RESEARCH
PIPELINE QUARTERLY

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Research Pipeline Quarterly presents NDC funded research and non-dairy funded papers that offer new or novel findings.

MESSAGE FROM THE EDITOR

EDITOR
Agnieszka Kuzmicka

Dear Reader,

Welcome to the 2018 fourth issue of the Research Pipeline Quarterly!

We begin this issue with studies from nutrition research program. Chris Cifelli provides and overview of an NHANSE study that suggests that increasing conformance with healthy eating patterns among US adults could reduce healthcare costs, with billions of dollars in potential savings. Matt Pikosky presents a paper on protein quality and the recovery of muscle strength during rehabilitation in older adults. Food Safety expert, Tim Stubbs provides an overview of the novel in-package treatment that reduces Listeria and may help extend shelf life of cheese. We close this issue with paper from the Sustainability team. Rajesh Chintala provides an overview of paper he co-authored along with Juan Tricarico that looks at the research done to understand how decisions are made on the dairy farm about managing manure, and what factors may be important to help dairy farmers in these processes.

Thank you,
Agnes

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NUTRITION RESEARCH

Health economic evaluation modeling shows potential healthcare cost savings with increased conformance with healthy dietary patterns among adults in the United States

Scrafford CG, Bi X, Multani JK, Murphy MM, Schmier JK, Barraj LM. Health economic evaluation modeling shows potential healthcare cost savings with increased conformance with healthy dietary patterns among adults in the United States. J Acad Nutr Diet. 2018

SUBJECT MATTER EXPERT COMMENT

Many American adults have one or more chronic diseases related to a poor diet, resulting in significant health care costs. This is the first study to model the potential health care costs and savings from chronic health outcomes associated with conformance to healthy eating patterns recommended by the Dietary Guidelines for Americans. Modelled increases in conformance with either the Healthy US-style or Healthy Mediterranean-style eating patterns resulted in over $16B in health care cost savings. The 2015 Dietary Guidelines Advisory Committee noted that healthy eating patterns are consistently higher in vegetables, fruits, whole grains, low-fat and fat-free dairy, seafood, legumes and nuts. However, most Americans are under-consuming these healthy foods, including dairy. Increasing dairy food consumption to meet the recommended 3 servings of dairy every day is an easy way to improve conformance with the recommended healthy eating patterns for improved health.

- Chris Cifelli, PhD

HEADLINE

Following the Healthy US-style or Healthy Mediterranean-style eating patterns projected to save billions in healthcare costs.

ABSTRACT

BACKGROUND: Many American adults have one or more chronic diseases related to a poor diet, resulting in significant direct and indirect economic impacts. The recent Dietary Guidelines for Americans (DGA) recognized that dietary patterns may be more relevant for predicting health outcomes compared to individual diet elements and recommended three healthy patterns based on evidence of favorable associations with many chronic disease risk factors and outcomes. Health economic assessments provide a model to estimate the potential impact on costs associated with changes in chronic disease risk resulting from improved diet quality in the United States (US) adult population. OBJECTIVE: To estimate the impact on healthcare costs associated with increased conformance with the three healthy patterns recommended in the 2015-2020 DGA including the Healthy US-style, the Healthy Mediterranean-style, and the Healthy Vegetarian eating pattern.

Due to the length of the abstract we could not include it fully in this newsletter. Please follow this link for paper's full text: https://jandonline.org/article/S2212-2672(18)30461-1/fulltext

CONTRIBUTION TO THE STATE OF SCIENCE

The Dietary Guidelines for Americans recognized that dietary patterns may be more relevant for predicting health outcomes. Indeed, the 2015 DGAC concluded that there is strong and consistent evidence that healthy eating patterns are associated with clinically meaningful impacts on cardiovascular risk factors and moderate evidence that they are associated with favorable outcomes related to healthy body weight, risk of obesity, the risk of developing type 2 diabetes and lower risk for certain cancers. Accordingly, the objective of the current study was to quantify the net annual change in costs, in terms of direct medical costs and indirect costs, associated with increased conformance among adults in the US with the Healthy US-style, the Healthy Mediterranean-style and the Healthy Vegetarian eating patterns.

This new study included data on (1) the relative risk estimates of the association between conformance with each eating pattern and health outcome; (2) direct and indirect costs associated with each health outcome and (3) conformance with each eating pattern among the US adult population. The Healthy Eating Index (HEI) and Mediterranean diet scores (MED) were used to determine conformance. Estimates of conformance with the HEI and MED among adults in the US were based on food consumption records collected in the What We Eat in American component of the 2013-2014 National Health and Nutrition Examination Survey, a large dietary survey of a nationally representative sample of the U.S. population.

Two dietary scenarios were modeled in the study, one where the average conformance score was increased by 20% and a second where the average conformance score was increased to achieve 80% of complete conformance. Interestingly, based on the inclusion criteria, no studies on the association between conformance with a vegetarian dietary pattern and health outcomes were identified. As such, the current quantitative analysis is limited to studies that evaluated the healthy US-style and Mediterranean-style eating patterns.

The results showed an estimated annual cost savings of $31.5B and 16.7B based on a 20% increased conformance from the average for the Healthy US-style and Mediterranean eating patterns, respectively. Further, if the US adult population were to reach a target of 80% maximum adherence, the annual cost savings were estimated to be $55.1B and $88.2B for the Healthy US-style and Mediterranean eating patterns, respectively. Thus, this study shows that a modest, realistic shift in conformance to two dietary patterns that were included in the current Dietary Guidelines could result in significant health care cost savings.

Status: Published

Communication Ready: Yes

Type of Research: Observational

Funding Source: National Dairy Council

Key Words: Dietary Guidelines, eating patterns, health care costs, NHANES

NUTRITION RESEARCH

Improving dietary protein quality reduces the negative effects of physical inactivity on body composition and muscle function

Arenston-Lantz EJ et al., Journal of Gerontology.
https://doi.org/10.1093/gerona/glz003

SUBJECT MATTER EXPERT COMMENT

The negative impact of short-term bed rest on body composition and muscle strength/function is a significant issue for the health and quality of life in older adults. While higher protein diets have been shown to mitigate some of these negative effects, the excess calories that accompany higher protein diets may not be advisable as it could contribute to weight gain. Supplementation with essential amino acids and/or leucine has also been shown to have some benefit. This strategy may be impractical for broad, real-world application however, as these amino acids can be costly and are not palatable. Whey protein may be a practical solution as it is one of the highest quality proteins available providing a concentrated source of essential amino acids and leucine for a relatively modest amount of calories. This study demonstrated that improving the overall protein quality of the diet simply by supplementing with modest amounts of whey protein at each meal, without a need to increase total protein and calorie intake, can be beneficial. This data provides support to the notion that whey protein can be a practical and cost-effective way to counter the detrimental effects of bedrest in older adults. This could have broad implications to a variety of clinical populations.

- Matt Pikosky, PhD

HEADLINE

Improving protein quality of the diet with whey protein reduces the negative effects of bedrest on body composition and improves the recovery of muscle strength during rehabilitation in older adults.

ABSTRACT

BACKGROUND: Brief periods of physical inactivity can compromise muscle health. Increasing dietary protein intake is potentially beneficial but complicated by difficulties reconciling anabolic potential with a realistic food volume and energy intake. We sought to determine if increasing dietary protein quality could reduce the negative effects of physical inactivity. METHODS: 20 healthy, older men and women completed 7-days of bed rest followed by 5-days of rehabilitation. Volunteers consumed a mixed macronutrient diet (MIXED: N=10; 68 ± 2 y; 1722 ± 29 kcal/day; 0.97 ± 0.01 g protein/kg/day) or an isoenergetic, whey augmented, higher protein-quality diet (WHEY: N=10; 69 ± 1y; 1706 ± 23 kcal/day; 0.90 ± 0.01 g protein/kg/day). Outcomes included body composition, blood glucose, insulin, and a battery of physical function tests. RESULTS: During bed rest, both groups experienced a 20% reduction in knee extension peak torque ($p<0.05$). The WHEY diet partially protected leg lean mass (-1035 vs. -680 ± 138 g, MIXED vs. WHEY; $p=0.08$) and contributed to a greater loss of body fat (-90 vs.-233 ± 152 g, MIXED vs. WHEY; $p<0.05$). Following rehabilitation, knee extension peak torque in the WHEY group fully recovered (-10.0 vs. 2.2 ± 4.1 Nm, MIXED vs. WHEY; $p=0.05$). Blood glucose, insulin, aerobic capacity and short physical performance battery (SPPB) changes were similar in both dietary conditions ($p>0.05$). CONCLUSIONS: Improving protein quality without increasing total energy or protein intake, has the potential to partially counter some of the negative effects of bed rest in older adults.

CONTRIBUTION TO THE STATE OF SCIENCE

The negative effects of physical inactivity and bedrest have been well documented. Even brief periods of bed rest (5-7) days can lead to negative changes in body composition (loss of muscle and gain of fat) and a significant loss of muscle strength/function. While feeding higher amounts of protein during these periods has been shown to help minimize these negative effects, there are potential concerns of increasing total energy intake during this time, as it could contribute to unwanted weight and/or body fat gain. Previous research by these investigators demonstrated that supplementing meals with leucine (~4g per meal) during 7-days of bedrest partially protected several key markers of muscle health. With this study, the investigators sought to determine if a more practical approach to improve protein quality of the diet via whey protein (a high-quality protein with one of the highest concentrations of essential amino acids and leucine) would have similar beneficial effects. Healthy older adults (n=20, ages 60-80 years old) underwent 7-days of bed rest followed by 5-days of rehabilitation (daily 45-minute bouts of supervised progressive stretching and balance/strength focused exercises) at the UTMB Institute for Translational Sciences-Clinical Research Center. Subjects were randomized to either the MIXED or WHEY diet groups. Diets were matched for total calories and macronutrient composition (55% carbohydrate, 29% fat and 16% protein). The MIXED group consumed a diet containing protein from a variety of whole-food, plant and animal sources (68 ± 1.2 % animal; 32 ± 1.6 % plant protein). In the WHEY cohort, whey protein isolate replaced some of the whole-food sources of protein (74 ± 1.0 % animal; 26 ± 1.0 % plant) at each meal. Body composition, blood glucose and insulin, and a variety of tests to assess muscle strength/function were determined at baseline and following the intervention. As anticipated, bed rest resulted in a decrease in muscle mass (whole body and leg lean mass) and strength in both groups. However, the WHEY diet was able to partially protect leg lean mass (trend for significance, $p=0.08$) in comparison to the MIXED diet. Additionally, the WHEY group lost more fat mass than the MIXED group during bed rest. Following the 5-day rehabilitation period, the WHEY group experienced a full recovery of muscle strength, while the decrement persisted in the MIXED group. The authors concluded that simply improving the protein quality of the diet via use of whey protein, without increasing total calorie or protein intake, can help to partially mitigate the negative impact of short-term bed rest on body composition and support improved recovery of muscle strength during rehabilitation in older adults.

Status: Published

Communication Ready: YES

Type of Research: Clinical Trial

Funding Source: National Dairy Council, National Institute of Nursing Research at the National Institutes of Health and in part by the Claude D. Pepper Older Americans Independence Center grant and the National Center for Research Resources

Key Words: physical activity, body composition, nutrition, whey protein, protein quality

PRODUCT RESEARCH

Effect of high voltage atmospheric cold plasma on inactivation of Listeria innocua on Queso Fresco cheese, cheese model and tryptic soy agar.

Zifan Wan, S.K. Pankaj, Curtis Mosher, Kevin M. Keener LWT - Food Science and Technology 102 (2019) 268–275

SUBJECT MATTER EXPERT COMMENT

This paper shows clear proof-of-principle for a new, non-thermal treatment to reduce pathogens in dairy products. The treatment times used in the study are too long to be practical in commercial scale dairy processing facilities, but it does indicate the potential for a revolutionary new process. Assuming further refinement and reduction in treatment times, this technology could be used for cheese blocks, shreds and other packaged dairy as a food safety hurdle and shelf life extender. The Innovation Center Listeria Consortium is working on an extension to the original study to refine the technology and reduce treatment times.

-Tim Stubbs, CFS

HEADLINE

Novel in-package treatment reduces Listeria and may help extend shelf life of cheese.

ABSTRACT

High voltage atmospheric cold plasma (HVACP) is a novel technology which has shown promising results on microbial inactivation under low temperature, and thus offers opportunities on decontamination of biological materials. In this study, *Listeria innocua* spot inoculated tryptic soy agar (TSA), Queso Fresco cheese (QFC) and cheese model (CM) samples were treated with HVACP under direct and indirect mode of exposure in dry air gas environment for 5 min. After direct HVACP treatment, a reduction of 5.0, 3.5 and 1.6 $\log_{10}$ CFU/g was observed for TSA, CM and QFC, respectively. Direct plasma treatment was more effective in *Listeria innocua* inactivation on CM and QFC compared to indirect treatment. Surface analysis has shown that the differences in surface roughness and micro-structure of the substrate hugely impact the efficacy of the HVACP treatment by affecting the attachment of the bacteria cells on the surface and providing protective locations for the microbes within the surface.

CONTRIBUTION TO THE STATE OF SCIENCE

This project demonstrates the efficacy of HVACP in controlling Listeria in dairy. It also showed potential to reduce other spoilage organisms thereby improving shelf-life which may provide processors an economic incentive to adopt the technology. The model system used, Queso Fresco, is one of the most challenging due to its high moisture and pH which make it susceptible to microbial growth. Historically this type of cheese has caused some of the highest profile illness outbreaks in dairy which have negatively impacted Dairy's reputation. The HVACP approach would fill a need for effective Listeria control technologies for queso fresco and similar cheeses. Other advantages of the HVACP technology are that it is clean-label, involves no additives, and the treatment occurs in the final consumer package which minimizes chances of post-processing contamination.

Status: Published

Communication Ready: YES

Type of Research: Food Safety

Funding Source: Innovation Center *Listeria* Research Consortium

Key Words: Food Safety; Cheese; Listeria monocytogenes; Queso fresco; high voltage atmospheric cold plasma; HVACP

SUSTAINABILITY

A Review of Social Determinants for Dairy Farmer Decision Making on Manure Management Strategies in High-Income Countries

*Niles, M.T., Horner, **C., Chintala, R., Tricarico, J.** (2019). Environmental Research Reviews. Forthcoming.*

SUBJECT MATTER EXPERT COMMENT

The dairy industry is an important source of human nutrition globally, while also having challenges for managing manure. Manure can be used as an important natural fertilizer resource on farms for growing crops and improving soil health but can also present environmental challenges. Farmers have many ways they can manage this manure from how they collect it, store it, process it, and apply it to soils, which have different benefits and challenges. In this paper we look at the research that has been done to understand how decisions are made in the dairy farm about managing manure, and what factors may be important to help dairy farmers in these processes. Understanding the behavioral components of these decisions can be useful for helping dairy farmers transition to best management practices on their farms that maximize the benefits of manure and minimize the potential challenges.

- Rajesh Chintala, PhD

HEADLINE

Farmer decisions on manure management affected by a broad-suite of factors

ABSTRACT

The global dairy sector is a major source of human nutrition and farmer livelihoods, while also generating manure, an important nutrient for crop production, but one that must be managed to minimize environmental risk. Manure management- manure handling, processing, storage and application- is an important part of managing a dairy system. Rising awareness of environmental stewardship is increasing for dairy production that meets multiple sustainability goals. Importantly, a large body of research has identified a suite of potential manure management strategies (MMS) that can contribute to reduced environmental impact, and in some cases, provide additional benefits for farmers and society. Despite this growing body of technical and agronomically-focused research, there has been far less research on farmer decision-making and adoption of MMS. To explore this gap, we conduct a systematic literature review of peer-reviewed articles exploring the drivers of farmer adoption and decision-making related to MMS. We focus on high-income countries, where MMS strategies are more diverse and often involve advanced technologies. We find 36 articles across Europe, the United States, and Canada and use a comparative analysis focused on four key areas: 1) farm size and structural characteristics associated with MMS adoption; 2) Existing adoption of MMS practices; 3) socio-economic and regulatory factors associated with MMS adoption; and 4) individual information, attitudes, and demographics associated with MMS adoption. We identify and discuss three gaps in the existing literature: 1) a dearth of studies exploring farmer adoption of MMS, especially from certain highly productive milk regions; 2) a lack of comparative studies across multiple regions and/or across time to identify more direct casual pathways of decision-making; and 3) technical and other feasibility needs for future MMS adoption. These suggest a clear pathway for future research to better understand the myriad factors that influence dairy farmer decision-making as it relates to MMS.

CONTRIBUTION TO THE STATE OF SCIENCE

How dairy farmers manage manure and the factors that influence those decisions has critical importance for the sustainability of the dairy industry. Despite a large body of research in the agronomic and technical sciences to explore the impact of different manure management systems (MMS) on environmental outcomes such as greenhouse gas emissions or water quality, very little research has been conducted on the social science and decision-making components of these strategies. Here we conducted a systematic review across the social sciences literature to better understand the factors that are related to how farmers manage manure and their implications. We found that MMS are themselves inherently connected across collection, processing, storage, and application methods, making such systems hard to decouple. We also found that while there are no universally consistent effects, larger farms tend to be more likely to adopt certain MMS such as storage or treatment strategies including anaerobic digesters. Contact with agricultural advisors, researchers and other farmers was consistently found to increase adoption of best practices in MMS, and farmer attitudes about environmental and social benefits and being neighborly were more likely to adopt certain MMS such as anaerobic digesters. In contrast, economic barriers were consistently found to be one of the most influential factors in farmer decision-making for MMS, with cost being prohibitively expensive for smaller farms to adopt many best management practices. The policy and regulatory landscape were also consistently found to be an important factor for MMS decisions; with farmer uncertainty around regulations negatively affecting their decision to adopt improved MMS.
We further found that there is a dearth of articles exploring these topics, particularly in contrast with agronomic or technical research, and that most studies come from only a handful of countries, and often from regions that may not be major dairy producing places (e.g. a disproportionate amount of articles from Louisiana). We found no research comparing farmer adoption of MMS and their drivers across multiple regions, another point for future.

Status: Published

Communication Ready: YES

Type of Research: Modelling study

NDC Staff Co-Authored Paper

Funding Source: U.S Center for Dairy Innovation

Key Words: Farmer decision-making, manure management, farm characteristics, policy,