Journal of the

Minority Science Apprentice

HU Pre-Vet Fellows Share the Importance of Animal Care and Research
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Overview

In the US and its associated islands, close to one in three people are diagnosed with cancer in their lifetime [HealthPeople.gov]. Roughly 50% are over the age of 55 and are minorities, yet of those, less than 10% under the age of 30 actually eat a health conscious diet. One of the goals of the Hampton University Undergraduate Cancer Research Program (HUUCRP) is to raise cancer awareness in the minority community for those who are at extreme risk and to educate those individuals in prevention. HUUCRP is a volunteer-college-student-operated activity and can be used as a portfolio builder for a host of professional school and/or employment requirements during the summer and academic year(s).

Aims and Scope

The Journal of Minority Science Apprentice (JMSA) is a National peer-reviewed journal sponsored by the Hampton University Undergraduate Cancer Research Program and published under the auspices of the U.S. ISSN Center at the Library of Congress. The journal publishes mini reviews, short communications, and short research articles. The main focus is to understand the biological shortcomings that lead to the development of cancer and mechanisms that can prevent this disease. Priority will be given to observations that clearly enunciate observations relevant to the cancer research community. Focal areas include: molecular analysis, animal models, pharmacology, toxicology, nutraceuticals, preventive medicine, pharmacogenomics and on innovative cancer research. Submitted articles must clearly emphasize the cancer process.

Manuscripts in the area of technological advances in cancer research will be expedited for acceptance if they involve medical imaging, radiobiology, molecular techniques, transgenics or medical physics.

The Editors will also accept manuscripts (under 7500 characters total) on scientific discovery that may be of interest of the Journal. JMSA does not charge for pages. Students at HBCU, TC, HSI, or APIs are encouraged to submit articles.

Format for submission

- Figures (2 max limit)  Color (max size 3x3 inches)
- Tables (1 max limit)   (max size 2x2 inches)
- 12-point Arial, 0.5-inch margins
- Title, author, address, body (<7500 characters total), references

Works cited in the body (example below)

(Yang et. al., 2013)

References


Submit all inquiries and manuscripts to Editor-in-Chief, JMSA at nicholas.kenney@hamptonu.edu

Allow 6 weeks for a response
The Significance of Animal Research

Tiara Easley
Department of Biological Sciences, Hampton University, Hampton, VA

What importance does animal experimentation have on us as humans? Many animals such as salmon, rats, and even certain primates are used for research. This nonhuman approach of research often benefits the community. For example, infectious salmon anemia virus (ISAV) is a constant major threat to farm-raised and wild Atlantic salmon worldwide. Many epidemics have recently been reported in the most important salmon farming regions of the world, including Chile (2007-2009). The movement of infected fish caused approximately 7 of those outbreaks and explains about 6% of the total number of cases during the epidemic. Results from this study provide one of the largest documented ISAV epidemics in the world (Mardones et. al, 2014) and may be used to help prevent, detect, and control future ISAV outbreaks (Mardones et. al, 2014). Similarly, this documented research helps inform communities of suffering from ISAV epidemics from consuming salmon infected with this deadly virus. Major government research entities such as the Centers for Disease Control (CDC), Atlanta, GA encourages expedited research on animals to provide real-time information on pandemics to prevent further outbreaks.

Additionally, the use of primates in radiology imaging and radiobiology helps research move forward despite the lack of radiation victims. Primate research links the human response to unplanned radiation exposure and/or treatment and helps provide control end points for radiation exposure and treatment.

A key difficulty in developing countermeasures against radiation-induced health impairments is the clear lack of controlled clinical studies, due to the relatively low number of radiation victims worldwide. Rather, primate radiobiological research has contributed significantly to present day biomedicine and aeronautics, the latter contributing to the first earth orbit, a model used today for long-term spaceflight (Dörr et. al, 2014). Lastly, you may have heard of rodents being used for research more commonly than any other animal models. Rodents are rather small, can be housed in groups have a short lifespan and inherently share very similar growth and disease characteristics with humans. For example, when N-Nitroso N-methyl urea was singly intra-rectal administered in rats, this chemical induced colon cancer similar to humans. In conjunction with this, the researchers did a single pass-whole length-colon in-situ perfusion with p-glycoprotein inhibitors (a anticancer agent). The rats were divided into 5 groups some with cancer and some without. The results indicated that p-glycoprotein inhibitors along with irinotecan can enhance the therapeutic benefit in the treatment of the colon cancer; suggesting rats can act as an important model for drug intervention [Neerati et. al, 2013].

So if you are interested in helping animals as well as the well being of people, veterinary medicine might be the field for you. Animal research is very relevant to improving the human condition.

Tiara Easley is a Junior Biology major interested in Veterinary Medicine and a native of Virginia. She can be reached at tiara.easley@gmail.com.

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References


Cancer Metabolism

Myron K. Gibert Jr.
Department of Biological Sciences, Hampton University, Hampton, VA

A key issue in the battle against cancer is the metabolism of cancer cells and how this affects their growth and proliferation (Heiden et al, 2009). Cancer is the rapid growth of cells in an uncontrolled manner, so understanding how and why these cells reproduce so rapidly and uncontrolled would naturally be an important issue.

Normal cells will gather most of their energy via mitochondrial oxidative phosphorylation. This is a process by which FADH$_2$ and NADH, energy rich molecules, transfer electrons to oxygen, a process by which a third phosphate group is added to adenosine diphosphate, thus creating adenosine triphosphate, or ATP. This process commonly occurs in the mitochondria of eukaryotic cells. (Heiden et al, 2009)

Cancer cells however, commonly rely on aerobic glycolysis, or the process of converting glucose into pyruvate in the presence of oxygen, commonly referred to as the Warburg Effect. This is considered an inefficient method of creating ATP (Only 2 ATP per molecule of glucose), and therefore an inefficient source of energy. The process also occurs in the cytosol, versus in the mitochondria. Recent observations have determined that this process may be conducive to proliferation of cancer cells, and may be similar to fermentation, which unicellular organisms use to proliferate in ideal situations. This similarity may very well be the source of a cancer cell’s ability to reproduce. Additionally recent findings also reveal tumor cells produce lactate, which is a common product of fermentation. (Heiden et al, 2009) In addition to the change in cell metabolism, cancer cells experience a mutation that prevents the cell from ceasing replication. In a normal situation, differentiated cells will grow and replicate until they have filled available space. Cancer cells lack the ability to cease replication, and will continue to proliferate.

This, combined with the ability to use anaerobic respiration to enhance its ability to reproduce, indicates the metabolism of cancer cells within any given site is a selective process and key target for understanding tumorigensis. Discovering the dynamics that modulate cancer metabolism will lead to more effective means of cancer treatment. (Caims et al, 2011)

Myron Keith Gibert Jr is a Junior Molecular Biology-Leadership Studies major from Maryland. His career goal is to become a Radiation Oncologist. He can be reached at mkgibertjr@yahoo.com

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Eat the Cancer Away

Ola Badru
Department of Biological Sciences, Hampton University, Hampton, VA

Imagine you are making a hearty salad after your afternoon workout and you want to make it healthy, but tasty. You settle on a spinach and mixed field green salad with chicken, apples, cranberries, raisins, with a homemade basil and garlic vinaigrette dressing. Sounds great, right? You grab a fork, say the grace and dig in. Little do you know, you are fighting cancer! Almost all those ingredients in that delicious salad have antioxidant and anti-inflammatory properties, which are vital in cancer reduction therapies (Sherman, 2013). Cancer is defined as the uncontrolled growth of cells in the body. Cancer occurs in many different parts of the body, like the brain, heart, liver, lungs, or virtually any organ or tissue. Cancer is known for its inflammation and subsequent growth. Inflammation of the tissues is characterized by oxidative stress, inflammatory cytokines, and other compounds. There are many different types of food that can be utilized for their anti-cancer properties in many different cancer treatments. A multitude of studies have been conducted to examine what exactly makes these and other foods such powerful disease-fighting tools.

One recent study examined the role proteins derived from different food sources against the antioxidative and anti-inflammatory responses multiple diseased human cell lines in vitro and in vivo (Chakrabarti et. al 2014). The sources for proteins included egg whites, cereal flours, hempseed, and flounder. They were tested in spontaneous hypertensive rats, mouse fibroblasts, rat pheochromocytomas (tumor in the medulla or the adrenal glands), and monkey kidney fibroblasts respectively. These results suggested that in different animal models, there was a decrease in oxidative stress, cell death, and cytotoxic responses to molecules derived from a healthy diet (Chakrabarti et. al 2014). Baojun et al., 2012 also supported this finding by also showing that antioxidant properties from different yet common legumes also respond well in fighting against cancer. Their study essentially showed that at least 9 different human and mouse cancer cell lines responded well to the legumes; green peas, chickpeas, adzuki beans, lentils, red & red kidney, pinto, black and soy beans. Interestingly, the major antioxidant properties from the majority of the beans tested came from there phenolic content, since colored beans have stronger antioxidant properties when compared to other legumes in the group. Additionally, Mung and Adzuki beans were also found to contain anti-proliferating capacities as well. The active compounds in all these beans are under review for further cancer fighting properties (Baojun et al., 2012).

Speaking of phenols, have you had a cup of tea today? Tea is an awesome source for phenols and antioxidants (Yang and Liu, 2013). Recently, Yang and Liu, 2013, examined the phenolic and antioxidant properties of green tea, oolong tea, black tea, decaffeinated green and black tea. They discovered that green tea has the highest phenolic and flavonoid content, followed by oolong tea and black tea. Since flavonoids are rich with anti-inflammatory, antioxidant, and anti-cancer properties, they tested these teas on the cancer cell lines, HepG2, Caco-2 and MCF-7, to detect the amount of proliferation. Expectantly, HepG2 a liver carcinoma derived-cell line, Caco-2 a colorectal adenocarcinoma derived-cell line, and MCF-7 ER+ breast derived-cancer cell line all responded differently. The treatment of cell lines with green tea extracts had the highest effect on cell proliferation whereas Oolong and black tea had an antiproliferative effect on the Caco-2 and HepG2 cell lines, when administered in a dose-dependent manner. Puzzling though, extracts from black tea and decaf black tea did not have an effect on the MCF-7 breast cancer cell line.

Next up: sushi! My favorite is the California Roll with wasabi and ginger. Wasabi, a strong spice was recently investigated for its effects on human pancreatic cancer cells (Chen, et al. 2014). The active compound, 6-(methylsufinyl)hexyl isothiocyanate (6-MITC) was tested against PANC-
1 and BxPC-3 cell lines to determine its effect on cell viability. In this study, Aldehyde dehydrogenase (ALDH), which is commonly found in cancer stem cells, was used as a control marker for viability. Interestingly, the results suggested that the percentage of ALDH-positive PANC-1 cells were reduced substantially with treatment of 6-MITC and its synthetic sister, 6-(methylsulfonyl)hexyl isothiocyanate (I7447). Not only was the active compound able to knock out cell viability but the number of available stem cells was enriched as well their ability to undergo cell to cell signaling.

A wise man named Hippocrates once said, “Let thy food be thy medicine and thy medicine be thy food”. Grab some black beans or lentil soup or mashed potatoes with Wasabi or that really good chicken salad, and stock up on those antioxidants! Not only is healthy food really good, but also it induces a lifestyle change which can reduce risk for many different cancers and diseases. Most cancer therapies would involve the active compounds of the antioxidant-rich food, but preventative measures are always a win. With studies like this offering proof, how could you not want to dig in?

Ola Badru is a senior Biology major at Hampton University and is originally from Powder Springs, GA. She can be reached at olabadru2013@gmail.com

References


Breast Cancer; Early Detection is Perfection

Michelle Hill  
Department of Biological Sciences, Hampton University, Hampton, VA

Do you know someone in your family that is terrified of going to the doctor? Also, do you know someone that just refuses to take any test because the thought of knowing that they may be ill is devastating? I know you are reading this to yourself right now, and saying, “yes” in your head to both questions. I actually have a grandma that hates going to the doctor, and refuses to respond to notifications of having check-ups. Recently, my coworker the same age range as my grandmother told me that she went for her yearly checkup over the holidays and the doctor diagnosed her with breast cancer. She told me she was happy she found out when she did because the cancer was restricted to the breast and had not spread to other parts of her body. I told her that I was happy she found out early, and that she is truly blessed.

In 2013, studies have estimated that there will be 232,340 new cases of breast cancer, and an estimated 39,620 people will die of the disease (Seer, 2013). Breast cancer is a very common disease for women. A mammography is the most widely used screening modality, with solid evidence of benefit for women aged 40 to 74 (Kerlikowske et. al, 1996). The benefit of screening with a mammography is a decrease in breast cancer mortality rate (Kerlikowske et. al, 1996). Mammography screening is an early detection method that is saving lives.

Since the introduction of mammography screening the absolute number of patients with a more advanced stage at diagnosis and the number of patients undergoing mastectomy has been steadily declining (Christiansen et. al, 2014). However, Just being a minority female, you are at a very high risk of developing breast cancer. According to the Susan B. Komen Breast Cancer Foundation, other risk factors include age, family history of breast or ovarian cancer, inherited mutation in BRCA1 or BRCA2 genes, high breast density, lack of exercise, current or recent use of birth control pills, all increase the odds of getting the disease. Obviously as our increased knowledge in the disease reveals a whole new list of risk/genetic factors that initiates the cancer, it’s never any harm in having a screening test or a Clinical breast examination. Eight out of nine women who develop breast cancer do not have an affected mother, sister or daughter (Collaborative Group on Hormonal Factors in Breast Cancer, 2001). Although women who have first degree relatives with a history of breast cancer are at an increased risk of the diseases, most will never develop breast cancer, and most who do will be aged over 50 when cancer is diagnosed (Collaborative Group on Hormonal Factors in Breast Cancer, 2001). Thus, ladies always keep in mind that although knowing you have breast cancer can be devastating, not knowing you have breast cancer can cost you your life. Which do you prefer? Remember, “early detection is perfection” for you and your health.

Michelle Hill is a senior Biology major at Hampton University and is a native of Texas. She can be reached at michelle.hill6@my.hamptonu.edu

References


Genes Are Not Our Fate

Sierra Clark
Department of Biological Sciences, Hampton University, Hampton, VA

Most people believe that most cases of cancer are passed down and not preventable when in reality that is not the case at all. Only five to ten percent of all cancer cases are genetically related. The other ninety to ninety-five percent stem from the environment or one’s lifestyle (Anand et. al., 2008). What people do not realize is that our genes are not our fate. Cancer is an end result of defects in our genes and these “mutations” are due to the interaction with one’s everyday lifestyle and environment. Once you are aware that cancer is a result of your lifestyle in conjunction with your genetic makeup, you will understand how cancer is preventable.

Tobacco, alcohol, diet, obesity, infectious agents, environmental pollutants, and radiation are important lifestyle factors that affect the incidence and mortality of cancer (Anand et. al., 2008). In relation to cancer deaths, twenty-five to thirty percent are due to tobacco, thirty to thirty-five percent are related to diet, fifteen to twenty percent are related to infection, and the remaining percentages stem from radiation, stress, and physical activity, environmental pollutants. Anand and colleagues present tips on how to prevent cancer due to the previous risk factors; limit alcohol and tobacco consumption, limit diets containing fatty acids, red meats, nitrates, exercise regularly, and be aware of and limit exposure to infectious agents, radiation, and pollutants. So don’t forget your lifestyle is just as important as your jeans!

Sierra Clark was a recent Fall 2013 Biology graduate of Hampton University and a former HUUCRP Fellow at the Hampton University Skin of Color Research Institute.

References

Correlation Between Vitamin D and Breast Cancer

Shannon C. Anderson  
Department of Biological Sciences, Hampton University, Hampton, VA

Breast cancer is the most commonly diagnosed non-skin cancer and is also ranked second on the list of cancer-related death in women (Chiang et al., 2014). New therapeutic techniques have been invoked in order to treat and prevent the metastasis of cancerous cells. Of these new strategies, vitamin D supplementation has been increasingly used for cancer treatment. Vitamin D is a steroid hormone that is derived from either food (milk, fish) or through the exposure to sunlight (Mehta et al., 2014). The direct primary role of vitamin D is to modulate calcium homeostasis, an essential component for bone mineralization. Although it is “classically” considered to be a regulator of calcium homeostasis, it is now apparent that the hormonal form of vitamin D, 1,25(OH)₂D also known as calcitriol, plays a vital role in the regulation of cellular growth and differentiation (John et al., 1999). Both in vitro and in vivo studies have shown that 1,25(OH)₂D regulates the growth and differentiation properties of normal and cancerous cells, including human breast cancer cells (John et al., 1999). These findings deductively suggest that vitamin D intake plays a vital role in the prevention and treatment of breast cancer as well as a variety of other chronic conditions.

Although individual studies are not thoroughly consistent, recent interpretations of published epidemiological data supports the concept that vitamin D has a significant effect against the development of breast cancer (Welsh, 2011). Extensive research proves that vitamin D acts directly in mammary tissue to suppress tumorigenesis, therefore providing a basis for the correlation between vitamin D intake and breast cancer risk (Welsh, 2011). The bioactive form of vitamin D, 1,25(OH)₂D, may be sequestered in mammary tissue by primarily interacting with nuclear vitamin D receptor (VDR) in the intestine, bone, breast, and other tissues (Chiang et al., 2014). VDR activation also induces downstream transcription of cancer fighting genes as well (Yao and Ambrosone, 2013).

In other areas of the body, Previtamin D accumulation stemming from both diet and sunlight sources is hydroxylated in the liver to 25-hydroxyvitamin D (25(OH)D). 25-hydroxyvitamin D is further hydroxylated to 1,25-dihydroxyvitamin D 1,25(OH)₂D by the 1a-hydroxylase enzyme. Much of this hydroxylation takes place in the kidney nephron, however recent studies indicate that this activity can also be found in the breast and other target tissues. Interestingly, a portion of 1,25(OH)₂D is produced and used locally (Bertone-Johnson et al., 2012).

Dietary vitamin D is proven to not only be an unique bioreactive molecule but also an essential precursor to the steroid hormone 1,25(OH)₂D or calcitriol, which has anti-proliferative, anti-inflammatory, pro-differentiating, and pro-apoptotic properties in many chronic diseases such as breast cancer (Krishnan et al., 2012).

Shannon C. Anderson is a junior Molecular Biology major at Hampton University from Fort Washington, Maryland. She can be reached at shannoncanderson@gmail.com. All her work is dedicated to her wonderful, magnanimous mother.

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Antioxidants/Free Radicals: Help or Hindrance

Ashton L. Green
Department of Biological Sciences, Hampton University, Hampton, VA

When was the last time you enjoyed eating an acai berry because of its high content of antioxidants (Moura et al., 2012)? Antioxidants are bioactive molecules that have a strong possibility to delay cellular damage. Antioxidants can be either natural or synthetic. For instance, natural sources of antioxidants can be found in the majority of fruits and vegetables (Vrailas-Mortimer et al., 2012), while the synthetic version is made in the lab and essentially swallowed. Antioxidants help defend against cellular damage caused by unique molecules such as free radicals.

Historically speaking, free radicals have been shown to be one of the main culprits in triggering cancer (Jensen et al., 2008), yet free radicals are naturally occurring biomolecules essential in normal cellular processes. They are naturally created within the cell (i.e., when the body converts food to usable energy for exercising) or a product from a hazardous cellular environment (i.e., pollution, sunlight). A hazardous byproduct of the free radicals production is known as oxidative stress, a series of chemical chain reactions within a normal cell that leads to detrimental outcomes. Recent evidence suggests oxidative stress is a possible trigger to cancer and a variety of other diseases (Vrailas-Mortimer et al., 2012). Antioxidants with the help of its cognizant enzymes help stabilize free radicals preventing oxidative stress in normal cells. Several specific antioxidants include, beta-Carotene, Lycopene, Vitamins C, E, A, among others (Jensen et al., 2008).

Although previous studies have shown that antioxidants behave in a “Pro-Oxidant” manner, during a recent summit in 2003, data was presented from a beta-Carotene and Retinol Efficacy Trial (CARET) in which individuals in a 2x2 factorial design were given beta-Carotene, a placebo, or mixture of both to treat lung cancer. The results indicated that those with the beta-Carotene treatment had a significant rate of incidence compared to the placebo (Meyskens FL Jr, Szabo E, 2005). Based on these observations, The National Cancer Institute continues to monitor the long-term health effects of beta-Carotene and other supplements (Jensen et al., 2008).

While vegetables and fruits contain high sources of antioxidants, the U.S. Government still recommends a diet rich in both sources. As research continues to accrue, surmounting evidence is pointing towards individuals that ingest an increasing amount of these foods have a lower risk for several diseases (20-30%) (Jensen et al., 2008). These observations could be the product of the protective effect of nutritional agents from dietary intake (Christen et al., 2000).

Ashton Green is junior Molecular Biology major (pre-PhD candidate) from Raleigh, NC who is interested in cancer research. He can be reached at ashtongreen06@gmail.com.

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