Establishment of the USDA/ARS Children’s Nutrition Research Center at Baylor College of Medicine and Texas Children’s Hospital in 19781–3

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Abstract
The Children’s Nutrition Research Center (CNRC) is a unique cooperative venture among Baylor College of Medicine, Texas Children’s Hospital, and the USDA/Agricultural Research Service. The CNRC is dedicated to defining the nutrient needs of children, from conception through adolescence, and the needs of pregnant women and nursing mothers. Scientific data from the Center enable healthcare providers and policy advisors to make dietary recommendations that improve the health of today’s children and that of generations to come. CNRC research has already impacted feeding guidelines for normal U.S. children and all children of the world. J. Nutr. 139: 188–191, 2009.

“By mutual confidence and mutual aid,
Great deeds are done, and great discoveries made;
The wise new prudence from the wise acquire,
And one brave hero fans another’s fire.”

Introduction
After completing my Pediatric Residency at Yale, I was recruited to join the Pediatrics Department at Baylor College of Medicine (BCM)4 in 1964 with the understanding that as Associate Director of the NIH General Clinical Research Center, I could do research in nutrition and gastroenterology and direct the house staff at Texas Children’s Hospital. My primary BCM research was with malnourished infants with persistent diarrhea and clinical carbohydrate intolerance. The development of total parenteral nutrition in 1969 proved to be life saving for these infants suffering from secondary malnutrition as a result of severe mucosal damage and persistent diarrhea. This clinical success with total parenteral nutrition led to the establishment of the Section of Pediatric Gastroenterology and Nutrition on January 1, 1970. The Clinical Gastroenterology and Nutrition Section is presently 1 of the top 4 in the United States according to US News and World Report. Between 1968 and 1971, NIH grant funding was secured for clinical research on altered energy metabolism and body potassium in infants with primary malnutrition living in Jamaica, Mexico, and Guatemala. These international investigations allowed collaboration with some of the leading human nutrition scientists of the day: John Waterlow, Sylvestre Frenk, and Fernando Viteri. I also had an NIH training grant for Clinical Fellows in Pediatric Gastroenterology and Nutrition. In 1971 these NIH resources became unavailable, and I began to examine alternative concepts for nutrition research and training support.

Founding of the Children’s Nutrition Research Center
The legal authorization for establishing the Children’s Nutrition Research Center (CNRC) was Senate Report 35, which was published on September 12, 1963. This report prepared by the USDA Agriculture Research Service (ARS) was entitled “Proposed Plan for Expanded Research in Food and Nutrition.” It reviewed the previous 70 y of human nutrition research in the USDA and recommended expansion of human nutrition research by construction and funding of 3 regional laboratories. Senate Report 35 was brought to my attention by Dr. Harold Sandstead in 1973, and as a consequence; a proposal was prepared and submitted to the Agriculture Rural Development and Related Agencies Subcommittee of the House Appropriations Committee in 1974.

1 Published as a supplement to The Journal of Nutrition. Presented as part of the symposium “History of Nutrition: Legacy of Wilbur O. Atwater: Human Nutrition Research Expansion in USDA” given at the 2007 Experimental Biology meeting on April 30, 2007, in Washington, DC. The symposium was sponsored by the American Society for Nutrition. The symposium was chaired by Jackie Dupont.
2 Funded by USDA/ARS through a series of cooperative agreements with BCM.
3 Author disclosure: B. L. Nichols, no conflicts of interest.
4 Abbreviations used: ARS, Agriculture Research Service; BCM, Baylor College of Medicine; CNRC, Children’s Nutrition Research Center; IOM, Institute of Medicine; RDI, recommended dietary intakes; TEE, total energy expenditure; UNU, United Nations University.
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Committee in 1974. The application, sponsored by Rep. Bob Casey (D-TX), was based on the proposition that the scientific support for nutritional recommendations for infants and children needed to be strengthened and expanded. The focus was on normal children from conception to adolescence and mothers during pregnancy and lactation. Noninvasive approaches were envisioned, which included body composition, calorimetry, and stable isotope measurements. This initial application was unsuccessful.

We began another cycle of application, sponsored by Rep. Bob Gammage (D-TX), in 1976, which was administratively supported by Dean Joseph Merrill at BCM and Board Member George Bellows at Texas Children’s Hospital. This time, the House Agriculture and Related Agencies Subcommittee of the Appropriations Committee, chaired by Jamie Whitten (D-MS), requested a feasibility study. Dr. Jack Iacono, from the ARS National Program Staff, organized a site visit by ARS and external nutritional scientists, including Dr. Harold Sandstead, which was held on January 27, 1977. The site visit report was submitted to the House Agriculture and Related Agencies Subcommittee. On March 16, 1977, I had a telephone call from Dr. Jean Mayer, President of Tufts University, informing me that Tufts was seeking to establish a Human Nutrition Laboratory on Aging and that appropriate enabling language had been added to the 1977 Farm Bill. In 1977 the House marked up appropriations for both BCM and Tufts centers, but the Senate Agriculture Subcommittee only included Tufts. This time the Senate leadership was from Rep. Jack Hightower (D-TX) and Rep. Bill Archer (R-TX). Leadership was from Senator Lloyd Bentsen (D-TX) in the Senate. On February 21, 1978, I appeared before the McGovern Senate Select Committee on Nutrition, where I reported on the legal authorizations for our request and our proposed program objectives. I was introduced by Rep. Bob Gammage. In 1978 the House Agriculture Subcommittee again marked up funds for the Tufts and BCM Centers, but the Senate did not. I was present on September 15, 1978, when the House/Senate Agriculture Appropriations Subcommittee only included Tufts. This turn of events lead to a rallying of support by the full Texas Congressional Delegation in the House and Senate in 1978. In the House, leadership was from Rep. Jack Hightower (D-TX) and Rep. Bill Archer (R-TX), Leadership was from Senator Lloyd Bentsen (D-TX) in the Senate. On February 21, 1978, I appeared before the McGovern Senate Select Committee on Nutrition, where I reported on the legal authorizations for our request and our proposed program objectives. I was introduced by Rep. Bob Gammage. In 1978 the House Agriculture Subcommittee again marked up funds for the Tufts and BCM Centers, but the Senate did not. I was present on September 15, 1978, when the House/Senate Agriculture Appropriations Conference Committee met and accepted the House recommendations. The Dean of the Texas Delegation, Chairman of House Appropriations George Mahon (D-TX), walked over to the gallery and reported “Well Doc, you got your center.” The conferences directed that the centers maintain close cooperation with NIH. Creation of the USDA/ARS CNRC at BCM and Texas Children’s Hospital was announced on November 2, 1978, by Senator Lloyd Bentsen. Dr. Jack Iacono from ARS attended and reported that the House Agriculture Subcommittee had deferred >40 competing requests to establish human nutrition centers at other institutions for his review. The CNRC programs began in temporary facilities. Increased 1979 appropriations allowed establishment of a Stable Isotope Laboratory.

On July 27, 1984, in response to leadership by Rep. Jack Hightower and Rep. Bill Archer with Speaker Jim Wright (D-TX), the House Agriculture Rural Development and Related Agencies Subcommittee marked up funds for the construction of a facility for the CNRC. The facility was to be used for research on the nutrient needs and nutritional status of mothers, infants, and children. The Committee justified this appropriation “based upon proximity to Baylor College of Medicine and Texas Children’s Hospital,” noting that “these institutions had conducted nutrition research for the past 20 y and will provide ready access to newborn and maternity care and to pregnant and lactating women and their unbore and newly born children.” The Agriculture Appropriations Conference Committee approved this recommendation in Public Law 98–396 on August 22, 1984. On April 13, 1985, ground breaking occurred on a 1-acre site adjacent to Texas Children’s Hospital. The Assistant Secretary of Science and Education of USDA, Orville G. Bentley, announced the $49 million appropriation for constructing and equipping the CNRC building. He reported that the CNRC is already employing some of the most advanced research methods of their kind in the world, with emphasis on determining protein and energy requirements of women for pregnancy and lactation and of infants and children for growth and development. Safe, non-radioactive isotopes are being used as tracers of individual nutrients to determine their absorption and utilization.

The completed facility for the CNRC, which was clad in Texas granite to recognize the universal endorsement of the Texas Congressional Delegation, was dedicated October 7, 1988. Chairman of the House Agriculture Committee, “Kika” de la Garza (D-TX), was the keynote speaker. He envisioned “the impact of the important research contributions of the CNRC to USDA programs for child nutrition” and expanded his view of the Center’s remit to include “all children of the world.”

A Cooperative Agreement between BCM and ARS that formalized the CNRC management system was signed on October 1, 1985. This stated that the mission of the CNRC is “to conduct research that will lead to a definition of the nutritional requirements needed to assure health in children from conception through adolescence, and in pregnant and lactating women.” The agreement 58–7MN1–6–100 has been renewed every 5 y maintaining the same mission statement.

In contrast to the investigator-initiated research management system of NIH and National Science Foundation, ARS research is oriented toward solution of problems of importance to U.S. agriculture, nutrition, and health policies. The USDA/ARS Human Nutrition (NP107) Action Plan 2009–2013 Goals for nutrition are described below along with key CNRC performance measures (1).

To visualize progress toward ARS goals, performance measures have been established as follows (1).

**Performance Measure 5.2.1.**

Monitor food consumption/intake patterns of Americans, including those of different ages, ethnicity, regions, and income levels, and measure nutrients and other beneficial components in the food supply. Provide the information in databases to enable ARS customers to evaluate the healthfulness of the American food supply and the nutrient content of the American diet.

CNRC scientists have focused on the dietary intakes of infants, children, and mothers as highlighted above and as described below.

**Performance Measure 5.2.2.**

Define the role of nutrients, foods, and dietary patterns in growth, maintenance of health, and prevention of obesity and other chronic diseases. Assess bioavailability and health benefits of food components. Conduct research that forms the basis for and evaluates nutrition standards and Federal dietary recommendations.

CNRC scientists have focused on the role of food intakes of infants, children, and mothers on growth and health as highlighted above and as described below.
The following specific performance measures have made a profound impact on U.S. and international nutrition policies and recommendations for food intake of children. Parallel accomplishments in increased understanding of food needs of pregnant and lactating mothers have been omitted because of space.

**Normal child bone growth and food calcium needs**
The CNRC has established the norms for bone growth in healthy children. An example of this for girls is shown in Figure 1. Bone mineral content was determined by a minimally invasive procedure to measure bone dimension and density. Similar data for boys are available at the web site. In addition, CNRC scientists, using stable isotope technology, have determined the bioavailability and retention of calcium from foods during childhood (2–15). These studies have been incorporated into the Institute of Medicine (IOM) Recommended Dietary Intakes (RDI) for Children (16).

**Normal child lean-body growth and food protein needs**
The CNRC scientists have established the reference values for growth of lean (nonfat) tissues in the normal child (17–20). This was accomplished by measuring the total body potassium, located mostly in lean tissues, with a noninvasive technique. Estimates of rates of potassium deposition for infants from 9 mo through 3 y of age (18) and total body potassium content from 4 through 18 y of age (20) were utilized to estimate rates of lean-body growth and protein deposition: protein deposition = total potassium accumulated (mmol/d) / 2.15 (mmol potassium/g nitrogen: 6.25). The $^{40}$K analyses that formed the basis for the computed protein depositions are given in Figure 2.

It is clear that the CNRC has contributed to the estimation of protein requirements for U.S. children by determining the rates of potassium and hence protein deposition in normal children. These CNRC studies were the basis for increasing the protein allowance for children by ~25% in the 2002 IOM RDI (21) and have been adopted as international standards by FAO and WHO (22).

**Normal child energy expenditures and food energy needs**
The CNRC scientists have undertaken the direct measurement of total energy expenditure (TEE) by the doubly labeled water technique perfected in the Stable Isotope Laboratory (23–26).

The method represented a distinct advantage over previous TEE evaluations that had to rely on a factorial approach and/or on food intake data, both of which have limited reliability. CNRC investigators submitted almost all of the individual infant and child TEE and ancillary data including age, gender, height, weight, basal energy expenditure, and descriptors for each individual in the data set. The measurements were obtained from infants and children whose ages, body weight, height, and physical activities varied over wide ranges, so they provide an appropriate base to estimate energy expenditures and requirements at different life stages in relation to gender, body weight, height, age, and for different activity estimations. These data were used to estimate the current energy recommendations and also have been used to refine WHO childhood energy intake recommendations. The consequences of these normative CNRC data are shown in Figure 3, where child energy intake is reduced by ~20% in the 2002 IOM RDI (21) and have been adopted internationally by FAO/WHO/UN University (UNU) Committees (22). It is anticipated that this reduction of recommended energy intake can play a role in the prevention of childhood obesity.

**Contributions of the CNRC to understanding of food needs of children and mothers**

ARS Performance Measure 5.2.3 reads:

> Publish research findings not encompassed under the other performance measures for this objective likely to significantly advance the knowledge of human nutrition, extensively influence other researchers in the same or related field, or yield important new directions for research citation rates.

The scientists of CNRC published >3000 peer-reviewed articles and invited reviews from 1978 through 2007. Led by Dr. Dennis Bier since July 1, 1993, CNRC presently has 42 scientists in 8 research clusters: 5 groups on normal development or accomplishments in increased understanding of food needs of pregnant and lactating mothers and prevention of obesity; 1 on mineral absorption; 1 on nutrient-gene interactions; and 1 on phytonutrient biochemistry. Under Dr. Bier, CNRC scientists have successfully implemented the 1978 Congressional Mandate to integrate with NIH by matching the ARS research budget with NIH-funded nutrition...
research programs. Working to provide better scientific information about body growth and food needs, CNRC scientists have made progress in fulfilling the vision of Chairman of House Agriculture Committee de la Garza on October 2, 1988, when he predicted “the impact of the research contributions of the CNRC on food guidelines for USDA programs for child nutrition” and “all children of the world.”

Other articles in this supplement include references (28–32).

Literature Cited