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ACCULTURATION AND NUTRITION RESEARCH

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Introduction

Culture is a part of our everyday lives, and acculturation has a significant role in nutrition and dietetics because of its ties to food intake, physical activity, body image, and health care practices. But, how does acculturation really affect diet, and how do we deal with it in nutrition research? This article will provide an overview of acculturation concepts, measures of acculturation, and also the associations between acculturation and food intake-related outcomes. The examples from the literature will focus on Hispanics or Latinos as the largest minority group in the United States (U.S.) who often face nutrition and health disparities.

What is Acculturation and How is It Measured?

Acculturation can be defined as the process by which people "adopt the attitudes, values, customs, beliefs, and behaviors of a new culture".[1] Acculturation is often seen as a change that only immigrants go through, but this would be equal to seeing only half of the picture. Because culture is not a static phenomenon, communities and societies also change over time and through the influence of their community members. Therefore, both individuals and societies go through acculturation. However, because nutrition research is usually focused on individuals, a majority of the published studies about acculturation and nutrition-related outcomes are about changes that individuals or immigrants go through while they become accustomed to the characteristics of a newer culture.

Acculturation is a multidimensional process. In addition to the changes in communities and the society overall, cultural changes that individuals experience can have many facets because of the countless combinations of traits people can retain from their primary culture (culture of origin) or adopt from the new culture. Although many phases within the acculturation continuum exist, four major categories have been proposed: assimilation (complete adaptation to the new culture and loss of traits from the culture of origin), marginalization (exclusion of both cultures), separation or segregation (retention of traits from the culture of origin without integration into the new culture), and integration or biculturalism (acceptance of both cultures).[2-4]

Measures of Acculturation

The multidimensionality of acculturation makes it difficult to measure this concept. Furthermore, researchers' ability to use instruments that can measure various dimensions of acculturation for both cultures – primary and new – is often constrained by limitations in time and resources because these instruments involve several questions and take more time to complete. Therefore, researchers resort to shorter scales that serve as proxy measures and usually focus on one or two

In this issue:

aspects of acculturation by using unidimensional questions or scales, such as language use at home, country of birth, or length of residence in the U.S.[2]

Some of the acculturation scales, such as the Bidimensional Acculturation Scale,[5] are designed to measure the individuals' characteristics both from the primary and the new cultures to give a bidimensional picture of the acculturation status. More comprehensive acculturation scales measure multiple dimensions of acculturation by including questions about values, beliefs, attitudes, language use, ethnic interactions, and relevant characteristics. Examples of multidimensional scales are the Acculturation Rating Scale for Mexican Americans-II (ARSMA-II)[6] and Hazuda Scale.[7]

How to Interpret Acculturation Research?

Interpreting the literature about the associations between acculturation and nutrition or health outcomes can be confusing. One of the reasons is the considerable variety of acculturation measures in use. As a result, the responses to similar nutrition research questions can be quite mixed. Another reason is because acculturation can bring about both positive and negative influences on nutrition- and health-related behaviors, and these positives and negatives can change over time or from one target population to the next.

Additionally, because acculturation has many dimensions or phases, it is often not linked to nutrition and health outcomes in a linear fashion. For example, less acculturated individuals may have healthier food intake patterns in the country of origin, but these behaviors may deteriorate during the earlier phases of migration as immigrants experience cultural, language, and socioeconomic or structural barriers. However, they may end up with healthier behaviors again years later when they are more acculturated and better equipped to function well in the new environment. A simple, "less versus more acculturated" type of comparison would most likely not capture the extent of these changes or could give contradicting results between different studies.

The influence of acculturation depends on the specific characteristics of the new culture and the individual's culture of origin. For example, the acculturation experience of an immigrant who came from a big city and settled in a small border town in the southern U.S. would probably be different than that of an immigrant who came from a rural town and settled in a big city in the northeastern U.S. In both of these scenarios, the structural (i.e., system-wide, society-specific) elements are likely to affect individuals' experiences but not necessarily lead to the same outcome. The underlying assumption about a mainstream American diet that immigrants may eventually adopt is also questionable because of the heterogeneity of the population in the U.S. Immigrants acculturate toward the culture of the communities around them, and these communities also change by the influence of their members. Hence, the new culture in the U.S. is likely to have many variations over time and in various parts of the country.[4]

Lastly, one must also keep in mind the pitfalls of stereotyping. Although sometimes we have to study and apply the research findings to an entire minority population such as Hispanics/Latinos or Asians, we must remember that there are many subgroups within each of these populations who originate from various countries and may exhibit quite different cultural traits and lifestyle behaviors.[4]

Acculturation and Food Intake among Hispanics in the United States

Research results about acculturation and diet usually point to healthier dietary intake patterns among less (versus more) acculturated Hispanics in the U.S. Despite the inconsistencies partially stemming from different acculturation measures used, examples of reported healthier eating patterns include higher consumption of fruits, vegetables, whole grains, and beans, and lower consumption of sugar, sugar-sweetened beverages, salty snacks, desserts, and added fats. [(reviewed in 4,8)]

In addition to differences in the types of foods consumed, diet quality (e.g., macro and micronutrient content) and compliance with national food intake recommendations also seem to vary by acculturation status among Hispanics. For example, higher intake levels of fiber, protein, vitamins A, C, E, B6 and folate as well as calcium, potassium, and magnesium have been reported among less acculturated Mexican Americans in comparisons to their more acculturated counterparts.[4,8,9] The national data from the NHANES 1999-2004 showed that after adjusting for health care access,

health status, and demographic and socioeconomic characteristics, more acculturated Hispanic adults with diabetes were less likely to meet the saturated fat and fiber recommendations.[10]

The effect of acculturation on adults' behaviors can extend into the succeeding generations through infant feeding and parenting practices. On a positive note, less acculturated Hispanic women are more likely to initiate breastfeeding or breastfeed for longer duration than their more acculturated counterparts, although this practice seems to vary by the country of origin.[3] Conversely, some questionable feeding strategies (e.g., offering alternative foods or rewards and using bribes or threats to influence children's eating behaviors), which can contribute to less healthful eating behaviors for the child, are more common among less acculturated Mexican American parents.[11] Specific consequences of these feeding practices among Hispanics are not known, but similar to the trends seen among adults, studies indicate that greater acculturation is related to worsening of dietary intake among Hispanic youths as suggested by decreased consumption of fruits and vegetables and greater intake of soda, fast food, sodium, energy, and fat.[4]

In addition to the influence of parents' acculturation on children's behaviors, children can catalyze the acculturation process for their families as well. One of the biggest changes in children's diets after moving to the U.S. has been suggested to be with the foods children consume at school. It has been reported that although Mexican American children liked the traditional ethnic foods they received at home, they preferred the American foods they were served at school. Further, they were not aware of the healthfulness of traditional Mexican foods (such as fruits, vegetables, and beans) or potential health risks of the typical American diet, which they perceived as pizza, hotdogs, hamburgers, and French fries.[12,13] As children develop their own self and ethnic identities, they may seek separation from their parents and acceptance from their peers and may identify fast food and other less healthful food options with the culture of the U.S. This can eventually lead to less healthful dietary patterns both for children and their families because children are likely to affect food purchasing decisions in their households.[13]

When looking into the influence of acculturation on food intake behaviors among children and youths, another important element of the social environment, media exposure, must be addressed because of its potential to affect children's behaviors. American children spend more than seven hours per day using or watching media such as television, computers, video games, or movies (i.e., screen time). Estimated screen time seems to be higher among minorities in comparison to non-Hispanic whites[14] and among more (versus less) acculturated individuals.[15] The data from the 2003-04 National Survey of Children's Health indicated that, in comparison to U.S.-born non-Hispanic white children with U.S.-born parents, foreign-born Hispanic children with immigrant parents were 31% more likely, while U.S.-born Hispanic children with U.S.-born parents were 51% more likely to watch television for three or more hours per day.[15] This kind of media exposure can serve as a delivery tool for less than ideal eating habits through food advertisements, unrealistic body images, and unhealthy eating patterns.

Acculturation has close ties to socioeconomic status (SES). Economic conditions can amplify the barriers that new immigrants experience, but education and employment opportunities can speed up the acculturation process. Hence, some of the reasons underlying the changes in eating patterns through acculturation can be actually rooted in socioeconomic factors. For example, affordability and increased availability have been reported as reasons to consume snacks, sweets, and fast food more in the U.S., especially when these foods were more expensive and eaten only on special occasions or seen as a status symbol in the countries of origin.[4,12,16] From an economic perspective, higher rates of food insecurity and low SES among minorities and immigrants are likely to force individuals to purchase relatively cheap and filling but often nutrient-poor, energy-dense foods.[17-19] Additionally, the convenience of fast food seems to be an enticing solution especially for time-strapped immigrant families with children.[20]

Although less studied in the nutrition field, residential context may also have an influence on the acculturation process and eating patterns. Immigrants may experience added barriers in accessing healthier and/or ethnic foods in the U.S.

because of limited availability and quality (e.g., freshness, taste), and lack of economic resources or language barriers can further inhibit access. Conversely, neighborhood socioeconomic conditions can sometimes work to the immigrants' advantage. Previous research suggested that immigrant-dense residential areas were linked to more fruit and vegetable intake and less high-fat/processed food intake.[21,22] These results might be stemming from socioeconomic advantages through greater social capital, availability of stores with healthier ethnic food options (because they serve the clients' demands), and greater retention of social norms, values and (healthier) food intake habits in these neighborhoods.[21]

In summary, less acculturated Hispanics in the U.S. seem to have healthier dietary intake patterns, but there are many pathways in which acculturation can affect dietary intake and lead to different outcomes. Therefore, it is important to examine these different characteristics and behavioral patterns comprehensively in order to formulate appropriate surveys, research interventions, and practice recommendations.

Conclusions

Acculturation is a multidimensional process that affects both individuals and communities. Interpretation of acculturation in nutrition research can be complicated because of several factors such as acculturation's non-linear relationship with nutrition or health-related outcomes, its close ties to individuals' experiences from countries of origin, characteristics within the new host cultures, and socioeconomic conditions. The use of comprehensive acculturation scales is appropriate to take some of these factors into consideration in nutrition research, but simple proxy measures can also have their place in nutrition and dietetics practice when only a short amount of time is available for assessment. In either case, it is important to look into the acculturation and socioeconomic characteristics of individuals, families, and environments when working with immigrant populations.

Research on acculturation and food intake among Hispanics or Latinos in the U.S. generally suggests healthier dietary intake patterns among less acculturated individuals. Therefore, this presents itself as a critical time for primary prevention because of nutrition and health disparities that minorities and immigrants often face in the U.S. It is crucial in nutrition and dietetics practice to recognize these healthier dietary intake patterns among less acculturated individuals in order to help them maintain these patterns rather than trying to change it back after the change occurs in their later years in the U.S.

However, we cannot automatically assume that less acculturated individuals would be more likely to have healthier intake patterns. Culture, socioeconomic conditions, and food environment continue to change in other countries as well as in the U.S., and availability of highly processed foods, sugary drinks, and fast food is likely to rise in many countries around the globe.[23,24] Depending on the cost and availability of foods in the location of origin, immigrants could increasingly be facing similar – and often less healthful – food choices in their home countries as well as in the U.S. Therefore, nutrition and dietetics professionals still have to evaluate past and current intake patterns of each patient or target group to be able to better understand and promote healthier lifestyles.

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Continued on page 5

Chair's Report

Dear Research DPG Members

Chris Taylor, PhD, RD, LD

After attending the Public Policy Workshop in Washington D.C. this spring to represent the Research DPG, it is evident how pivotal this time is for our profession. Many of the nation's challenges, from the Farm Bill to the medication shortages, have roots in nutritional issues that RDs and DTRs contend with on a daily basis. Underlying all those efforts are the scientific advances and research breakthroughs made by trained dietetics experts. Furthermore, our D.C. legislative team has been able to meet with legislators on the Hill, armed with evidence from the Academy's Evidence Analysis Library, to support the role of dietetics professionals. Therefore, we have a great deal of influence over the trends facing the US and the world and the time to act is now.

Because of the nature of our DPG, we are unified by a support or expertise in the central tenet of dietetics – being evidence-based. We embody advances in all facets of the practice of dietetics; the consummate translational scientist before it was a buzz word. This vast membership provides numerous opportunities for collaboration, dialogue and collegial support. Numerous opportunities are now before us to champion the evidence-based initiatives of the Academy. Over the coming months, you will receive calls for action by our members to support these efforts.

As an Executive Committee, we are working continually to enhance member benefits. I welcome suggestions of potential ways we can serve you better. With additional member benefits, there are additional ways to serve and gain valuable collaborative and leadership experiences. I look forward to serving you for the next year.

Chris Taylor, PhD, RD, LD
Chair, Research DPG

Acculturation and Nutrition Research

Continued from page 4

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Member Spotlight

Dr. Melinda M. Manore

Erin Gaffney-Stomberg, PhD, RD

Dr. Melinda M. Manore

For this edition of The Digest, we are spotlighting RDPG member Dr. Melinda M. Manore, a Professor of Nutrition in the School of Biological and Population Sciences (Area: Nutrition and Exercise Sciences) at Oregon State University (OSU). While at OSU, she has served as Department Chair and as a Nutrition Extension Specialist. Her research and teaching experience is in the area of nutrition and exercise, including nutrition for health and performance, prevention of obesity and chronic disease through diet and exercise, nutrition assessment, supplements, and functional foods. She has presented more than 100 invited scientific and lay lectures on nutrition topics including sports nutrition, dieting and weight control, the female athlete triad, supplements, and the role of diet and exercise in disease prevention. She is the author of over 100 scientific publications, book chapters, and review articles and has advised over 30 nutrition and nutrition and exercise graduate students. Dr. Manore serves or has served on the editorial boards of the American College of Sports Medicine (ACSM) Health and Fitness Journal, Medicine and Science in Sports and Exercise, the International Journal of Sports Nutrition and Exercise Metabolism, Journal of Physical Activity and Health, and the Journal of the Academy of Nutrition and Dietetics (formerly the Journal of the American Dietetic Association). She is a fellow of ACSM and has chaired and served on numerous committees for the Academy of Nutrition and Dietetics (the Academy). She is also a member of the American Society of Nutrition (ASN), the Obesity Society, and the President's Council on Fitness, Sports and Nutrition Science Board. Finally, she chairs a collaborative panel between ACSM, the AND and USDA which is planning an Energy Balance Expert Panel meeting titled, "Energy Balance Crossroads – Translating the Science into Action" in Washington DC in the fall of 2012.

Dr. Manore, please tell us about your background. How did you get to where you are now?

I received my BA from Seattle Pacific University, and I hold a MS in Health from the University of Oregon and a PhD in Nutritional Sciences with minors in health and exercise science from OSU. I am also a Registered Dietitian (RD) and a Certified Specialist in Sport Dietetics (CSSD) from the Academy.

While I was at the U of Oregon completing my MS in health, I had also become a long distance runner, and my running buddy was the University Health Center dietitian. I kept asking her what active people should eat and found out there was very little information available. I was also very interested in nutrition after taking a class in my undergraduate degree, so I decided to pursue a PhD in nutrition at a University where I could also do research in nutrition and exercise and learn more about exercise.

What is your current research interest?

Currently, I am focused on energy balance in active individuals across the weight continuum. We just completed an intervention in active women to reverse exercise induced menstrual dysfunction. We also completed a diet study with two levels of protein and a high intensity exercise intervention in overweight, sedentary, premenopausal women with abdominal obesity to determine changes in metabolic syndrome risk. Overall, I am interested in how we can help people match energy intake with expenditure to maintain a healthy weight across the lifecycle.

How did you become involved/ interested in your current line of research?

From the time I began graduate school I was interested in the energy and nutrient needs of active individuals and how they differ from their sedentary counterparts. I sought out individuals who had similar interests and partners in the exercise science area to work with me on my projects.

What advice would you give to a young researcher for developing a successful line of research?

After graduate school, find a mentor in your area who has been successful in research (e.g., funding, managing grants and publishing) and mentoring graduate students.

What are your career goals?

1) To get the nutrition and exercise science professions to work more closely together and appreciate the strengths each brings to the table in helping individuals manage weight and improve their health and performance.
2) To understand the issues of energy balance and how to communicate this integrated concept to students, health professionals and the public.
3) To find/create manageable solutions to reverse our sedentary lifestyles, improve our health, and manage our weight.

How has your affiliation with the Academy impacted your career progression?

I joined the Research DPG soon after I became an RD. The individuals I met in this group have been my friends and colleagues over the years. They have had a strong impact on my career, made my work enjoyable and were a source of guidance and advice when it was needed.

If someone were to ask, "why is research important to the field of dietetics?", what would you say?

Research is the basis of all the science that we teach in dietetics and the evidence based standards we use in treating diseases and making recommendations for healthy eating. Without research we would have no basis on which to make dietary recommendations and no confidence that our recommendations could make a difference in the lives of clients.

Nuts and Bolts

A Basic Glossary of Research Terms from A to Z – **A B C**

Inés M. Anchondo, DrPH, RD, LD, CSP

Abstract – a brief summary of the research that appears at the beginning of a peer- reviewed journal article. It is usually no more than 500 words including objectives, methods, results, and conclusion

Attrition – loss of study participants. When attrition is high, the results of the study cannot be generalized/ applied to the rest of the population. The researcher needs to understand why some participants remained in the study and why some left to determine whether selection bias occurred.

Assent form – a written document reflecting agreement between a researcher and study participant who is a mentally incapacitated individual, minor, child, or teenager. The assent form has to be written using very simple language, first grade level or lower. The assent form explains the purpose of the research, the requirements for participation, the potential side effects, and the researcher's name and contact information. It also contains information about whom to contact to learn more about the research, to stop participation, and to report side effects. The assent form has to be in the language the participant understands or prefers. Participant's parents need to receive a copy of the assent form after child or teenager signs it.

Assumption of normality – assuming that the data in a study follows the normal distribution or Bell curve, which means that the variability within groups is similar. Parametric tests such as Pearson correlation, t-test or a ANOVA, depend on the assumption of normality.

Bias – any influence that can obscure an existing relationship among study variables (e.g. selection bias) happens when there is a 'systematic' difference between individuals participating (in either the control or intervention group) and individuals not participating in the study (from the general population).

Case-Control Study – a type of study design that is observational to examine cases and controls. Cases are individuals with the condition or disease of interest while controls are individuals without the condition or disease of interest. Controls are matched with cases on characteristics that are thought to cause the condition or disease of study.

Causal relationship – a relationship between the 2 variables in which the presence or absence of one variable determines the presence or absence of the other.

Cohort Study – a study design where participants are followed prospectively (into the future) to identify which characteristics or risk factors are associated with the disease or condition of interest.

Confounding variable or confounders – a variable or variables that can 'obscure or exaggerate existing associations' between variables. It can occur when a factor or number of factors happen in a non-random manner in the study participants and also in the 'source population' from which the study participants were recruited.

Consent form – a written document reflecting agreement between a researcher and an adult study participant. The consent form has to be written using simple language, 2nd to 3rd grade level. It contains information about why is the study being conducted, what would happen with participation, potential side effects, researcher name and contact information, and who to contact to learn more about the study, stop participation, or report side effects. A consent form has to be in the language participant understands or prefers. Participants need to receive a copy of the consent form after signing it.

Continuous Variables – a type of variable that has a numerical value; the space between values is defined and can be measured like height and weight.

Cross-sectional study – a study design that collects data at a single point in time for the purpose of inferring trends over time.

Note: *this writing was inspired by Mary Easaw, a clinical dietitian in a cardiothoracic hospital in Malaysia*

Friends and foes in our gut: Colonic microflora and colon cancer risk

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Introduction

Despite the litany of dietary supplements and fortified foods in grocery aisles claiming to promote a "healthy gut", keep you "regular", and "boost" your immune system, the science linking diet and supplements to our gut flora and gastrointestinal disease is more complex. In particular, the relationship between diets, gut flora and colon cancer risk remains unclear. In the marketplace, consumers face the complicated task of navigating the language that has been developed around the notion that our gut flora is amenable to dietary change. In patient care, clinicians must interpret related scientific literature that necessitates an understanding of both bacterial taxonomy and cancer biology. Therefore, this article aims to demystify the terminology, review the biology and explain the significance of gut flora on risk of colorectal cancer.

Overview of the Gut Flora

The human microbiome consists of small micro-organisms (also called microflora or microbiota) that coat almost all suitable epithelial layers, the majority of which are bacteria.[1] The overall number of microflora in the human body exceeds the total amount of human cells by a magnitude of ten or more.[1,2] These bacterial species are named taxonomically using the canonical notation, listed here from least to most specific: phyllum, class, order, family, genus, species.[3] The large intestine has the highest concentration of microflora in the body and, therefore, is largely influenced by their behavior.[1] The content of bacteria in the colon is so high that in a study of British participants, bacteria accounted for over half of fecal mass.[4] Although each individual is a host to a unique microbiome, there are compositional similarities across a population that can be influenced by the diet.[1,5-8]

Consistent with other microbe-host interactions, bacteria in the gut lumen compete with each other and maintain homeostasis in the gut.[1,8-12] Innate behavioral mechanisms used by microflora to achieve this purpose include: competition for mucosal attachment sites,[9] competition for nutrients from the host,[11] secretion of bacteriocins to discourage other bacteria from thriving[12] and modulation of the host's eukaryotic cells' signaling.[10] When the gut is in homeostasis the host receives benefits that include but are not limited to protection against luminal cell damage, vitamin synthesis, fat storage, and maintenance of intestinal vascularity.[5,13] Homeostasis is maintained when anti-pathogenic (also known as "beneficial" and "good") bacteria (ex. *Bifidobacterium and Lactobacilli*) are able to overcome or minimize the behavior of pathogenic (also known as "bad" and "harmful") bacteria (ex. *Enterobacteriaceae and Clostridium*).[1,8] The development of a *Clostridium difficile* infection after the use of extensive antibiotics is a common clinical example of when this balance is destabilized. The infection occurs due to the depletion of other susceptible lumen microbes following antibiotic therapy, thereby allowing the toxin-secreting and antibiotic-resistant *Clostridium difficile* bacteria to flourish.[14]

Findings from many disease settings have shown that regulating the enteric microbiome is vital to human health and disease prevention.

The bacterial colonies in the large intestines coexist with the host and are able to metabolize digestion-related nutrients, such as the bile acids and saccharides, into xenobiotics.[15] These xenobiotics are released into the colon environment and can be either tumor promoting (*e.g.* the secondary bile acid deoxycholic acid)[16] or preventive (*e.g.* the short chain fatty acid butyrate). If these bacterial byproducts are not excreted in the feces, they can be absorbed by enterocytes. The enterocytes can either use the metabolites or can move them into enterohepatic circulation with other nutrients absorbed from the gut lumen.[17] The effect of specific diets and dietary supplements on the colonic nutrient content will be discussed later in this review.

Dietary Patterns that Modify the Microbiome

Human intestines harbor a diverse panel of bacteria and the relative and actual abundance of each species can depend on the diet across a human lifespan.[1,5-8] Microbes begin to inhabit our intestinal track as infants and subsequently contribute to innate and adaptive immunity.[5,18,19] The specific types of microbes, however, are dependent on the diet of an infant. Specifically, breast-fed infants have a higher percent of *Bifidobacterium* colonizing their intestines as compared to formula fed infants.[18,19] The intestinal microbiota of children are also

responsive to dietary patterns. De Filippo, *et al*.[20] compared the gut microbiomes of western European and rural African (Burkina Faso) children ages 1-6. The rural children who consume a high fiber, high carbohydrate and low animal protein diet, had a much higher *Actinobacteria* and *Bacteroidetes* fecal content. Conversely, the European children on a Western diet had higher *Firmucutes* and *Proteobacteria* fecal content. Moreover, the biodiversity and relative quantity of bacteria was notably greater in rural children. Potentially as a result of the varied microbiomes, rural children also demonstrated significantly higher colonic butyrate and propionate content than their westernized counterparts. Adults who undergo a dietary intervention also present with changes in their microbiome. Adults randomized to a vegan diet demonstrated significantly different gut bacterial patterns as compared to their baseline omnivorous diets.[21] Additionally, those participants who were randomized to a vegan diet also demonstrated further microbial modifications upon switching to a lactovegetarian diet later in the study. Clearly, diet is a vital tool in maintaining an ideal colonic microflora content. Although beyond the scope of this review, it should be noted that colonic microbiota content can also be modified by drugs (ex. antibiotics, proton pump inhibitors)[14] and disease states (ex. obesity, inflammatory bowel disease).[22] Additionally, the microbiota differs by sex and race/ethnicity, which may be a reflection of unique dietary patterns in these subgroups.[23]

Specific Dietary Factors that Modify the Microbiome and Risk of Colon Cancer

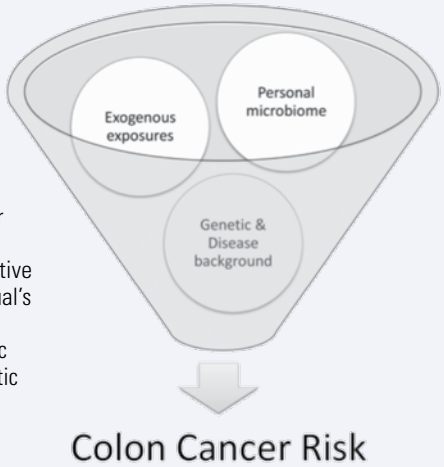
The host-colonic microbiome relationship is complex and interdependent. Dietary intake can select for specific microflora and change microflora fermentation methods by altering the colon microenvironment, which includes changes in nutrient/substrate availability, pH, and fecal transit time. Conversely, different species of microbes present in the colon produce different molecular substrates that can bring about anything from DNA damage and pro-tumorigenic changes to growth inhibition and anti-cancer effects.[24] Older mechanistic studies describe microflora that prefer a lactic acid rich environment, such as *Lactobacillus* and *Bifidobacterium*, as anti-tumorigenic in the colon.[25,26] Evidence suggests that these bacteria reduce pro-carinogenic enzyme activity in the bowel,[27,28] lower colonic pH to a protective level, physically bind meat-related carcinogens[29] and degrade nitrosamines.[30] However, largely due to limitations in technology that the field is only now overcoming (see **Conclusion and Future Directions**), clinical trial and epidemiological data linking colon cancer, the microbiome and dietary intake remains largely absent.

Prebiotics, Probiotics and Synbiotics. Prebiotics endeavor to select for non-pathogenic micro-organismal growth in the large intestine by consisting of food sources (ex. inulin, starches resistant to digestion) preferred by so called "good" bacteria. Probiotics are live, anti-pathogenic microflora that are ingested in order to directly promote growth of a given bacteria in the gut (ex. *Lactobacilli* and *Bifidobacteria*). A synbiotic is the result of combining both a probiotic and a prebiotic into one supplement.[31] These supplements purportedly decrease risk of colon cancer by modulating the type, amount and frequency of microflora.[24,31] The safety of supplementing with common pre-, pro- and synbiotics is well documented.[32] Rafter, *et al*.[33] documented that randomization to a synbiotic treatment (an inulin and lactic acid bacteria-based synbiotic) in participants with a history of colon cancer or a polyp led to increases in *Lactobacillus* and *Bifidobacterium*, while decreasing *Clostridium perfringes* counts. Further, decreases in the circulating inflammatory and pro-carcinogenic markers, interleukin 2 and interferon gamma, were noted. On the other hand, Worthley, *et al.*[34] found that synbiotics were able to modify gut flora but not colon cancer related biomarkers. Clearly, randomized clinical control trials with a dietary intervention and modification of disease as an endpoint, coupled with thorough gut flora analysis, are required to fully address the synbiotic-cancer hypothesis.

Fiber, Saccharides and Short Chain Fatty Acids. Dietary fibers and other digestion resistant saccharides (*i.e.* inulin, oligofructoses and other inulin-like carbohydrates) are found naturally in foods (*e.g.* fruits, vegetables, whole grains) or in supplemental forms as prebiotics. Intake of these compounds promotes increased stool bulk and

Figure 1. Determinants of Colon Cancer Risk

Exogenous exposures, personal microbiomes and genetic/disease backgrounds work in concert in order to predict an individual's risk for colon cancer. Specific exogenous exposures include diet, carcinogens, drugs and other environmental exposures. The personal microbiome describes the actual and relative amount of various microbes in an individual's gut. The behavior of these microbes contributes to the pro- or anti-tumorigenic microenvironment of the colon. The genetic background and existing diseases of an individual are known risk factors for colon cancer.



decreased transit time; additionally these saccharides serve as a fermentable source of energy for gut flora.[35] Fermentation of fibers and digestion resistant saccharides leads to production of the short chain fatty acids butyrate, propionate and acetate. The rate of fermentation depends on the relative quantities of bacterial species, transit time and the availability of the substrates.[36] Butyrate acts as a vital energy source for healthy colonocytes while inhibiting cell growth of transformed cells.[17,37,38] Despite promising preclinical evidence, clinical intervention trials linking high fiber dietary patterns or dietary fiber supplementation to reduced colon cancer risk report little to no effectiveness.[39-41] Inulin, as a part of a synbiotic, has had mixed results.[33,34] Given that the beneficial effects of these saccharides are dependent on the make-up and plasticity of the microflora,[35,36] newer sequencing technology may allow for the reanalysis of older studies to determine if response to dietary intervention is microbiome-dependent.

Meat, Fat and Bile Acids. Red meats and dietary fats have been associated with colorectal cancer risk.[42,43] One mechanism by which both red meats and fats promote colon tumorigenesis is by modifying bile acid metabolism. Primary bile acids (cholic acid and chenodeoxycholic acid) are synthesized in the liver and then conjugated into bile salts via taurine or glycine addition. These bile salts are stored in the gallbladder until being released into the duodenum in order to emulsify dietary fats. The fate of bile salts after entering the small intestines is one of the following: they are re/absorbed at the ileum and enter enterohepatic circulation where they will be transported to the liver; they are excreted in the feces; or they enter the colon and are deconjugated into secondary bile acids (deoxycholic acid and lithocholic acid) by colonic bacterial Bile Salt Hydrolases.[44] The bile acid pathway is of particular interest because intake of red meats can increase taurine conjugated-bile acid content:[45] pathogenic colonic bacteria prefer taurine over glycine conjugated biles acids, and bacterial metabolism of taurine leads to production of pro-tumorigenic hydrogen sulfide and deoxycholic acid in the colon.[46]

Indirect evidence for the link between bile acids, the microbiome and neoplastic risk exists. For example, bile acid quantity is significantly and inversely associated with the colonic concentrations of anti-neoplastic colonic short chain fatty acids.[47] Additionally, a randomized clinical control trial where humans were treated with a tertiary bile acid (Ursodeoxycholic acid; functions to reduce carcinogenic secondary bile acids) led to decreased recurrence of colorectal adenoma with advanced features in men.[48] As the affordability and feasibility of microbial sequencing improves, comprehensive studies that test the diet, bile acid and colorectal cancer hypothesis in humans are anticipated to emerge.

Conclusion and Future Directions

Colon cancer occurs most often in well-developed countries and is a preventable disease in many cases.[47] It is widely believed that nutritional regulation of gut flora is an important, modifiable risk factor for this disease. In addition to diet, the following work in concert to determine relative risk of colon cancer: non-dietary exogenous exposures (drugs, carcinogen exposure, etc.); an individual's colonic microbiome; genetic background; and existing disease-states (Figure 1).[14,21,22,24,25,31,33,39-42,49] Due to the multi-factorial, interdependent effects of these variables and their potential role in colorectal cancer risk, further research is needed to make specific recommendations for risk reduction.

The advent of cheaper and more high-throughput DNA sequencing technology has pushed the study of the microbiome into the post-genomic era.[50,51] Using high-throughput sequencing, Eckburg *et al.*[13] determined that 395 unique bacterial phylotypes (>99% similarity in sequence) existed in the colonic environment of their subjects. The majority of these bacteria belonged to the *Firmicutes* and *Bacteroidetes* phyla. Further they found that between-person variation was rather large. Landmark studies like this one have paved the way for global projects to pursue a comprehensive classification of the entire human microbiome.[50,51]

Going forward, novel sequencing platforms combined with advanced statistical modeling will allow for some species-level and functional identification; whereas earlier sequencing-based studies were confined to higher level taxonomic classifications.[52] Overall, the analysis of biosamples (both from existing biobanks and from future studies) using newer techniques promises to deliver a significant and timely influx of data to this field.

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Student Research

Determining the Most Effective Way to Engage Undergraduate Dietetics Students in Research – Classroom Requirement or Volunteer Opportunity

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Abstract

Universities are in an excellent position to provide outreach to the members of their community by utilizing available resources to conduct research. The University of Northern Colorado has successfully included undergraduate dietetics majors in community research projects. Two different groups of dietetics undergraduates were recruited on campus for two similar research projects. Recruitment of the dietetics undergraduates was either through an elective research course or as a volunteer. Undergraduate dietetics students provided health lessons during an after-school program for elementary students. Undergraduate dietetics students involved in either project gained many skills including classroom management, working with children, lesson planning and presenting, research methods, and flexibility. Successful research experiences with undergraduate dietetics students should include leadership opportunities and a signed contract that details expectations for volunteers or a course requirement with a grade.

Introduction

Being part of a research team while pursuing a dietetics degree is not often feasible for undergraduate students. However, a basic understanding of research is essential for dietetics students in order to apply to a dietetic internship or graduate school. Research knowledge and skills are needed to conduct research and read evidence-based literature in order to provide best practice nutrition guidance to their clients and patients. In addition, the Registration Examination for Dietitians includes research-related questions.[1] Hyena-Hankinson, Martin, and Wirth imply that research competencies are rarely taught in undergraduate dietetics programs.[2] Few peer-reviewed manuscripts have been published regarding research involving dietetics students at the undergraduate level.[2-7] Not only is providing students with the opportunity to learn about research important for his or her future role as a registered dietitian (RD), but according to the Foundation Knowledge Requirements and Learning Outcomes for Didactic Programs in Dietetics,[8] "the curriculum must reflect the scientific basis of the dietetics profession and must include research methodology, interpretation of research literature, and integration of research principles into evidence-based practice." Finding ways to provide research experience to undergraduates in a beneficial way to both the student and faculty member is important. Universities are in a position to impact the lives of individuals within the community while utilizing enrolled student resources. Over the last two years, the dietetics program at the University of Northern Colorado (UNC) has offered undergraduate dietetics majors two opportunities to conduct a nutrition intervention with elementary school students. One of the purposes of the elementary school project was to determine the best way to provide undergraduate dietetics majors research opportunities either through an elective course or through a volunteer opportunity.

Methods

Research Experience through a Course

During the spring semester of 2009, a research methods elective course enabled students to learn about conducting research as well as how to be part of a research team. During the fourteen-week course, eleven dietetics undergraduate students were involved in a nine-week Community Nutrition intervention project. The intervention consisted of a participatory model where elementary school students engaged in hands-on nutrition education (e.g. educational games and activities, healthy snack preparation). Elementary school students were recruited from an after-school program through a convenience sample at a local elementary school. This school has over 85% of the children eligible for free or reduced-cost lunch. Both the parents and the children provided consent/assent to be a part of this project. Elementary school students were transported from their after-school program to UNC's Dietetics Foods Lab for nutrition education sessions. Sessions covered MyPyramid, eating for energy, fruits and vegetables, importance of eating meals as a family, and appropriate portion sizes. The undergraduate dietetics students developed and taught each of the nine sessions and participated in collecting and assessing data (height, weight, pre-test, post-test, process evaluations, and food records). In addition to working with the elementary school students, undergraduate dietetics majors also attended class where they participated in hands-on

activities and lectures on research ethics, needs assessments, survey development, development of research questions and study design, dietary assessment and validation, behavioral theory based research, and data analysis.

Research Experience through a Volunteer Opportunity

During the spring semester of 2011, a volunteer opportunity to conduct a similar nutrition intervention occurred without a course requirement. Undergraduate student involvement was determined through an application process, selecting one paid undergraduate Research Assistant and twelve undergraduate dietetics student volunteers. The Research Assistant position required a major in Dietetics with a minimum 3.2 grade point average. Sophomore status with a dietetics major was required for all undergraduate dietetics major volunteers. This research experience took place at the same after-school program used during the elective course. Recruitment and informed consent/assent was gathered the same way as in the first experience. A mandatory orientation on research methods and overall project goals was provided, including how to administer pre- and post-test surveys and how to utilize/analyze/evaluate food diaries. The twelve undergraduate volunteers and one paid Research Assistant developed two lesson plans and participated in collecting and assessing data (height, weight, pre-test, post-test, process evaluations, and food records). Two nutrition classes were provided by the undergraduate volunteers, directed by the paid Research Assistant, and supervised by university faculty from the dietetics program. Nutrition topics included appropriate portion sizes and eating for energy with the Research Assistant leading the planning of lessons and organizing undergraduate volunteers.

For both experiences (elective course and volunteer), recruitment occurred at the same elementary school's after-school program and similar nutrition education topics were provided to the elementary school students. However, during the elective course, more nutrition topics (nine vs. two) were provided to the elementary school students and a more in-depth description of research methodology was explained to the undergraduate dietetics students. The same elementary school students' questionnaires and diet assessment tools were used during both experiences.

Data from the elementary school students' surveys were entered into SPSS (17.0) to calculate frequency distributions and independent samples t-tests. A p-value of $<.05$ was determined to detect significant differences. Qualitative open-ended questions from the undergraduate dietetics students' questionnaires on what they enjoyed, learned, and would recommend for future efforts between UNC and local elementary schools were evaluated to determine themes among respondents.

Results

The undergraduate dietetics students in both experiences (elective course and volunteers) all rated their research experience as positive and remarked how they enjoyed working with the elementary school children. In addition, the undergraduate dietetics students reported that they valued the experience of being part of a research team. Undergraduate students in both experiences reported via open-ended questions that they learned about the research process and about the amount of planning required. They also discovered that educators need a variety of motivational tools to establish and maintain children's attention spans; children need different methods of encouragement to try new foods and accept new ideas about nutrition; and being flexible when working with children in a classroom setting is imperative to any project.

The main difference was observed in the undergraduate dietetics students' responses to the different experiences. The undergraduate dietetics student volunteers expressed more frustration, felt less empowered, and noticed some of their fellow students were less committed to the project. The paid undergraduate Research Assistant in the second pathway and the undergraduate dietetics students who completed the research through a course had similar feedback in their qualitative open-ended questions.

In addition, data collected from the elementary school students measured the effectiveness and appropriateness of the two nutrition interventions. Overall, 25 different elementary school students participated. The majority of the elementary students who participated were 10 years old (80%), Hispanic (80%) and 75% had a BMI within the "at risk for overweight" (90th%ile) category on the CDC growth charts (SEM=1.10). All of the elementary students enjoyed

coming to the nutrition sessions, making and eating the snacks, and learning from "college students." Ninety-six percent (24 out of 25) of the elementary students rated that they strongly agreed (on a Likert scale) that they enjoyed coming to the classes because they learned how to "eat healthy" and how to "be healthy." Food record results also suggested elementary students who attended all the nutrition sessions tended to consume fewer calories (p=.10), more calcium (p=.10) and less sodium (p=.10) from pre- to post-test as compared to those who did not, but the results were not significant.

The undergraduate dietetics students in both experiences were also able to present the results of their research projects at UNC's Research Day and at the 2009 American Dietetic Association Food and Nutrition Conference and Expo which provided them the opportunity to network with other researchers.

Discussion

Both research experiences described show how nutrition education research interventions impact the surrounding community when provided by undergraduate students. The experiences also were beneficial to the undergraduate dietetics students in learning research basics, lesson planning, and presenting. The students who participated comprised a group of talented and enthusiastic workers who planned and implemented interventions under the under the direction of a dietetics faculty member. This project demonstrated the enthusiasm of the elementary children having college students interacting with them and also provided evidence that the undergraduate dietetics students are interested in being members of a research team with a chance to plan and teach nutrition lessons.

This project determined what worked well and what should be considered before utilizing undergraduates in a research project in the future. The main concern is volunteer involvement. The first opportunity was a required project in the research course the undergraduates were enrolled in with participation and project outcomes as part of their course grade. The second opportunity utilized voluntary undergraduate support. The voluntary nature of the second experience is believed to be the main reason participation was not consistent or reliable with a small number of the volunteers. Seven of the twelve volunteers stated they felt less involved and only as "volunteers" without a leadership role. The feedback recommended more leadership opportunities instead of only one Research Assistant and a contract so volunteers understood what was expected and felt more empowered. Also, the Research Assistant reported that receiving volunteer responses to emails, planning meetings, and lesson planning was difficult. Ninety percent of the volunteer dietetics students recommended the creation of a method to hold each volunteer accountable for the tasks s/he agreed to complete.

Conclusion

Based on the feedback from both groups of dietetics undergraduate students as well as test scores from the elective course, the opportunity to learn about and conduct research as part of a team was a success and a teaching strategy to continue in the future. One important finding was that at the undergraduate level, a course with a grade or a contract that clearly stated the importance of the undergraduate student's role and the expectations for each task is recommended to improve volunteer dependability. Recommendations on ways to improve volunteer dependability were noted, especially if the research project was not a course requirement and did not provide a direct leadership role. Either research pathway provided undergraduate dietetics students insight into research methods and hands-on experience in learning how to plan and teach nutrition education to elementary school students.

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Awards Offered by the Research Dietetic Practice Group

The RDPG Executive Committee feels that it is extremely valuable to recognize our members' accomplishments and honor them during FNCE. There is an award for all type of member and the applications are easy to complete. Consider applying for 2013! All awards are granted at the FNCE RDPG member breakfast and application deadlines are in the summer.

Student Awards:

One undergraduate and one graduate student are chosen each year. Applicants must have an accepted abstract to be presented at FNCE and MUST be student members of the RDPG. The winner receives $400 to be used to fund their trip to FNCE. Applications are due at the end of June each year.

The Research DPG Pilot Grant Award:

A $3000 seed grant is given to a RDPG member each year. This grant is intended to fund a pilot study with an RD as the Principal Investigator. All applicants MUST be RDPG members. Applicants are due at the end of May each year. Recipients receive the award at the annual member breakfast at FNCE where they will be asked to speak about their project. They'll also report on its progress after one year.

Published Paper First Author Award:

One RDPG member will be selected to receive this award each year. This award recognizes a significant contribution to the field of nutrition and dietetics in the form of a published paper with an RD as the first author. The paper must have been published in a refereed journal between May 1 and April 30th of the year of application. Applications are due at the beginning of June each year.

Upcoming Conferences

August 9-10, 2012
Human Performance and Dietary Supplements Summit
(Bethesda, MD)

September 3-14, 2012
Imperial College London, School of Public Health 4th International Course in Nutritional Epidemiology
(London, England, UK)

September 19, 2012
Fifth International Scientific Symposium on Tea and Human Health
(Washington, D.C.)

September 20-24, 2012
The Obesity Society 30th Annual Scientific Meeting
(San Antonio, TX)

October 6-9, 2012
Academy of Nutrition and Dietetics: Food and Nutrition Conference and Expo
(Philadelphia, PA)

November 1-2, 2012
American Institute for Cancer Research: Research Conference on Food, Nutrition, Physical Activity and Cancer
(Washington, D.C.)

November 7-10, 2012
Annual Biomedical Research Conference for Minority Students
(San Jose, CA)

SAVE THE DATE!

-A Pre-FNCE Event Presented by-

-Mediterranean Diet-

A Dietary Pattern for the Ages
Featuring Walnuts, Olive Oil and Red Wine

Saturday, October 6th
Lowes Hotel Philadelphia
Commonwealth Room ABC
1:00-3:00 pm

We invite you to mark your calendar to join us at our pre-FNCE event to enjoy networking, Mediterranean tastings and an insightful presentation by Connie Diekman, MEd, RD, LD, FADA., focusing on recent outcomes from the landmark PREDIMED Study: Effects on Cardiovascular Biomarkers, Med-Diet Eating Patterns and more.

Let us know you are attending. Find more information and register for our pre-FNCE event at: www.walnuts.org/FNCE.

1 Free CE available.

We are looking forward to seeing you at FNCE! Learn more about the exciting activities planned at the California Walnuts FNCE Booth #852 on our website.

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