22.7
Kidney and Renal Pelvis*	21,580,203	4,679	21.7	19.6
Thyroid*	21,580,203	3,030	14.0	13.4
Pancreas*	21,580,203	2,894	13.4	12.2

*increased risk with obesity

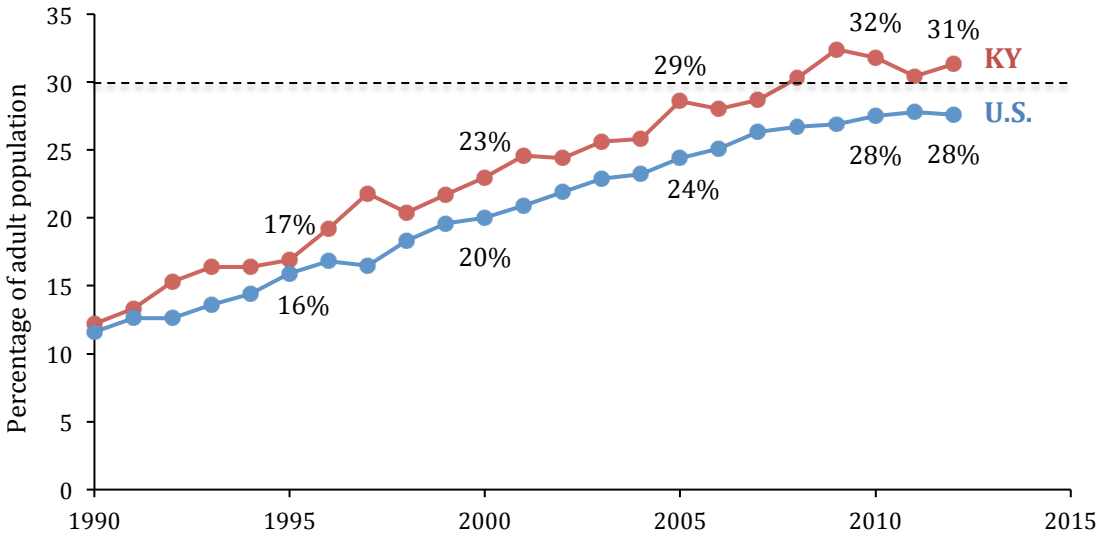

Figure : Obesity trend (BMI 30+) for adults in Kentucky and the U.S.

*For 2012 and 2013, the rates represent the percentage of adults who are obese (2011 BFRSS methodology)

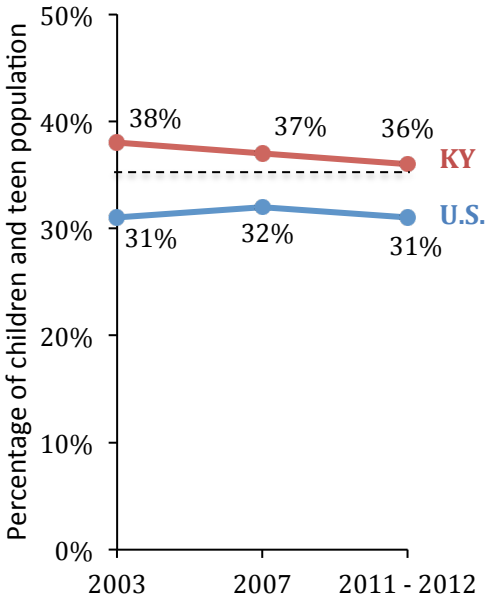

Figure : **Obesity trend (BMI 30+) for children and teens in Kentucky and the U.S.**