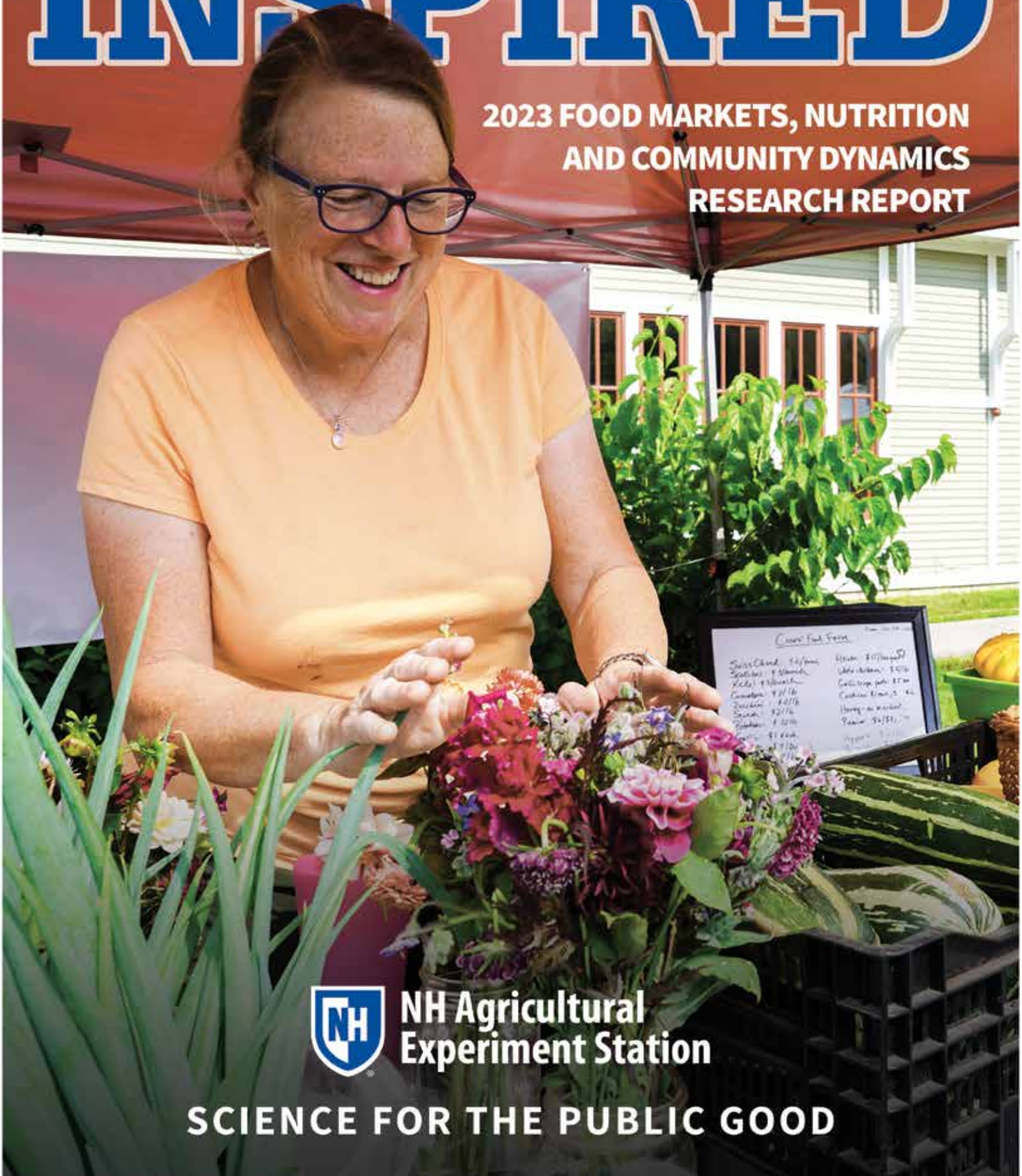


A PUBLICATION OF THE NEW HAMPSHIRE
AGRICULTURAL EXPERIMENT STATION

SUMMER/FALL 2023

INSPIRED

2023 FOOD MARKETS, NUTRITION
AND COMMUNITY DYNAMICS
RESEARCH REPORT



NH Agricultural
Experiment Station

SCIENCE FOR THE PUBLIC GOOD

MESSAGE FROM THE DIRECTOR

Dear members of the New Hampshire food systems community and beyond:

For over a century, the New Hampshire Agricultural Experiment Station has been at the forefront of research, delivering insights and innovations crucial for understanding the dynamics in rural communities. These include the effects of shifting demographic and socioeconomic traits; consolidation within the food processing sector; evolution in local, state, and federal policies; and trends in nutrition and health behavior among increasingly diverse populations and communities. Today, scientists at the Station persist in this robust tradition, striving to identify and address significant challenges that impact the economic and social welfare of farming communities. And their work is pivotal in discovering new methods to promote healthier lifestyles, thereby ensuring the long-term well-being and sustainability of all Granite Staters.

The research presented here sheds light on key findings that enhance our comprehension of both producers and consumers within New Hampshire's dynamic food systems. Among the topics explored are the expansion of public engagement in alternative food networks and the development of stronger connections between New England farmers and large retailers through values-based supply chains. Additionally, this research addresses the issue of food insecurity, especially among college students with disabilities, and the need to adapt to changing state demographics to ensure equitable food access. And it delves into the intricate interplay between food, dietary habits, and the gut microbiome and its impact on the diverse and growing populations in our state.

Each research brief included in this issue offers a snapshot of the rigorous science and practical takeaways that can empower our food producers and systems to become more resilient and can enable our policy makers and non-profit organizations to be more successful in supporting some of our most vulnerable and changing populations—ultimately highlighting how scientific discoveries have the ability to strengthen the Granite State.

Thank you for supporting our efforts to improve the lives of every Granite Stater.



ANTON BEKKERMAN
Director, NH Agricultural
Experiment Station

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SCIENCE FOR THE PUBLIC

LOCALLY INSPIRED. GLOBALLY IMPORTANT.

The mission of your New Hampshire Agricultural Experiment Station is to ensure the resiliency of the Granite State's diverse communities and local

economies. For more than 130 years, we've served the state as the agricultural, food, natural resource and environmental research arm of the UNH land-grant mission. From the lab to the field, forest and sea, our researchers push scientific frontiers in pursuing sustainable food production and natural resource management across New Hampshire and beyond.

High-Stakes Issues
World-Class Science
Sustainable Advancement

The small-scale, diverse agricultural and food industries are critical to the state's economy. In 2022, agriculture directly contributed to \$235 million in output and its food system led to \$29.3 billion in economic benefits for New Hampshire. In part, this is due to the strong farm-to-table presence in the state. Ranking top in the nation in this area among states with farms that directly sell to consumers, New Hampshire, and its farmers, benefit from access to nearly



A University of New Hampshire Student collecting data for the College Health and Nutrition Assessment (left), members of the UNH Cucurbits Research and Breeding Program working at UNH's Kingman Research Farm (center), and the UNH Organic Garden Club's farm stand (right).

GOOD



150 farmers markets and farm stands and consistent consumer participation in community supported agriculture (CSA) and community supported fisheries (CSF) programs. The proximity of agricultural operations to U.S. population centers represents a unique opportunity for both food producers and consumers in the Northeast, however, challenges remain for sustaining small-scale farming operations, responding to market trends, adapting to demographic changes and understanding healthy nutritional choices.

But these challenges can be overcome through science-based solutions. Researchers with the New Hampshire Agricultural Experiment Station produce impactful knowledge to support the state's highly diversified food system so that it can support the resilience and vitality of Granite State communities. Through a better understanding of demographic changes, eating and health choices, desire to consume foods produced in New Hampshire, effectiveness of state and federal policies, among other factors, scientific discoveries by Station scientists will provide recommendations for ensuring a healthier workforce, cost-effective stewardship of public program funds, reduced stress on the state's healthcare system, and economic sustainability for food producers and rural communities.



ENHANCING PUBLIC ENGAGEMENT IN ALTERNATIVE FOOD NETWORKS

A. BRUCE, S. WEBB, J. CARSON, C. ZHENG, E. NEIDECKER AND I. LESLIE

Alternative food networks (AFNs), such as farmers markets and community supported agriculture (CSA), are marketing models that shorten the supply chain and aim to offer fair prices, transparency and environmental sustainability. Small and mid-sized farms have higher survival rates when they market directly to consumers, a central feature of AFNs that is fostered by diversified marketing channels and income streams. However, AFNs have not reached beyond a small, saturated niche market, and their growth has plateaued in the past decade. This project aims to identify characteristics of underserved markets and develop strategies that producers can use for engaging a broader customer base.

Project Goals and Research Objectives

The research goal is to enhance farmers' ability to meet diverse consumer needs and preferences and to identify priorities and communication strategies that resonate with a broader audience of New England

KEY TAKEAWAYS

Emphasizing food attributes such as taste, quality, healthiness and affordability is key to growing consumer participation in AFNs.

Perceptions of how food is grown or who grows it are less important than previously thought.

Shopping behaviors are linked with people's self-perceptions, and consumers who saw themselves as the “type” of person who buys local foods were more likely to report shopping at AFNs.

consumers. The key questions addressed by this research to expand participation in New England AFNs are:

1. What are the food shopping behaviors and values of potential customers who do not currently purchase local foods?
2. How does culture and identity shape food preferences and purchasing behaviors?
3. What are consumers' perceptions of AFNs?

To answer these questions, a survey was conducted of New England adults with varying levels of engagement in AFNs. The survey, supported by the UNH Survey Center, garnered a total of 2,110 responses and employed a probability-based sampling methodology, allowing the results to be generalizable to all New England adults.



Alternative food markets, like farmers markets and CSAs, have struggled to reach beyond a niche audience.

Insights for Broadening Consumer Participation

The survey findings provide information about strategies for increasing consumer participation in AFNs and aiding farmers and practitioners in expanding AFN market reach. Several key points of guidance emerged.

Emphasize important attributes: To appeal to a broader customer base, highlighting attributes such as taste, high quality, healthiness and affordability—which are deemed important by a majority of New

England adults—may help AFNs appeal to a broader audience.

Maintain support for small-scale farms: Attributes about how food is grown or the people who grow it, such as grown on a small or family farm are not deemed important by as many New Englanders.

Increase public education: Raising awareness of the benefits associated with small farms may cultivate long-term value recognition by consumers.

Recognize cultural identity and AFNs: Cultural identity, which encompasses how individuals define themselves in relation to different social groups, plays a significant role in shaping food preferences and practices. Recognizing and addressing cultural distinctions within AFNs is pivotal to inclusivity and to serving individuals from diverse backgrounds.

Table 1. Percent of New England Adults Marking Each Characteristic as "Important"

| Characteristic | Percent |
|-----------------------------------|---------|
| Tasty | 88.3 |
| High quality | 79.3 |
| Healthy | 79.1 |
| Affordable | 77.3 |
| Convenient | 64.1 |
| Inexpensive | 58.9 |
| Supports fair wages | 56.6 |
| Sustainable | 56.6 |
| Local | 53.6 |
| Grown on a small farm | 32.7 |
| Grown on a family farm | 32.0 |
| Organic | 31.3 |
| Grown by people I know personally | 21.0 |

Source: University of New Hampshire "New England Food Shopping Habits and Preferences Survey," collected November 2022 through March 2023. *Note:* Estimates are weighted. Calculated among respondents with valid responses to each attribute question (n =1,826)

Insights for Marketing Directly to Consumers

The survey results offer valuable insights about marketing food products directly to consumers.

Understand impact of food attributes: Approximately 70% of New England adults consider attributes like taste, quality, healthiness, and affordability as factors when selecting food (**Table 1, pg. 7**).

Growing practices are important but less than perceived: Attributes related to how food is grown or who grows it—such as organic, small-scale/family farms—and personal connections are only deemed “important” by approximately 30% of New England adults, contrasting with the emphasis often placed on these attributes in AFN marketing.

Self-perception of AFN consumers matters: Consumers are divided about whether they think there is a type of person who buys local foods and where they think of themselves as that type of person (**Table 2**).

Cultural identity is linked with shopping behavior: New Englanders who prioritize attributes related to how their food is grown also identify themselves as the “type” of person who buys local foods. Those who associate themselves with this type are more likely to perceive their food choices as part of their identity. Furthermore, people who say that they are the “type”, shop at farmers markets, farm stands and CSAs at three times the rate of those who say that they are not the “type”.

Exploring Cultural Identity and Food Preferences

The survey findings open avenues for exploring the influence of cultural identity on individuals’ values regarding food. The research highlights that cultural identity significantly shapes food preferences and practices. For example, terms like “locavore” or “foodie” suggest the emergence of a cultural identity rooted in values-based food shopping. While this cultural identity motivates certain individuals to engage with AFNs, it may inadvertently discourage potential customers who do not identify themselves in the same way.

Continued research will include conducting interviews with a diverse range of New England consumers to enable a deeper exploration of the relationships between cultural identity, food preferences and AFN engagement, encompassing the diversity present among New England consumers.

Enhancing public engagement in alternative food networks is vital for promoting sustainable food systems and supporting small and mid-sized farms. By prioritizing attributes that resonate with the broader population and addressing cultural distinctions, AFNs can expand their customer base and increase their impact. The survey findings provide valuable insights for farmers and practitioners, offering a foundation for developing effective strategies to engage diverse consumers in New England.

Table 2. Percent of New England adults who think their food choices say a lot about who they are, by belief in a certain type of person who buys local farm foods

| | <i>Yes, and I’m that type</i> | <i>Yes, and I’m not that type</i> | <i>There’s no type</i> |
|-----------------------------------|-------------------------------|-----------------------------------|------------------------|
| No, food choices do not say a lot | 18.1 | 30.8 | 38.7 |
| Yes, food choices say a lot | 72.5 | 56.4 | 43.7 |
| Don’t know / not sure | 9.5 | 12.9 | 17.7 |

Source: University of New Hampshire "New England Food Shopping Habits and Preferences Survey," collected November 2022 through March 2023. Note: Estimates are weighted. N=2,081. p<0.001



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CONNECTING NEW ENGLAND FARMERS TO LARGE RETAILERS THROUGH VALUES-BASED SUPPLY CHAINS

A. WILHELM, I. LESLIE AND A. BRUCE

Mid-sized farms in the U.S. can meet increasing demand for locally and regionally produced food, but direct-to-consumer markets are unable to meet the needs of mid-sized farms or consumers. This market mismatch often leaves mid-sized farms without the market avenues necessary to sustain them. Values-based food supply chains (VBSCs) are potentially capable of meeting the needs of both mid-sized producers and consumers using strategic partnerships to “scale down” pre-existing conventional and grocery retail supply chain infrastructure where most consumers already buy their food.

Defining VBSCs and Methods

Values-based food supply chains (VBSCs) are alternative supply chain models that use collaboration and equitable partnerships to achieve beneficial values or outcomes. To facilitate access to larger retail markets, VBSC partners agree to collaboratively overcome barriers that exist for small and mid-sized

KEY TAKEAWAYS

Regional, values-based food supply chains (VBSCs) can improve market access for at-risk mid-sized farms.

VBSCs facilitate collaboration among supply chain partners by sharing risk and leveraging physical and informational infrastructures.

VBSCs can connect producers to larger retailers by using existing infrastructure to serve consumers in markets where they buy most of their food.

producers, but these solutions can be difficult to identify and enact.

Using 22 interviews with New England-based producers, intermediaries, large-chain retailers or grocers, and key informants, the research found three areas where VBSCs can improve producer access to large retail markets, as well as more specific strategies used by interviewees.

Risk Sharing

Participation in large wholesale markets may involve a high-risk burden for producers; that is, producers are disproportionately susceptible to financial loss. VBSCs may serve to redistribute or share risk along a supply chain, using multiple mechanisms to deliver certainties of market access to producers.

Advanced volume commitments: Advanced volume commitments by buyers such as bids and contracts that are typically offered only to large producers, provide a guarantee of market access that helps redistribute risk by passing it up the value chain.

Market flexibility for seasonality and shifts in supply: Flexible delivery quotas, where shifts in volume between individual deliveries are tolerated and compensated for by a buyer, may help reduce risk for

producers when they experience shifts in their supply due to seasonality, weather and disease or pests.

Market flexibility for volume: VBSCs may commit to “scaling down” their large volume requirements using strategies such as allowing producers to supply individual stores directly rather than using industrial warehouse aggregation or by creating smaller markets for specialty goods.

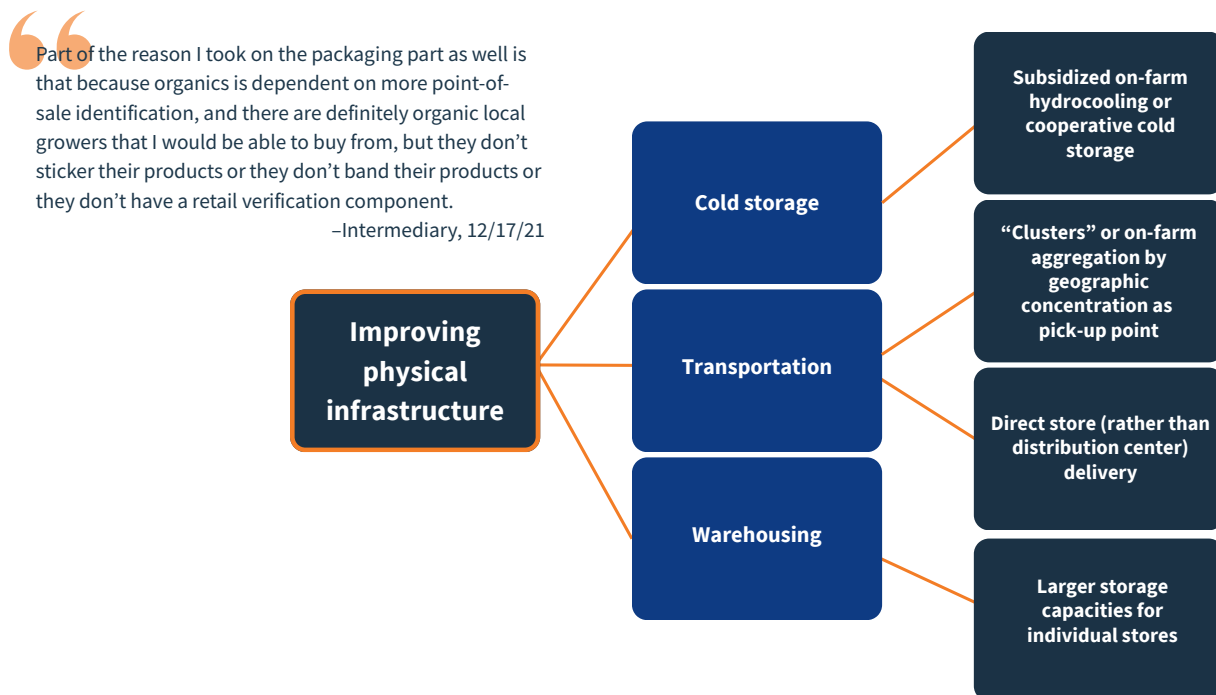
Physical Infrastructure

The physical infrastructure necessary for moving local and regionally produced food through conventional markets is often an obstacle that hinders producer capacity to access appropriate markets. Improvements in key physical infrastructure factors and identifying ways to increase producers’ access to existing infrastructure is important for enacting values (Fig. 1).

Cold storage: Access to proper refrigeration, like hydrocooling, as soon as possible after harvest is important for meeting retail quality standards. VBSCs facilitate shared access to costly cold storage technology for smaller producers.

Transportation: Transportation can be difficult for producers who are solely responsible for managing and absorbing the costs of frequent deliveries over extended distances. VBSCs practice direct store

Figure 1. Physical infrastructure connecting New England farmers to large retailers via values-based food supply chains.



delivery, allowing producers to deliver to closer retail locations rather than distant warehouses, and aggregation networks between smaller farmers.

Warehousing: Proper warehouse and storage facilities are also integral for larger market access. VBSCs are specially positioned to ensure access to shared storage spaces via collaborative strategies.

Informational Infrastructure

Improved systems for the distribution of information are critical for the function of VBSCs. Retail and supermarket supply chains may be less direct and more complex, with many participants involved in a single chain. In such cases, creating pathways for information to flow between and amongst participants may be foundational for cooperation (**Fig. 2**).

Software systems: Software and ordering platforms are vital in the intermediary position and streamline communication, especially in complex supply chains.

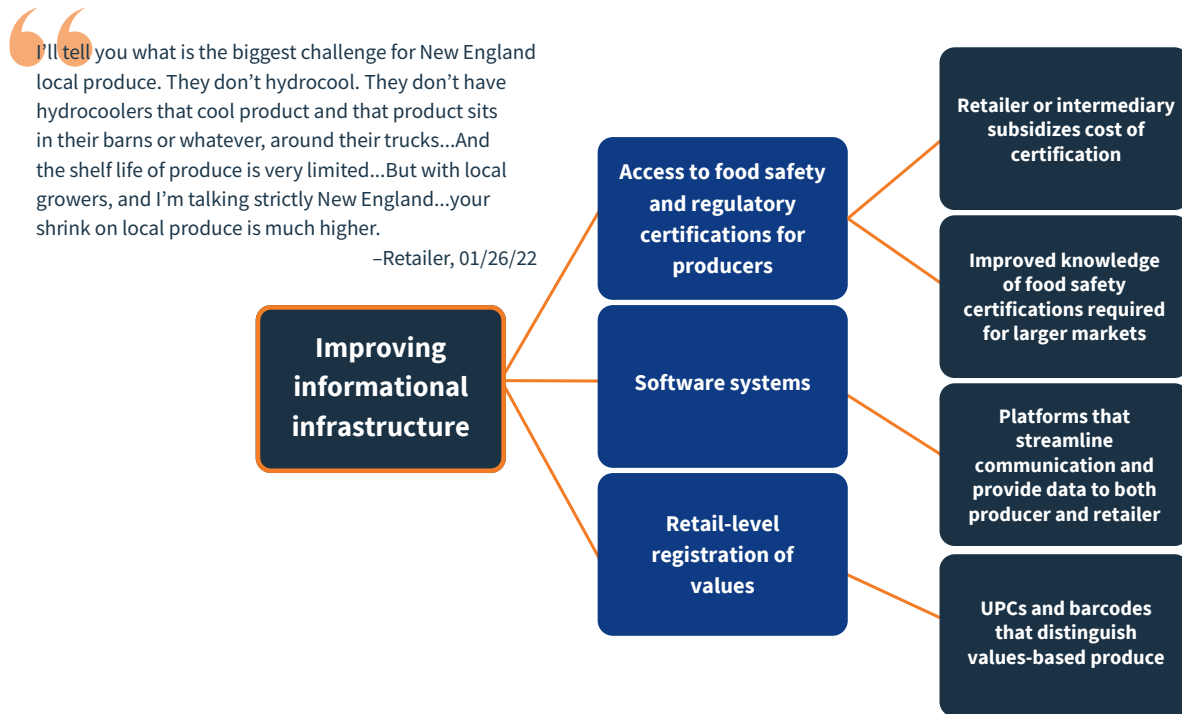
These might include online catalogs and other platforms designed to simplify information sharing.

Access to food safety and regulatory certifications for producers: Certifications often required by larger retailers, such as good agricultural practices (GAPs) and Harmonized GAP, can be difficult and costly to obtain. Improved educational and financial resources make certifications more accessible for producers.

Retail-level registration of values: UPCs (universal product codes) or barcode systems for differentiating local or regionally produced products, at a retail level, generally do not exist. Packaging is used as a tool to distinguish values such as local or regionally produced.

While values can be difficult to act upon in economic partnerships like VBSCs, “scaling down” existing food supply chain infrastructure to create market pathways for mid-sized farms is achievable through collaborative strategies like the ones identified here.

Figure 2. Informational infrastructure connecting New England farmers to large retailers via values-based food supply chains.



“I’ll tell you what is the biggest challenge for New England local produce. They don’t hydrocool. They don’t have hydrocoolers that cool product and that product sits in their barns or whatever, around their trucks...And the shelf life of produce is very limited...But with local growers, and I’m talking strictly New England...your shrink on local produce is much higher.”

–Retailer, 01/26/22



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UNVEILING THE CHALLENGES OF FARM VIABILITY IN NEW ENGLAND

A. BRUCE, E. NEIDECKER, C. ZHENG, I. LESLIE AND A. WILHELM

A pressing concern for New England’s food system is the need to enhance local food production and establish resilient regional supply chains amid uncertainties posed by climate change and the COVID-19 pandemic. Achieving these goals hinges on the ability of farmers to increase food production. However, there is a lack of evidence-based understanding regarding the barriers and opportunities for farmers in this context. To address this knowledge gap, a comprehensive study was conducted to explore the strategies employed by New England farmers to make a living and sustain their farm businesses.

Farmers’ Livelihood Strategies

The study conducted in-depth interviews between 2021 and 2022 with 37 New England farmers from diverse backgrounds and agricultural practices. Additional insights were gathered from 26 agricultural service providers and leaders of grassroots organizations closely working with farmers in the region. Employing

KEY TAKEAWAYS

It is financially impossible for most New England farmers to rely on producing food to earn a living.

Revenue from agricultural production contributes a small portion of many farmers’ household income, despite requiring much of their time and labor. The food system incentivizes farmers to rely on non-production strategies, like agritourism, as well as off-farm sources of income, instead of farming full-time.

Many New England farmers define “farm viability” as keeping the farm going from year to year and staying in business, rather than meeting the income needs of the farm family as the USDA defines it.

a Sustainable Livelihoods Framework, various factors influencing farmers' income-generation strategies were integrated into the research, considering both individual circumstances and the broader institutional and market context.

The findings reveal that a range of livelihood strategies are employed by New England farmers, combining resources such as off-farm jobs, agritourism and complementary enterprises supporting their farm businesses. Cooperative efforts and mutual aid also play a crucial role in filling gaps and ensuring sustainability. While a significant amount of time and labor are demanded by agricultural production, it only contributes a small portion to farmers' overall livelihoods. Vital elements supporting New England farmers' endeavors include inherited wealth, land and financial support from loans and grants.



Many New England farmers must rely on agritourism and other methods to keep their operations viable.

Farm Viability

Traditionally, farm viability has been defined by the U.S. Department of Agriculture as meeting the income requirements of the farm family while covering operational costs. However, a different perspective is indicated by the interviews with New England farmers. For most farmers, farm viability is viewed as the ability to keep their operations running from year to year, rather than exclusively relying on the income generated—an important disparity between public interest in local food systems and the financial realities faced by farmers.

“Viability – That would mean...can this thing be kept going? Can it help to pay for itself? Can the time and money required be afforded – with the income from the produce, those things together – can the farm survive?”

–Farmer

“There’s been a lot of buzz around small-scale farms and local foods, sustainability, and it just hasn’t really translated into dollars in [farmers’] pockets. And if it doesn’t translate into dollars in people’s pockets... if it’s just not financially viable, then it’s just not going to work.”

–Farmer

The challenges faced by New England farmers in achieving farm viability and increasing food production are important to recognize. The complexity of the issue is attributed to financial constraints, the diversion of attention from food production and differing definitions of viability. To overcome these challenges, a multi-faceted approach is essential.

Collaborative efforts among stakeholders, policymakers and agricultural organizations are necessary to implement supportive policies, provide resources and foster partnerships, thus creating an enabling environment for farmers. These concerted actions can cultivate a more sustainable and resilient food system, ensuring that farmers can thrive and meet the growing demand for local, high-quality food in New England and beyond.



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COLLEGE STUDENTS WITH DISABILITIES REPORT HIGHER RATES OF FOOD INSECURITY

G. STOTT, A. TAETZSCH AND J. S. MORRELL

New England is one of the least food insecure regions in the United States, with New Hampshire consistently ranking among the most food secure. However, averages can obscure significant variability that can occur among different demographic and socioeconomic groups, such as college students, who experience higher than national average rates of food insecurity. When coupled with other factors that may impair or restrict individuals from accessing food, the adverse impacts of food insecurity are exacerbated. This research aimed to explore the prevalence of food insecurity among college students with disabilities at a northeastern university. While previous studies have separately reported increased risks of food insecurity among college students and individuals with disabilities, the specific intersection of college students with disabilities had not been extensively examined. This study sought to address that gap.

KEY TAKEAWAYS

College students with disabilities are more likely to experience higher rates of food insecurity relative to students without disabilities.

More than one-third of students with disabilities reported food insecurity, with 23.1% experiencing low food security and 12.8% experiencing very low food security.

Among the total sample of college students, 18.8% reported food insecurity, exceeding the national average of 10.2% for all households in the United States.

Defining Disability and Food Insecurity

Disability refers to a condition of the body or mind that makes it more difficult for a person to perform certain activities and interact with the world around them. It includes impairments that can limit a person's ability to participate fully in various aspects of life. In this research, disability encompassed a range of conditions that may affect college students, including physical, cognitive, sensory and mental health disabilities.

Food insecurity refers to the lack of sufficient access to food that is necessary for an active and healthy life. It means that individuals or households do not have enough resources to obtain an adequate amount of nutritious food on a regular basis, which can lead to disruptions in eating patterns and reduced food intake. Food insecurity is a complex issue influenced by various factors, including economic circumstances, access to affordable and nutritious food, and individual or household resources.

Previous Studies on Disabilities and Food Insecurity Among College Students

Previous research has separately highlighted the increased risk of food insecurity among college students and individuals with disabilities. According to past studies, approximately one out of every five college students has been identified as having a disability, encompassing various physical, cognitive, sensory and mental health conditions. College students often face economic hardships, including food insecurity, due to the high costs of education and other expenses. Studies have shown that rates of food insecurity among college students range from 14% to 59%, which exceeds the national average for all households. Additionally, individuals with disabilities have been found to have higher rates of food insecurity compared to those without disabilities. Research indicates that young adults with disabilities are more likely to experience food insecurity in their households compared to their peers without disabilities.



UNH's Food Repurposing Project — a collaborative effort among COLSA, UNH Hospitality Services and the Gather food bank — takes unused food from UNH dining halls and distributes to those in the community in need.

Methodology

The study employed a cross-sectional research design and collected data between 2018 and 2020 at a public northeastern university. The data were part of the ongoing College Health and Nutrition Assessment Survey, which is intended to assess the multiple dimensions of college students' well-being, including food security and disability status. The researchers used an online survey to gather self-reported disability and food security information from a diverse sample of 880 participants. The sample consisted of college students, with a majority being female (61.6%) and white (94.5%), with an average age of 19 years. Among the participants, 13.3% reported having a disability. Chi-square and logistic regression analyses were employed to examine the differences in food insecurity between college students with and without disabilities.

Key Findings and Significance

The study found that approximately one out of every five participants reported low or very low food security, indicating inadequate access to food resources. Participants with disabilities were more than twice as likely to experience food insecurity compared to those without disabilities. This disparity highlights the vulnerability of college students with disabilities and emphasizes the need for targeted support and resources to address their unique challenges. By understanding the prevalence of food insecurity in this population, institutions can work towards creating a more inclusive and supportive environment for all students to thrive academically and personally.



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EXAMINING THE LINK BETWEEN SLEEP AND METABOLIC HEALTH IN EMERGING ADULTS

B. A. CHAUDHRY, M. S. BRIAN AND J. S. MORRELL

For many, the emerging adult (ages 18–24) life stage is transformational. Young adults might for the first time live away from their family, assume and begin to balance more personal and professional responsibilities, and start establishing lifestyle habits that can impact them not only as emerging adults but for future years to come. Given the critical nature of this period in young people’s lives, researchers sought to investigate the importance of sleep as a lifestyle factor during this crucial time.

An “Emerging Adult”

The term “emerging adult” refers to individuals who are in the transitional period between adolescence and full adulthood, typically ranging from 18 to 24 years of age. During this stage, young people often experience significant changes as they leave their family homes, pursue higher education or start their careers. This period is essential for personal growth and development, and the lifestyle habits established during this time can have long-lasting effects on their overall health and well-being.

KEY TAKEAWAYS

Short sleep duration (less than 7 hours per day) is associated with higher metabolic syndrome severity scores in emerging adults, increasing their risk for cardiovascular disease and diabetes.

Long sleep duration (more than 9 hours per day) also has adverse outcomes on metabolic syndrome severity.

Improving sleep habits could be an important lifestyle modification to consider in interventions aimed at reducing future chronic disease risk in young adults.

Understanding Metabolic Health

Metabolic health refers to the state of an individual's metabolism, which involves a complex set of processes that regulate energy production and utilization in the body. A person's metabolic health is influenced by various factors, including diet, physical activity, genetics and sleep patterns. Good metabolic health is characterized by a balanced metabolism, normal blood sugar levels, healthy blood pressure and appropriate cholesterol levels. Metabolic dysfunction can lead to conditions like metabolic syndrome, which is a cluster of risk factors associated with an increased risk of heart disease, stroke and type 2 diabetes.



A UNH nutrition graduate student gathers data for the College Health and Nutrition Assessment Survey.

Methodology

The researchers used data from the College Health and Nutrition Assessment Survey, which is an ongoing cross-sectional study conducted at a mid-sized northeastern university. The study period spanned 2012 to 2021. Participants in the study provided anthropometric measurements—height, weight, waist circumference and blood pressure—that helped to evaluate participants' self-reported health and obesity-related risk factors.



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To assess metabolic health, blood samples were analyzed to measure fasting blood glucose levels and lipid profiles, including cholesterol and triglycerides. These measurements provided valuable insights into participants' metabolic status and allowed the researchers to calculate the Metabolic Syndrome Severity Score (MSSS). The MSSS is a reliable indicator of metabolic syndrome severity, as it considers multiple risk factors simultaneously; higher scores indicate a greater risk of developing metabolic dysfunction and related health issues.

To determine sleep duration, participants self-reported their average daily sleep duration, bedtime, and wake-up time through an online survey. Self-reporting allowed for efficient data collection while still providing a reasonably accurate representation of participants' sleep habits. Additionally, the researchers collected information on potential confounding variables—such as physical activity levels, dietary patterns, and alcohol and tobacco use—to account for their potential impact on metabolic health.

Key Findings and Significance

The study's results revealed that both short sleep duration (less than 7 hours per day) and long sleep duration (more than 9 hours per day) were associated with higher metabolic severity scores among emerging adults. This suggests that both insufficient and excess sleep could be linked to an increased risk of metabolic problems during this critical life stage.

The findings from this study emphasize the significance of healthy sleep habits during the emerging adult life stage. Proper sleep duration plays a vital role in maintaining metabolic health and reducing the risk of metabolic syndrome. As young adults begin establishing lifestyle habits during this transformative period, incorporating sufficient and consistent sleep into their routines can positively impact their future health outcomes.

Furthermore, these results underscore the importance of considering sleep as a critical factor in public health initiatives aimed at promoting overall well-being and reducing the risk of cardiometabolic diseases in the emerging adult population. Future research in this area can provide insights into how optimizing sleep habits can contribute to better metabolic health and long-term wellness in young adults.



ASSOCIATIONS BETWEEN DIET QUALITY AND CHRONIC DISEASE RISK IN BHUTANESE REFUGEE ADULTS IN NEW HAMPSHIRE

D. MOORE AND S. BIGORNIA

Bhutanese refugees are one of the fastest-growing populations in the U.S., with approximately 100,000 ethnically Nepali Bhutanese displaced from Bhutan during the early 1990s. Around 80,000 Bhutanese refugees have resettled in the United States since 2008. In New Hampshire, Bhutanese refugees comprise one of the largest refugee populations in the state. These refugees, like many South Asian immigrants, face higher-than-average rates of chronic diseases, including cardiovascular disease and type 2 diabetes, compared to other racial/ethnic groups. The objective of this pilot study was to evaluate the potential benefits of SNAP-Education on the dietary quality and risk of chronic diseases among Bhutanese refugee adults residing in the Granite State. The ultimate aim is to enhance their overall health outcomes by implementing culturally tailored interventions.

KEY TAKEAWAYS

As currently structured, the SNAP-Education program, which provides nutrition education to resource-limited people, did not significantly improve the dietary quality or cardiometabolic risk profiles of Bhutanese refugee adults.

Bhutanese refugee adults who consumed more fruits and whole grains showed better inflammatory and lipid profiles.

Cultural tailoring of SNAP-Education interventions to emphasize fruits and a balance of whole and refined grains may be more effective in improving the health of Bhutanese refugee adults compared to general dietary recommendations.

What Is the SNAP-Ed Program?

The SNAP-Ed program focuses on providing nutrition education and assistance to low-income individuals and families to promote healthier dietary habits. In this study, Bhutanese refugee adults in New Hampshire were randomly assigned to either receive no SNAP-Ed intervention (control group) or participate in a 7-week program with six in-home nutrition lessons (Fig. 1). The lessons covered topics such as healthy eating using MyPlate, understanding nutrition labels, portion sizes, food safety handling, choosing more fruits and vegetables and making smart drink choices. These lessons align with the U.S. Dietary Guidelines and enhance dietary quality among participants.

Methodology

In partnership with Building Community in New Hampshire (BCNH), a non-profit organization supporting refugee communities, the researchers enlisted Bhutanese refugee adults residing in New

Hampshire. Through random assignment, participants were divided into two groups: the control group receiving no SNAP-Ed programming and the SNAP-Ed study group, which underwent a series of 6 SNAP-Ed lessons delivered in their homes. The investigators wanted to test the efficacy of SNAP-Ed as currently being delivered to Bhutanese refugee adults. These lessons were based on North Carolina’s Families Eating Smart and Moving More curriculum.

Data collection occurred at the beginning of the study and after 6–7 weeks. Three 24-hour dietary recalls and fasting blood samples were obtained to assess cardiometabolic risk factors like insulin resistance, dyslipidemia and inflammation. Additionally, participants receiving SNAP-Ed programming completed a brief evaluation survey, providing valuable feedback on the program’s effectiveness.

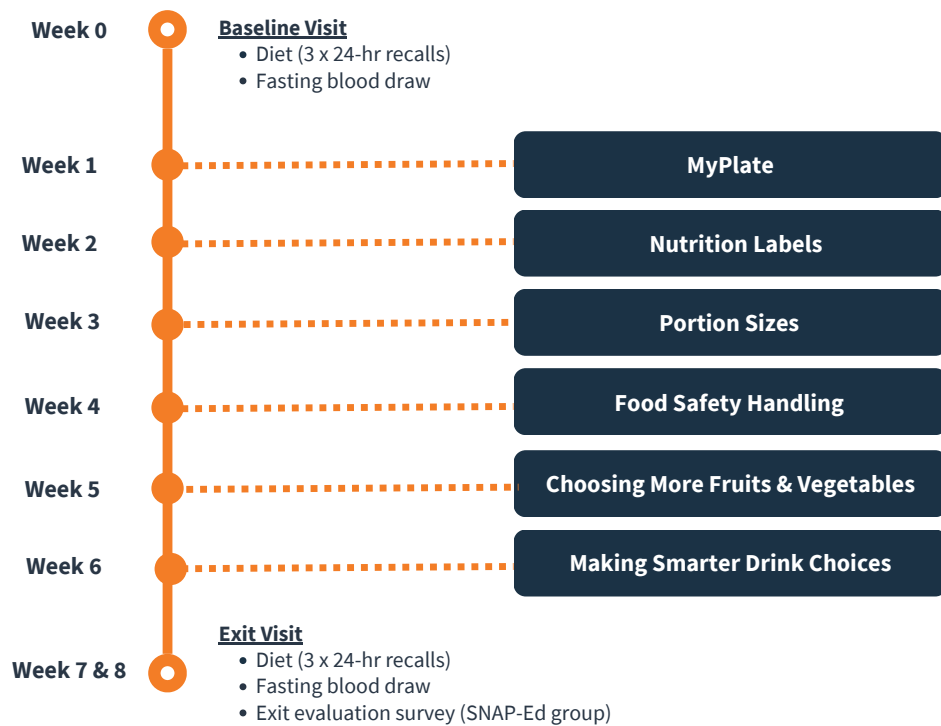
All interactions, including recruitment, consent, study visits and nutrition education, were conducted in Nepali by a community health worker who shared

the same Bhutanese refugee background as the participants. The curriculum was translated to the native language, Nepali, and some food images in lessons were replaced with traditional dishes, but no cultural tailoring was otherwise done. For analysis, the researchers utilized the Healthy Eating Index to evaluate dietary quality, with higher scores indicating better adherence to U.S. Dietary Guidelines.

Key Findings and Significance

The study observed that despite a high level of participant satisfaction with the SNAP-Ed program, there was no significant improvement in dietary quality or cardiometabolic risk profiles among Bhutanese refugee adults in New Hampshire (Fig. 2). Notably, the Making Smart Drink Choices lesson received the least favorable response, possibly attributed to the fact that most participants were already meeting the guidelines for added sugar intake. Additionally, while more than 90% of participants met the recommended levels for

Figure 1. Study design for understanding whether SNAP-Ed, as currently implemented, could improve dietary quality and biomarkers of risk in the short-term.





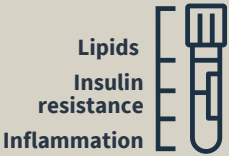




Note: The six nutritional lessons were translated to Nepali and delivered to study participants by bicultural and bilingual community health workers. Lesson information was provided one-on-one and in the homes of study participants.

vegetable and saturated fat consumption, less than 13% adhered to guidelines for fruits, whole grains and refined grains. Observational analyses revealed that individuals who consumed more fruits and whole grains demonstrated better inflammatory and lipid profiles, respectively.

The findings suggest that the current implementation of SNAP-Ed may not be effective in improving the dietary habits and cardiometabolic health of Bhutanese refugees in New Hampshire. They also underscore the potential benefits of cultural tailoring in enhancing the program’s impact. By focusing on promoting fruit consumption and striking the right balance between whole and refined grain intake, tailored interventions may hold the key to improving the health outcomes of this population. Understanding the specific dietary aspects that require attention, especially those where current guidelines are not being met, can aid in developing more targeted and effective interventions.

These results shed light on the challenges and opportunities in addressing the unique health characteristics and dietary behaviors of the Bhutanese refugee population. By highlighting the potential benefits of cultural tailoring, the study contributes valuable insights for future interventions aimed at improving the health and well-being of this vulnerable community. Moreover, the research emphasizes the need for ongoing evaluation and refinement of nutrition education programs like SNAP-Ed to ensure they are impactful and relevant to the diverse needs of different populations. Ultimately, this study serves as a steppingstone toward fostering better health outcomes and promoting health equity among Bhutanese refugees in New Hampshire and potentially other similar communities.

Figure 2. Study findings support that SNAP-Ed, as currently implemented, may not improve dietary quality and biomarkers of risk in the short-term.

| Experimental Analyses (SNAP-Ed vs. Control) | Observational Analyses | Exit Questionnaire |
|--|---|---|
|     |  ↑ Fruits ↓ Lipids  ↑ Whole grains ↓ Inflammation  ↑ Sea & plant protein ↓ Glucose | <p>97% satisfied with education</p> <p>96% would recommend to a friend</p> <p>Least satisfied with Making Smart Drink Choices lesson</p> |



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CHARACTERIZATION OF THE GUT MICROBIOME OF BHUTANESE REFUGEE ADULTS IN NEW HAMPSHIRE

B. MOSER AND M. C. DAO

The microbiota-gut-brain axis is thought to be a key component in the development and persistence of chronic diseases, such as type 2 diabetes (T2D). However, its relationship to inflammation and appetite regulation in the context of chronic diseases is yet to be fully understood. Further, microbiome composition is highly population-specific, as it is influenced by a multitude of factors including demographics, migration, and dietary patterns. This study aimed to better measure and understand the gut microbiome in relation to inflammation and appetite signaling in T2D in a population largely under-represented in microbiome research.

Study Background and Design

Bhutanese refugees were the second-largest refugee group in New Hampshire in 2019. Previous research (see pg. 18) investigated the impact of SNAP-Ed nutrition curriculum and education on the health and quality of diet among the Bhutanese

KEY TAKEAWAYS

Gastrointestinal tract microbes offer insights about the intersections of glycemic control, inflammation and appetite regulation in chronic diseases like type 2 diabetes (T2D).

The number of different types of microbes and how evenly they are distributed were found to be reduced in individuals with T2D.

refugee population in New Hampshire by collecting demographic, health and dietary data on participants along with biological samples.

Using these data, this study focused on a sample size of 50 Bhutanese refugee adults in New Hampshire. Of that sample, 42% had T2D and 92% were characterized as being overweight or obese—highlighting a substantial chronic disease burden in this population.

Microbiome and Immunoassay Methods

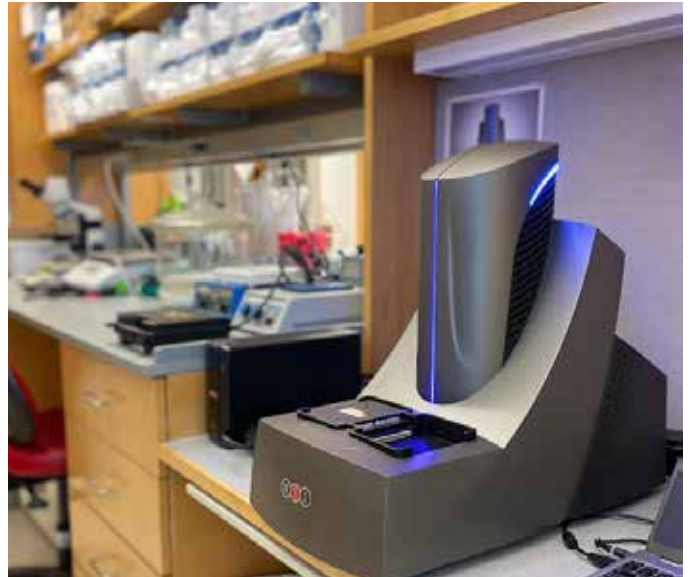
Shallow shotgun sequences on all participants for the microbiome analysis were used, conducted with established bioinformatics pipelines for metagenomic analyses to generate measures of taxonomic abundance, richness and diversity. The inclusion of appetite-regulating hormones provided a novel component in exploring the gut microbiome and T2D. Both appetite hormones and inflammatory markers were measured using an immunoassay that harnesses chemiluminescence technology and identifies biomarker concentrations across broad concentration ranges with high specificity.



Graduate student researcher Brandy Moser pipettes plasma samples onto an assay plate in an immunoassay to quantify levels of inflammatory and satiety markers.

Microbiome-related Inflammation Associated with Glycemic Regulation

Lipopolysaccharide binding protein (LBP) is a human protein that binds with lipopolysaccharide (LPS), a component of the gram-negative bacteria cell wall, once LPS crosses the intestinal barrier and activates the immune system. Thus, LBP is considered a marker



Mesoscale discovery plate reader in the Dao Research Lab. This electrochemiluminescence technology harnesses the ability to measure light to detect levels of biomarkers in human plasma samples through an immunoassay.

of intestinal permeability and increased levels are indicative of chronic inflammation. The occurrence of this phenomenon in the context of chronic disease has been termed metabolic endotoxemia. Researchers found that LBP concentration was positively correlated with glycemic impairment.

Microbiome Richness and Diversity Reduced in Individuals with Type 2 Diabetes

The gut microbiome can be characterized with various methods and metrics. The relative abundance of taxonomic groups provides insight into the community structure of the gut microbiome and can be visualized by organizing individuals based on their similarities (**Fig. 1**). Richness of the microbiome is a measure to quantify the unique number of species present, while diversity measures encompass both the unique number of species and their distribution.

This study identified lower richness and diversity in those with T2D compared to those without. Although

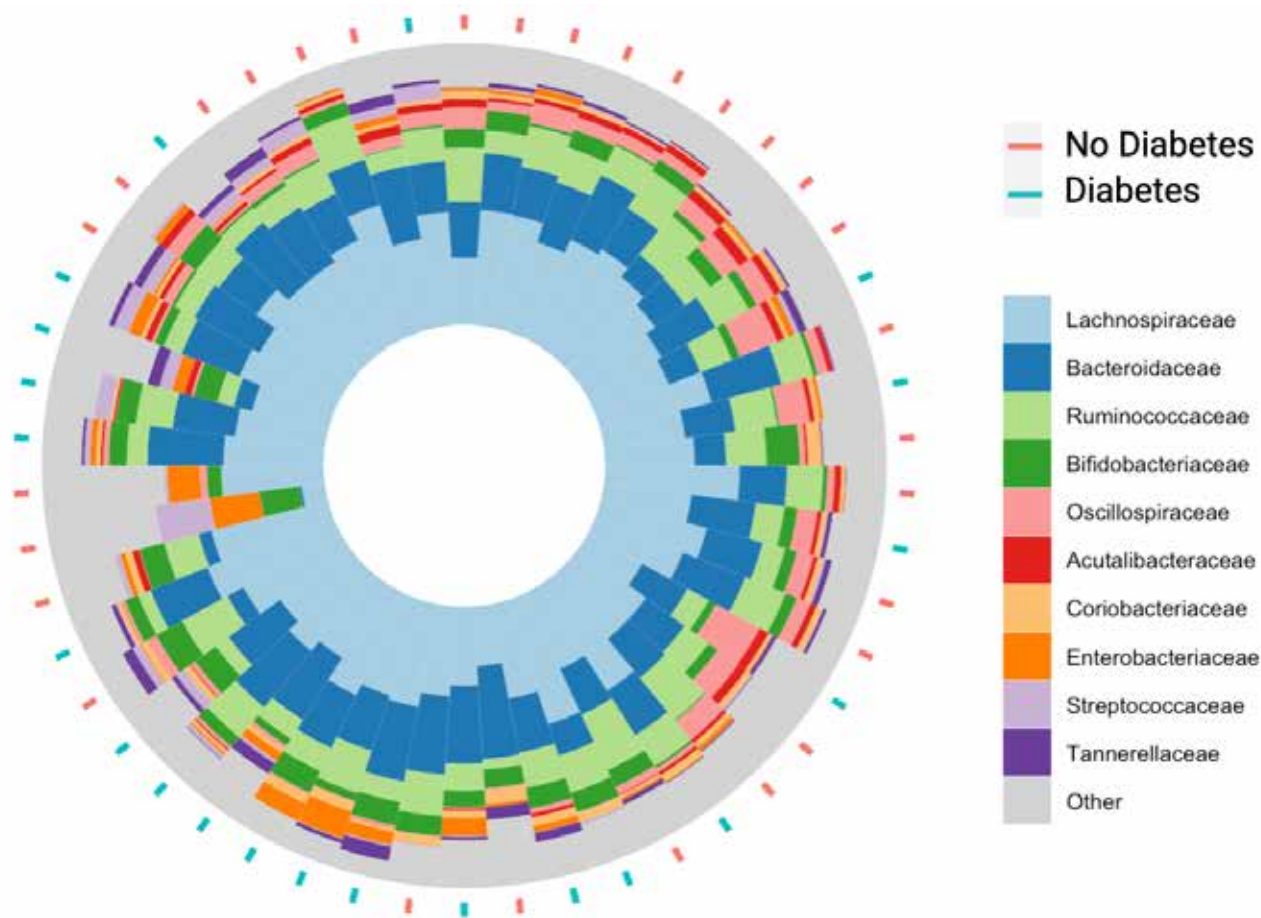
a reduction in richness and diversity has often been observed in those with obesity, findings according to T2D status have been inconsistent.

Conclusions

This study was the first characterization of the gut microbiome in Bhutanese refugee adults in New Hampshire. It aimed to explore the microbiota-gut-

brain axis, specifically inflammatory and appetite regulating pathways in the context of T2D and compositional characteristics of the gut microbiome. Microbiome-related inflammation and a reduction of species richness and diversity were linked to glycemic impairment in this sample. Participant recruitment and sample collection for this study were conducted by Sherman Bigornia.

Figure 1. Family level taxonomic characterization of the gut microbiome of each study participant.



Note: The red and blue dashes indicate which individuals had type 2 diabetes and those that did not. The order of arrangement represents similarities in microbial composition (unpublished results).



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MODEST POPULATION GAINS BUT GROWING DIVERSITY IN GRANITE STATE WITH CHILDREN IN THE VANGUARD

K. JOHNSON

The minority population of New Hampshire increased substantially over the past decade, and the growth of the state's minority child population suggests the state will become even more diverse in the next decade. In all, New Hampshire's population grew by a modest 4.6% during the past decade to 1,377,500 in April 2020. However, the number of minority residents, defined as those who were other than non-Hispanic Whites, increased by 74.4% to 176,900 in 2020.

Minorities Represent a Growing Population

Minority residents now represent 12.8% of the state's population compared to 7.5% (101,400) in 2010. Though the minority population grew, a substantial majority of the state's population remains non-Hispanic White. In all, 87.2% of state residents (1,200,600) reported to the Census Bureau that they were White alone, and not of Hispanic origin in the 2020 Census. This is 14,400 fewer than in 2010. New Hampshire's population became more diverse because the minority population grew, while the non-Hispanic White population did not. Though racial-ethnic diversity is

KEY TAKEAWAYS

Racial diversity increased in New Hampshire over the past decade from 7.5% to 12.8%.

While New Hampshire's population grew overall, the growth was attributed to increases in non-White populations and decreases in White populations.

New Hampshire's child population leads the state's growing diversity with more than 20% of the state's under age 18 population belonging to a minority group in 2020.

increasing in New Hampshire, it remains significantly less diverse than the nation, which is 42.2% minority. Only three states have a less diverse population than New Hampshire—Vermont, Maine and West Virginia.

Hispanics are the largest minority population in New Hampshire with 59,500 residents, or 4.3% of the population. The non-Hispanic Asian population is 35,600 (2.6%), and non-Hispanic Blacks number 18,700 (1.4%). These groups each had significant population gains between 2010 and 2020. The largest population gain was among multiracial non-Hispanic residents, who at 54,600, now represent 4% of the state. The population reporting that they were Native American or of “some other race” also increased; together, these two groups now represent 0.6% of the state’s population.

Children in the Forefront of Growing Diversity in Granite State

Children are leading New Hampshire’s growing diversity. In all, 20.2% of New Hampshire’s under age 18 population belonged to a minority group in 2020, with Hispanics, Asians and those of two or more races representing the largest shares (**Fig. 1, right**). The greater diversity among children is the result of two diverging trends. The minority child population grew by 16,800 (47.9%) between 2010 and 2020.

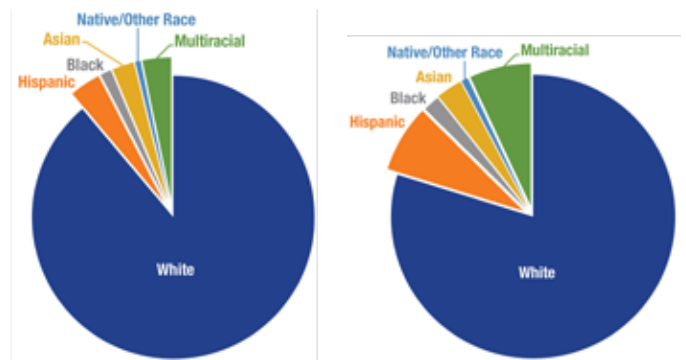
In contrast, the non-Hispanic White child population declined by 47,200 (18.7%). Because the minority youth gain was not sufficient to offset the non-Hispanic White loss, New Hampshire’s child population declined by 30,400 (10.6%). By comparison, the proportion of the minority adult population is considerably smaller than New Hampshire children, at 11.1% in 2020 (**Fig. 1, left**).

Racial-ethnic diversity is geographically uneven in New Hampshire, with the most diverse populations concentrated in the Manchester–Nashua urban corridor, the Hanover–Lebanon region and in a few areas on the Seacoast. This pattern is especially evident among children. For example, Manchester and Nashua are among the most diverse places in the state. The adult population in Manchester is 22.0% minority, and it is

25.9% minority in Nashua—both well above the state total of 11.1%. Among children, 43.1% of the children in Manchester and 45.4% of those in Nashua are minority.

New Hampshire’s growing racial-ethnic diversity, especially among those under the age of 18, means that youth-centered institutions, such as schools and health care providers, have been the first to serve a diverse population. The growing diversity of the state’s youngest residents gives them a greater opportunity to grow up in multiracial and multiethnic communities that will enhance interracial relations, widen friendship networks and prepare them for life in an increasingly diverse state and nation.

Figure 1. Left: New Hampshire Adults (18 and over) by Race and Hispanic Origin, 2020. Right: New Hampshire Children (Under 18) by Race and Hispanic Origin, 2020.



Note: “Native/Other Race” category includes individuals who report native origins as well as those who report “some other race.”

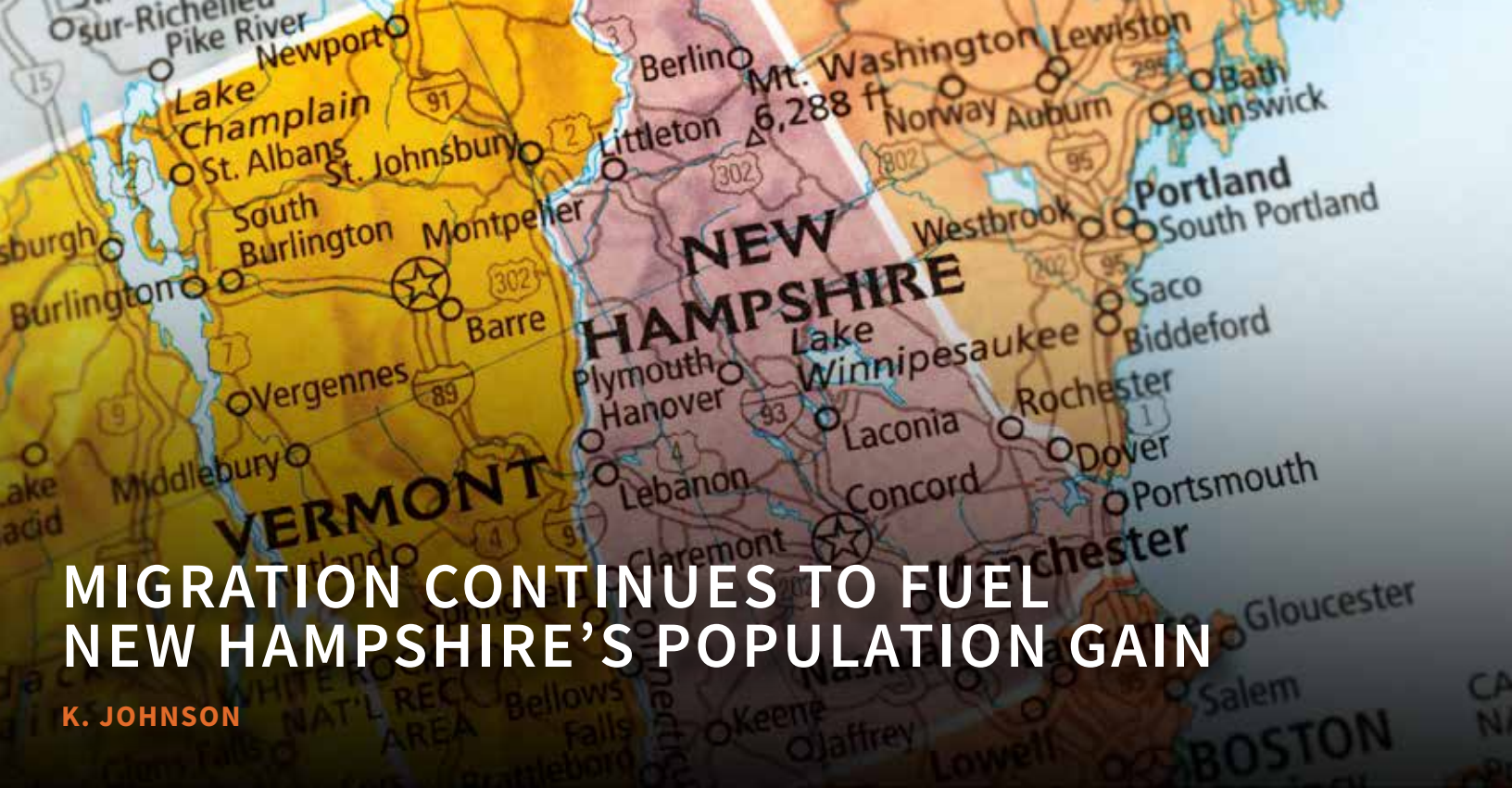
Methods and Data

Data are from the 2020 and 2010 Decennial Census. Race and Hispanic origin are defined separately in the Census and self-reported by respondents. In this study, the population is divided into Hispanic of any race; non-Hispanic White Alone; non-Hispanic Black Alone; non-Hispanic Asian Alone; non-Hispanic Native Peoples or those of Some Other Race Alone; and non-Hispanic of Two or More Races (multiracial). Changes in Census Bureau procedures made it challenging to make direct comparisons between the racial categories in the 2010 Census and 2020 Census. Moreover, concerns about the quality of the 2020 Census and the impact of the Census Bureau’s Differential Privacy algorithms on the accuracy of the 2020 Census remain unresolved at this time.



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MIGRATION CONTINUES TO FUEL NEW HAMPSHIRE'S POPULATION GAIN

K. JOHNSON

Migrants and immigrants played key roles in the growth of New Hampshire's population, according to data tracked from the start of COVID-19 (April 2020, when the latest Census was conducted) through July 2022. During that time, the Granite State's population increased by 17,700 (1.3%) to 1,395,000 residents. New Hampshire's population gain was also the second largest in New England and entirely due to migration.

New Hampshire's entire population gain accrued because 21,600 more people moved to the state than left it in April 2020–July 2022. Most of these migrants came from within the United States, but the state also received a significant number of immigrants. This migration gain was large enough to offset a natural loss of 4,100 people when deaths exceeded births in New Hampshire between April 2020–July 2022.

In April 2020–July 2022, each of the Granite State's 10 counties gained migrants (**Fig. 1**). In contrast, only 52% of the nation's counties gained population during the same period. Such widespread population gains are surprising given that deaths exceeded births in nine of

KEY TAKEAWAYS

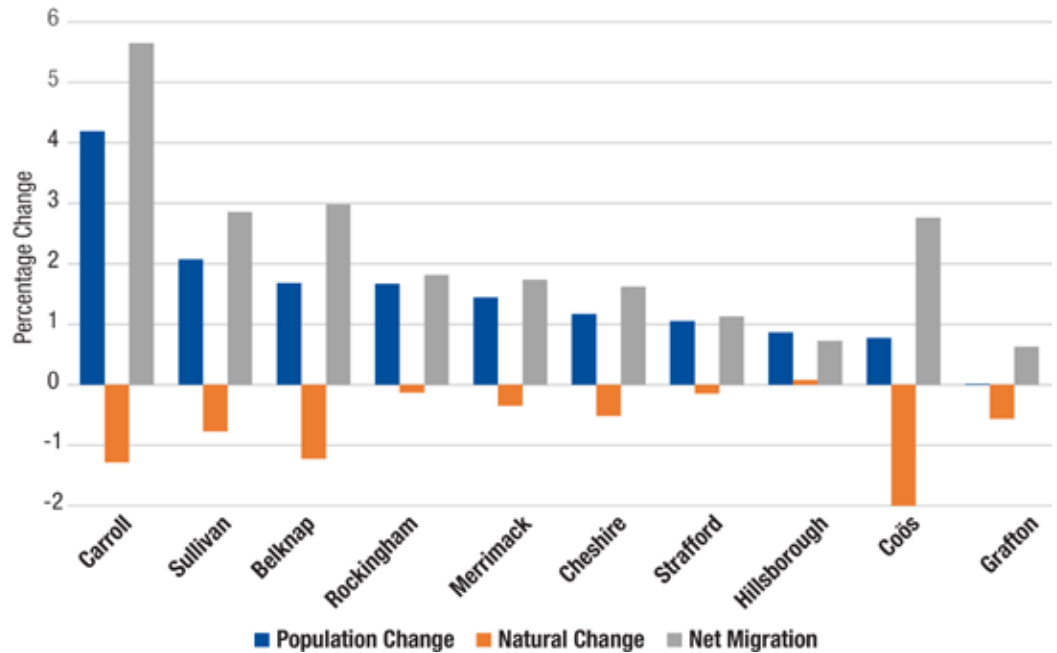
Census data suggest all New Hampshire counties gained population since the 2020 Census, despite deaths exceeding births in nine of the 10 counties.

From 2018 to 2022, New Hampshire's population gain based on annual population percentage change was the second largest in New England, behind only Maine.

New Hampshire migration gains resulted from attracting migrants from within the United States and significant immigration growth.

New Hampshire’s 10 counties, resulting in 4,100 more deaths than births statewide. Only Hillsborough County had slightly more births than deaths (0.1%) over the 27-month period. COVID certainly contributed to this loss, but annual deaths already exceeded births in the state before the pandemic. Carroll County—which has long attracted recreational and amenity migrants, including many from large urban areas—saw the largest migration gain of 5.7%.

Figure 1. Demographic Change in New Hampshire Counties, 2020 to 2022



Note: This analysis is based on population estimates and should be interpreted with caution.

In July 2021–July 2022, four New England states had more deaths than births. Only Connecticut and Massachusetts had more births than deaths. Connecticut grew from this excess of births over deaths and from a migration gain. Maine, New Hampshire and Vermont gained population because they had a large enough influx of migrants to offset the excess of deaths over births. In contrast, Rhode Island lost population both because it had more deaths than births and because it lost migrants. Massachusetts also lost population even though it had more births than deaths, because more people left the state than moved to it. Overall, New England’s population gain in July 2021–July 2022 was only 0.06% compared to a U.S. gain of 0.38%. Both these population gains are low compared to historical trends.

well as the need to retain residents with employment opportunities, affordable housing and childcare, and support programs.

Methods and Data

This analysis is based on population estimates released in March 2023. Readers should recognize that although the Bureau uses the best data and algorithms available at the time of release to generate the data, they remain estimates. Census Bureau estimates of natural change (births minus deaths), population, and migration are made using independent models, so they do not always sum to the total estimated population change. The difference is reported as a residual in Census Bureau databases, but not included here.

These recent data underscore the continuing importance of migration to New Hampshire’s future, as



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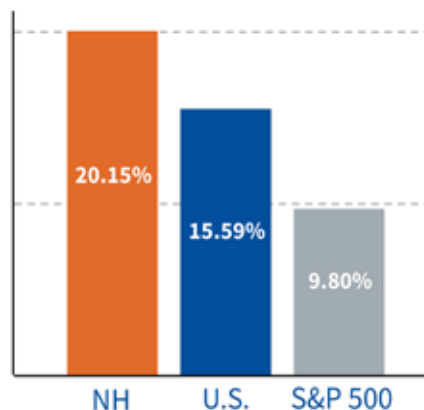
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| | |
|-----------|---|
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Annual Rate of Return on Agricultural R&D Investment



Source: Data from Plastina (2012), "Rates of return to public agricultural research in 48 states."

\$23.8 million

in competitive federal, state, and industry grants awarded to Station scientists to further support locally important research.

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FOR FURTHER READING

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Modest Population Gains but Growing Diversity in Granite State With Children in the Vanguard

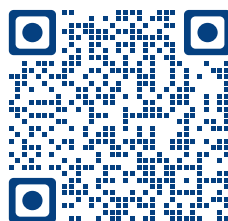
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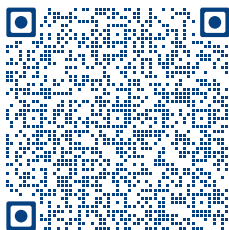




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