

Foundations

Introduction to Research

CHAPTER OUTLINE

- ▶ Introduction
- ▶ What Is Research?
- ▶ Purposes of Nutrition Research
- ▶ Ways to Classify Research
- ▶ Major Types of Nutrition Research Studies
- ▶ Practice-Based Research Networks
- ▶ Researcher Interview: Translational Research, Dr. Wahida Karmally

LEARNING OUTCOMES

- ▶ Explain what research is, and give the steps in the scientific method.
- ▶ Describe the four purposes of nutrition research.
- ▶ Identify a research study as quantitative or qualitative and basic or applied.
- ▶ Explain why quality improvement is not considered research.
- ▶ Define and identify research that is classified as intervention, outcomes, epidemiological, or translational research.
- ▶ Describe what a practice-based research network is and does.

INTRODUCTION

Nutrition research is varied—from work with cells and animals to clinical studies with humans to population-based studies. Whatever the approach, nutrition research contributes to our knowledge of the impact of diet and nutrients on the human body. This chapter will help you understand what research is, what it is not, and introduce types of nutrition research. Using this textbook, you will build on knowledge and skills from one chapter to the next to become fluent in reading research studies.

Quality research is the foundation for nutrition practice. Without it, we would not be able to counsel a client on how to lose weight or help a client with diabetes improve his hemoglobin A1c results. Although the concept of research may seem intimidating, you have no doubt already done some personal research. For example, if you need to buy a new laptop, you will consider what features you want and use a variety of sources to compare features and prices of new ones. You will probably read reviews and examine how many customers were satisfied overall with different computers, as well as ask others for advice. In the end, you will make a decision based on the data you collected. Personal research is similar to scientific research, but there are some important differences.

WHAT IS RESEARCH?

Before defining what research is, let's look at what it is *not*.

- *Research is not when you look really hard for information on a topic.* You may spend hours looking for some reliable information on a narrow topic in sports nutrition, for example. That is not really researching; it is more like finding information.
- *Research is not when you read a number of journal articles on a nutrition topic,* such as the effect of vitamin D on muscles. Yes, you certainly know more about this topic now, but what you did is not true formal research; that was done by the authors of the articles you read.
- Let's say you went further than just reading articles. You wrote what is commonly called a "research paper." After reading and highlighting lots of articles (we hope you were picky about which articles you selected), you organized your paper and proceeded to write it up, including supporting and referencing your statements using the articles you read. *Research is not when you simply transfer and summarize facts from what you read.* This is definitely closer to real research than simply reading journal articles. By interpreting and drawing conclusions from the facts, you are starting to get more involved in the research process.

Now that we know what research is not, we can look at how research is defined.

Research is a systematic process of collecting, analyzing, and interpreting information/data to answer questions to *extend knowledge*. A systematic process means that research is completed using a system, and that system is usually the **scientific method** (Figure 1.1). The scientific method is a step-by-step process used for investigating questions, interpreting data, and expanding our understanding. Researchers use the scientific method to guide their research studies. (This should be a review for most readers. If so, be sure you know all the boldface key terms.)

1. *First, the researcher considers and develops a specific **research question** designed to shed light on a current or potential problem, such as obesity. A research question poses a relationship between two or more variables. A **statement of the problem** explains the problem and provides the context for why this research is needed.* For example, the treatment of obesity is an area of concern because obesity affects health in many negative ways and treatment is difficult, but even a small amount of weight loss can improve health. An obesity researcher may then develop a research question such as: "Do obese adults who weigh themselves every day lose more weight and keep it off than obese adults who weigh themselves less than 7 days a week?" Research questions can be developed on the basis of problems, for example, in clinical nutrition, community nutrition, business/management, or food science. Consider a community nutrition research question such as this: "What is the impact of teaching children to eat more fruits and vegetables on plate waste in child feeding programs?"

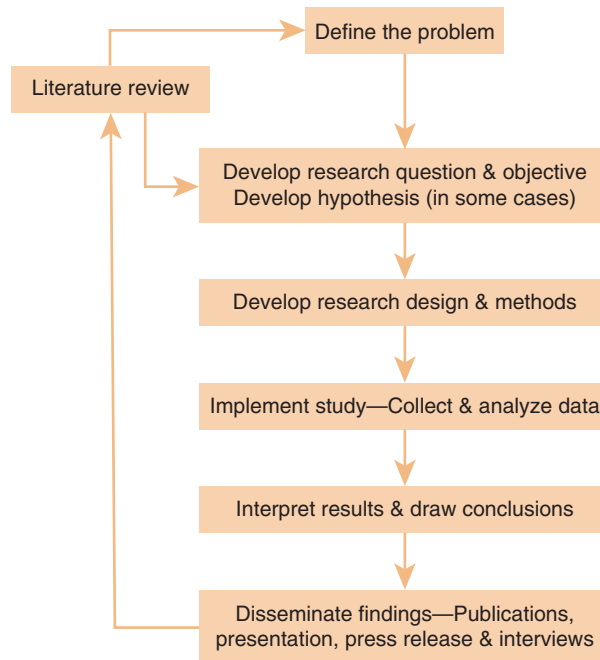


FIGURE 1.1 Scientific Method

2. The statement of the problem is based on a review of research already completed—commonly called a **literature review**. Prior research provides the foundation of what is known on the topic.
3. Based on the literature review and the research question, the researcher clearly states the **objective** (or purpose) of the study. For example, the objective for the obesity study could be stated this way: “To examine whether weighing every day produces greater weight loss compared with weighing less than daily for obese adults.” The objective needs to be clear, objective, and identify the key variables in the study.

Study **variables** are any characteristic that can take on different values, such as BMI or social support, and are measured, controlled, or manipulated in research. Variables are **categorical** when they take on values that are names or labels, such as sex, or **continuous** when they can be counted and have an infinite number of possible values. In the obesity study, the variables are weight and the frequency of weighing (using a scale). If you look at the abstracts of the original research papers in the *Journal of the Academy of Nutrition and Dietetics*, each study has an objective with variables.

4. Many, but not all, studies state a **hypothesis**. A hypothesis is a statement of what the researchers predict the relationship will be between two (or more) variables, and it must be able to be tested. Quantitative research designs are used to look at causal relationships as well as associations or relationships between variables. For example, in the obesity study, the hypothesis is that daily weighing will lead to greater weight loss at 6 months when compared with less frequent weighing. The hypothesis shows a relationship between two variables: an **independent variable** (what the researcher manipulates in certain studies) and a **dependent variable** (sometimes also called the **outcome measure**). In the obesity study, the researchers manipulate how often the study participants weigh

themselves—so that is the independent variable. Then the researchers measure the study participants' weight—the dependent variable. Research examines whether the independent variable affects the dependent variable. Many research studies that are more descriptive in nature, such as examining trends in global obesity, do not have a hypothesis and only have a research objective.

5. *Once the researcher has a problem statement, research question(s), and possibly a hypothesis, the researcher works on a detailed research plan that states precisely what data are required, where the data will come from, which methods will be used to collect the data, and how the data will be analyzed.* This series of decisions is called **research design**, and it focuses on the end product: getting the evidence required to adequately and accurately answer the research question(s).

A research design, such as a randomized controlled trial, is like a blueprint for a house. The blueprint can be used for a number of homes, but most blueprints will be changed to meet the specific needs of each homeowner. A good research design ensures that the evidence obtained answers the research question as accurately as possible (keep in mind that some research questions cannot be tested). Also keep in mind that although many research studies *generate new data*, some *analyze existing data*, such as from the National Health and Nutrition Examination Survey, to answer new questions (known as **secondary data analysis**).

If data is collected at just one point in time, this is referred to as a **cross-sectional study**. In a **longitudinal study**, participants are observed and multiple measurements taken over a long period of time. Longitudinal studies either go forward in time (**prospective**) or backward in time (**retrospective**).

6. *When you read a study, the “Methods” section addresses the research design, including how variables will be measured, the setting, how participants will be chosen (if used), and the statistical analysis.* **Research methods** refer to the many kinds of tools, techniques, and processes used in research to obtain data, such as questionnaires, case studies, and interviews. Measurement devices are also often referred to as **instruments**. In the obesity study, study participants are enrolled and randomly put into the **intervention group** or the **control group**. The intervention group (receives the treatment or intervention) is instructed to weigh daily using a smart scale (a scale that sends data directly from the scale to a website). Members of the control group also get smart scales and are instructed to use the scales less than daily. Participant weights at 3 months and 6 months are used to determine statistically whether the daily weighers lose significantly more weight compared with those weighing less than daily.
7. *Once the data are collected and statistical tests have been run, researchers interpret the meaning of the results as related to the problem and the research question.* Researchers also have to take into account possible **extraneous variables** (factors other than the variables being studied that might influence the outcome of a study) that can cause incorrect conclusions. Results are compared to other similar studies, and conclusions are drawn. Good research builds on previous studies and contributes to a broader knowledge of the topic. In the obesity study, it was found that weighing every day led to significantly more weight loss compared with the control group, leading the researchers to conclude that daily weighing is an effective weight loss tool.
8. *The last step is to report or disseminate the results.* This could take the form of an article published in a journal or another publication; presentation or a poster at a professional conference, meeting, or workshop; a press release to the media; or interviews.

As you can imagine, one research study is not the end of the process; each published study strengthens the literature and helps guide further research. As a matter of fact, most research articles end with specific ideas on further research—in other words, more questions to answer—so the research process is truly cyclical as illustrated in Figure 1.1.



APPLICATION 1.1

Read this study summary and answer the questions.

Study: Computer kiosks with interactive nutrition software were installed in three middle schools in Toulouse, France. The kiosks were used by students there for 6 months. Students would use individual identification cards with their personal profile to access the kiosk just before going to the cafeteria. The computer software was loaded with the food and beverage selections in the cafeteria and would adjust meal recommendations to each child's age, height and weight, and physical activity level. Each child interacted with the computer to compose a well-balanced meal meeting his or her individual needs. The ability to put together a balanced meal was measured for each child using the software. The children did not have to eat the meal they had chosen on the computer. After 6 months, results showed that BMI decreased significantly during the study, and the students became more competent at picking healthful meals using the personalized interactive software (Turnin et al., 2016.)

Questions: What were the research objectives, intervention, independent and dependent variables, outcomes measures, and results?

PURPOSES OF NUTRITION RESEARCH

The general purpose of nutrition and dietetics research is to answer questions and solve nutrition-related problems. Much nutrition research is conducted to build a body of knowledge that supports and advances practices for improved client **outcomes**. Outcomes can be defined as changes in a client's health or quality of life that result from health/nutrition care (or research intervention). This body of knowledge is the foundation for **evidence-based practice**. Evidence-based dietetics practice is the “use of systematically reviewed scientific evidence in making food and nutrition practice decisions by integrating best available evidence with professional expertise and client values to improve outcomes” (Academy of Nutrition and Dietetics, 2015).

In addition to providing quality care, Registered Dietitian Nutritionists (RDNs) are also accountable for providing cost-effective and efficient care for clients. Therefore, you will see research performed to ensure quality or productivity, assess cost-effectiveness, and compare and evaluate programs.

Of course, there is much research in nutrition and dietetics that is not directly related to patient care, such as determining whether customers use calorie information on restaurant menus or examining whether snacking affects overall diet quality. We provide examples showing the wide variety of nutrition and dietetics research.

One way to classify research (**Table 1.1**) is according to the purpose of the research. The purpose may be to

- Explore
- Describe
- Analyze
- Predict

Some research will *explore* a problem. Sometimes, a researcher wants to understand more about a problem that is not very well understood or for which there is little existing research. For example, an exploratory study was conducted to explore the

Table 1.1 Research Purposes and Examples

Research purpose	Study example	Possible research designs
Exploratory	Explore the barriers to eating healthy foods for Hispanic women in an urban community.	Qualitative study.
Descriptive	Examine the availability and price of low-fat and higher-fat milk in stores across the United States.	Descriptive cross-sectional study. Descriptive correlational design.
Analytic	Test the effect of a high-fiber diet on blood glucose control in people with type 2 diabetes.	Randomized controlled trial. Cohort study.
Predictive	Predict the rate of weight loss based on patient characteristics and intervention strategies.	Predictive correlational design.

barriers to eating healthy foods for Hispanic women in an urban community (Suplee, Jerome-D’Emilia, & Burrell, 2015). Exploratory studies are often based on qualitative research, and most exploratory studies are also descriptive studies.

Descriptive research attempts to *describe* a wide variety of phenomena often at a specific point in time—such as the nutrition knowledge, attitudes, and behaviors of youth athletes or the dietary quality of preschooler sack lunches. Descriptive research may measure, classify, and compare phenomena. For example, Rimkus et al. (2015) undertook a study that looked at the availability and price of low-fat and high-fat milk in stores across the United States. One of their findings was that the odds of finding low-fat milk were 32 to 44% lower in low-income communities when compared to high-income communities. Also, pricing of low-fat and nonfat milk was higher on average in grocery stores in majority black compared to majority white communities.

Descriptive studies often aim to provide information about relevant variables, but they do not test hypotheses or examine possible cause and effect. Good descriptive studies provoke the “why” questions of analytic research.

Analytic research goes beyond describing and looks at cause and effect. An analytic study tries to quantify the relationship between either an intervention *on* an outcome or an exposure *on* an outcome.

First, let’s look at a study with an intervention. A researcher may test a hypothesis such as this: “Eating a high-fiber diet improves glycemic control in people with type 2 diabetes.” To test this hypothesis, an **experimental design** is used. Requirements of true experimental research include a controlled manipulation of the independent variable, administration of the treatment to the experimental group, and random assignment of participants to the experimental or control groups.

Using the high-fiber diet hypothesis, the independent variable is the high-fiber diet, and the dependent variable is glycemic control. To figure out which is the independent or dependent variable, fill in the sentence: “The study is looking at the effect of variable A on variable B.” In this case, the study is looking at the effect of a high-fiber diet (A is the independent variable) on glycemic control (B is always the dependent variable).

Now, let’s look at the relationship between an exposure on an outcome. Sometimes researchers perform analytic studies, such as **prospective cohort studies**, to look for causes of a disease when it would not be safe or ethical to expose participants to a factor suspected to be harmful. In a cohort study, researchers form a hypothesis about the potential causes of a disease and then they *observe* a group of nondiseased people

(the cohort) over a (usually) long period of time to detect any changes in health (outcomes such as the presence of coronary artery disease) in relation to *exposure* to certain *risk factors* (such as obesity).

For example, The Nurses' Health Studies is a prospective cohort study started in 1976 that continually collects information from more than 100,000 nurses. The researchers obtain accurate information about exposures before disease develops in any of the participants. The data are then used to answer a variety of research questions about how risk factors affect disease outcomes, such as grouping participants based on their body mass index and then comparing their risk of developing heart disease (or cancer). Cohort studies such as the Nurses' Health Studies have provided important information about the link between lifestyle factors and disease. Prospective cohort studies are a good example of analytic studies that are observational, *not* experimental.

Another purpose of research may be to predict something, such as a questionnaire that can predict young adults at risk for eating disorders or a formula to predict resting metabolic rate in college adults. Being able to predict something does not mean that we can always explain why the phenomenon occurs or control the outcome. But predictive studies are good at isolating an independent variable that may enhance successful outcomes. For example, researchers have examined factors such as initial body weight and frequency of diet counseling to help predict the rate of weight loss (Finkler, Heymsfield, & St-Onge, 2012).



APPLICATION 1.2

Read this study summary and answer the questions.

Study: In the Swedish mammography cohort, the researchers used food frequency questionnaires from 33,747 female participants to calculate each participant's Dietary Inflammatory Index. During 15 years of follow-up, the researchers identified deaths due to cancer, digestive-tract cancer, and cardiovascular disease. Statistical tests were performed to examine the association between the Dietary Inflammatory Index and mortality (all causes, cancer, digestive cancer, and cardiovascular disease). Higher Dietary Inflammatory Index scores were associated with all-cause and digestive-tract cancer mortality (Shivappa, Harris, Wolk, & Hebert, 2015).

Questions: What was the purpose of this research: to explore, describe, analyze, or predict? Was this an experimental or a cohort study? Why is it an experimental or cohort study? What is meant by "higher Dietary Inflammatory Index scores were associated with all-cause and digestive-tract cancer mortality"?

WAYS TO CLASSIFY RESEARCH

When discussing research in this section, we will only be talking about original research studies. An **original research study** is a narrative of a single study designed and conducted by the researchers themselves. Original research articles are also called **primary research**. Other types of research articles that you may read are narrative reviews or systematic reviews. **Secondary research** includes **narrative reviews** in which authors organize, interpret, and summarize evidence from a number of primary studies in a particular research area. **Systematic reviews**, which are more rigorous than narrative reviews, belong in the category of **tertiary research** because they collect and distill information from both primary and secondary sources. Narrative and systematic reviews are both examples of synthesizing research (**evidence analysis**) and are discussed in Chapter 12.

You can classify research studies in many ways. For example, you can classify research by purpose (just discussed) or by research design (such as a randomized controlled trial or cohort study). In this section, we look at two additional ways to classify research: Is the study quantitative or qualitative? Is the study basic or applied research? When you first read a research study, you should try to answer these questions.

QUANTITATIVE AND QUALITATIVE RESEARCH

You have probably read a number of quantitative studies. **Quantitative studies** use a formal, objective, and systematic process of collecting, analyzing, and interpreting information/data—in other words, the scientific method. Quantitative data is expressed numerically and can be analyzed in a variety of ways. The goal of quantitative research is generally to describe and examine relationships among variables (descriptive studies) and examine cause-and-effect relationships (analytic studies). One thing to keep in mind is that no matter how powerful the findings of a quantitative study are, nothing is ever proven. The most that can be claimed is that the hypothesis is either supported or unsupported.

The concept of **control** is very important in a quantitative study, and it is even more important in an experimental study than in a descriptive study. Control is used to prevent *outside* factors from influencing the study outcome. Common areas in which researchers exert control include how participants are selected and how much they know about the study, selection of the research setting, and measurement of variables.

Qualitative research is quite different from quantitative studies. **Qualitative research** does not manipulate variables or put a group through an intervention. The qualitative researcher gets into the shoes of the study participants to capture information not conveyed in quantitative data, such as values, beliefs, or motivations behind behaviors. For example, Schindler, Kiszko, Abrams, Islam, and Elbel (2013) used **focus groups** to ask 105 New York City residents about factors that affected whether they used, or did not use, the calories posted on fast-food menus. Most participants knew the calorie information was there, but few used that information due to reasons such as a lack of understanding about calories or giving priority to what has been ordered in the past (habit). Qualitative research has been used for many years in social and behavioral sciences such as anthropology or sociology, and it is also used in nutrition research.

Like quantitative research, qualitative research is a systematic process, involves **rigor** in implementation, and generates knowledge. But the two types of research seem to have more differences than similarities (**Table 1.2**). The quantitative approach is objective, which means that it tries to be unbiased toward the participants. The qualitative approach is just the opposite: the researcher wants to understand the participant's experience. Whereas the qualitative researcher may conduct an open-ended interview with a participant, the quantitative researcher often counts and measures behavior with instruments such as food frequency questionnaires. Typical qualitative methods used in nutrition research are focus groups, observations, and document analysis.

The differences between quantitative and qualitative research spring from the researcher's paradigm on how the world works. Much nutrition (and medical) research is based on a **positivist paradigm** in which reality is ordered and events can be studied empirically and explained with logical analysis. Using a positivist paradigm, a researcher uses objectivity and control to study a world driven by natural causes. In contrast, qualitative researchers operate from a **constructivist paradigm** in which reality is mentally constructed by individuals. Therefore, they value the uniqueness of each individual and focus on the subjective. Data in qualitative research takes the form of words, sounds, and pictures, which are captured in field notes, transcripts, or photographs. Qualitative

Table 1.2 Comparing Quantitative and Qualitative Research

	Quantitative	Qualitative
Researcher's focus	<ul style="list-style-type: none"> To describe and test relationships among variables. Examine cause and effect by testing hypotheses. Make predictions. 	<ul style="list-style-type: none"> To provide details about human behavior, emotion, personality, and interactions; describe a problem or condition from the point of view of those experiencing it. To formulate theory or hypothesis after data is collected.
Reasoning	<ul style="list-style-type: none"> Deductive: the researcher tests the hypothesis with the data. 	<ul style="list-style-type: none"> Inductive: the researcher formulates a hypothesis after data is collected.
Objectivity/subjectivity	<ul style="list-style-type: none"> Objectivity is critical. 	<ul style="list-style-type: none"> Subjectivity is expected.
Setting	<ul style="list-style-type: none"> Controlled environment: try to control all factors that could affect the results. 	<ul style="list-style-type: none"> Natural social settings without controls.
Sampling	<ul style="list-style-type: none"> Sample population of interest, preferably random sample. Larger numbers of participants. 	<ul style="list-style-type: none"> Nonrandom purposeful sampling. Smaller numbers of participants give more in-depth information.
Methodology	<ul style="list-style-type: none"> Experimental or quasi-experimental designs to test for group differences, relationships, etc. Fixed design. 	<ul style="list-style-type: none"> Methods that explore and describe, such as case study, focus group, observation, or semi-structured interviews. Flexible design.
Data	<ul style="list-style-type: none"> Number based: precise, objective, measurable data. 	<ul style="list-style-type: none"> Mostly narrative: text based, images, objects.
Analysis	<ul style="list-style-type: none"> Statistical analysis. 	<ul style="list-style-type: none"> Interpretive analysis. Interviews and other data are often categorized or coded to identify themes and subthemes.
Reporting results	<ul style="list-style-type: none"> Statistics, tables, graphs. 	<ul style="list-style-type: none"> Organized by research question and presented as themes.
Study validation	<ul style="list-style-type: none"> Can be valid and reliable; largely depends on research design and measurement instruments. 	<ul style="list-style-type: none"> Can be valid and reliable, although validity and reliability are seen a little differently (Leung, 2015). Largely depends on skill and diligence of the researcher.
Generalize the findings to a larger population	<ul style="list-style-type: none"> More generalizable. 	<ul style="list-style-type: none"> Less generalizable.
Strengths	<ul style="list-style-type: none"> Allows for greater objectivity, control, and accuracy. Can examine possible causes under controlled circumstances. Tests theories or hypotheses. Can be replicated. 	<ul style="list-style-type: none"> Provide a holistic view and understanding of complex situations through rich detail of participants' personal experiences, etc. Gain initial insights into a new area of research. Describes phenomena and possibly generate a theory. Can respond to changes that occur during the study.

(continues)

Table 1.2 Comparing Quantitative and Qualitative Research (continued)

	Quantitative	Qualitative
Weaknesses	<ul style="list-style-type: none"> • Does not work as well with phenomenon that are hard to measure accurately (such as stress) or complex phenomenon. • Does not provide information on the context of the situation. • Does not capture the full breadth of human experiences. 	<ul style="list-style-type: none"> • Time consuming to collect and analyze data. • Smaller number of participants. • Not usually generalizable. • Results more easily influenced by researcher’s personal biases. • Difficult to compare to other studies.

researchers tend to gather data and analyze it to generate a theory or hypothesis (inductive reasoning), whereas quantitative studies often test a theory or hypothesis (deductive reasoning).

Although researchers often have a preference for one or the other, quantitative and qualitative research complement each other because they generate different kinds of knowledge. Qualitative research provides insight into problems, may identify variables important for future quantitative research projects, and can help researchers explore and develop a theory. Table 1.2 explains some of the major differences between the two types of research.

Mixed methods research “mixes” quantitative and qualitative research within a single investigation to provide a more complete data picture. Mixed methods research originated in the social sciences and has expanded into the health and medical sciences, including nursing and nutrition. It developed in part due to increased acceptance of qualitative research in the United States, increasing complexity of issues being researched, and a recognition that both quantitative and qualitative research have strengths that can be combined. Mixed methods research may also be referred to as multi-method or triangulated design.

Mixed methods research has several important characteristics (Creswell, Klassen, Plano Clark, & Clegg Smith, 2011).

1. The collection of both quantitative (close ended) and qualitative (open ended) data to answer research questions.
2. The analysis of both qualitative and quantitative data.
3. Integration of the two data sources in the results. The numbers provide the precision and the narratives supply the background texture.

By joining quantitative with qualitative methods, biases associated with one design alone are reduced, insight into the complexity of the problem is provided, and rigor in the study design is maintained (Creswell et al., 2011).

A study of parents of young children with type 1 diabetes mellitus is an example of how the use of mixed methods can uncover perceptions that might otherwise be missed (Patton, Clements, George, & Goggin, 2015). Because research shows that many young children with type 1 diabetes do not have healthy diets, the researchers wanted to learn more about what the parents know about healthful eating for their child, how they choose foods for their child, and any possible barriers to a healthful diet.

In this study, qualitative data was derived using semistructured interviews with parents, and the data was coded to identify themes and subthemes. Quantitative data came from an analysis (using the Healthy Eating Index–2010) of 3-day weighed food

records of each child’s intake, the Behavioral Pediatric Feeding Assessment Scale filled out by a parent, and the most recent HbA1c values. Results showed that “although parents may believe they know what constitutes a healthful diet (for T1DM), they do not always feed their child a healthful diet” (Patton et al., 2015, p. 279). This conclusion was possible to report because the quantitative data showed the quality of the children’s diets, and the qualitative data showed that parents perceived their child’s diet as healthful. Another interesting qualitative finding was that many parents didn’t want their children to feel “different” or be seen as “different” by their peers because of their diet needs and restrictions (Patton et al., 2015).



TIP

To tell if a study is quantitative or qualitative, carefully read the title of the study and the research methods and instruments used to collect the data. If the methods involve focus groups, in-depth interviewing, observations, or a case study, then it is clearly qualitative. If you see a lot of numerical data and statistics, it is likely to be quantitative.



APPLICATION 1.3

You are in charge of a nutrition education program that includes cooking classes taught at farmers’ markets to SNAP recipients in an urban setting. The purpose of your program is to improve eating habits by helping participants plan, buy, and prepare healthy meals using produce from the farmers’ market. Describe one way to evaluate the program using quantitative methods and two ways to evaluate it using qualitative methods. Also, describe two ways that the quantitative and qualitative data will be different from each other.

BASIC AND APPLIED RESEARCH

Another way to classify research is whether it is basic or applied. As is often the case, there is no clear-cut line between them. Consider a research study using mice in which leptin (a hormone made by the adipose cells that inhibits hunger) is found to suppress the response of taste cells to sweet compounds. This type of study is referred to as **basic research**—research performed without a specific application in mind and completed for the sake of knowledge alone. Much basic research, also called bench research, is conducted in laboratory settings, often using animals. Experimental conditions are strictly controlled. However, basic research is also done with humans. Whether using animals or humans, the intent is to build a knowledge base—usually by testing theories.

The complexity of diseases, such as obesity or cancer, provides the impetus for using animal models in much basic research. Many research questions cannot be answered using humans due to safety and ethical concerns, so animal models are quite useful. A model is not the real world, but simply a representation to help explain and predict observed phenomena. Mice, for example, are comparative living systems that enable researchers to explore areas such as cancer and answer questions about the underlying basis of how and why cancers arise. The most commonly used animal models for cancer research are mice and rats.

Whereas basic research is completed for the sake of gaining knowledge alone, **applied research** is done to solve real-world problems and to directly influence or improve nutrition practice. Applied research may be used to identify factors associated with weight loss or to determine whether a nutrition education program changes eating habits. Applied research can inform decisions in many nutrition areas.

The distinction between basic and applied research lies mostly with its application. Although it may seem that applied research is more useful, basic research questions often inform applied research.

When you address problems in *your own work setting* with the goal of solving an ongoing problem, this is known as **quality improvement**. Quality improvement (QI) consists of identifying problems and testing solutions to improve a process, a system, or an outcome. Ultimately, we want to improve delivery of care (services) within a department or an institution. For example, if a clinical nutrition manager in a hospital is concerned about how long it takes to get patient screenings done, he or she may start the QI process to improve timeliness. **Figure 1.2** shows the steps involved.

Although QI uses many components of the research process, it is not considered research using the definition provided by the Department of Health and Human Services (DHHS). DHHS defines research as “a systematic investigation, including research development, testing, and evaluation, designed to develop or contribute to *generalizable* knowledge” (U.S. DHHS, 2009, Code of Federal Regulations, Title 45, Part 46.112). The knowledge gained from QI is for a single institution and is not generalizable outside of that institution, so QI really cannot be considered research. Also, whereas a protocol in a research study is fixed, the steps taken in a QI project are flexible because the goal is improvement. The Academy of Nutrition and Dietetics provides an excellent resource on QI: “Using Academy Standards of Excellence in Nutrition and Dietetics for Organization Self-Assessment and Quality Improvement” (Price, Kent, Cox, McCauley, Parekh, & Klein, 2014).

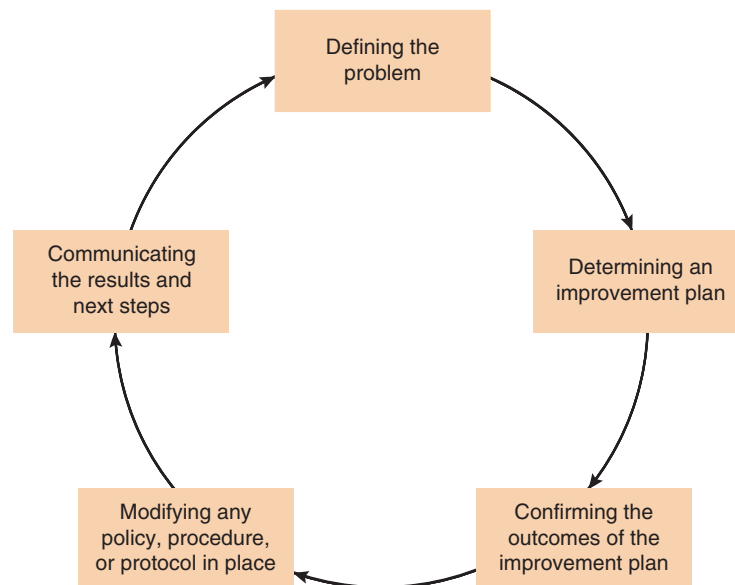


FIGURE 1.2 Steps in Quality Improvement

MAJOR TYPES OF NUTRITION RESEARCH STUDIES

When looking at nutrition research studies, it is helpful to know that there are some specific types of research being done, such as the following.

- Intervention research
- Outcomes research
- Epidemiological research
- Translational research

This does not mean that all the studies you read will fall into one of these categories; that is not the case. Also, you may read a study considered to be intervention or outcomes research that is also translational research. Therefore, some studies will fall into two categories. Each type of research is special in its own way, and knowing and understanding them will help you navigate the huge volume of nutrition studies. Following is an introduction to intervention, outcomes, epidemiological, and translational research.

INTERVENTION RESEARCH

Intervention research is a specialized type of research in the medical, nursing, and nutrition fields. It is distinguished by an intervention that can be quite varied: from treatment of patients with parenteral nutrition to a new behavioral intervention in a health care program. Interventions are techniques, treatments, or actions that are taken in a study to produce outcomes, such as successful management of a disease. Intervention studies also may be referred to as **clinical studies** because clinical studies use human participants to help researchers understand a certain condition or disease as well as how best to treat patients.

Intervention studies often use a research design known as a **clinical trial**, which is considered experimental research. In a clinical trial, researchers test new treatments, drugs, or medical devices to add to medical knowledge related to the treatment, diagnosis, and prevention of diseases and conditions. The Food and Drug Administration (FDA) requires (and regulates) clinical trials before a new drug, medical product such as vaccines, or medical device is sold in the United States. Clinical trials are often done in stages or phases.

Many clinical trials randomly assign participants to a group to test a specific treatment or to a control group; these are called **randomized controlled trials (RCT)**. RCTs are the gold standard because randomizing helps to reduce the risk that the effects of the intervention were due to the groups being different. The experimental group receives the treatment, and the comparison (control) group receives a dummy treatment or no treatment at all, with outcomes measured at certain points. Some RCTs are blinded, which means the participants do not know if they are getting the treatment or a placebo. In double-blind studies, the researchers also do not know which participants are receiving the treatment or a placebo. In triple-blind studies, anyone involved in data management is also blinded.

Compher (2010) states that “randomized clinical trials of drugs or procedures are most often **efficacy** studies that are designed to show whether the drug or procedure produces the desired clinical outcome under optimal conditions” (p. 598). Demonstration of efficacy (ability of a treatment to provide a beneficial effect) in an RCT does not guarantee that the treatment will work in actual practice settings because RCTs are very controlled and don’t normally represent the wide range of patients and settings

encountered in everyday practice. To see if a treatment will work in practice settings, researchers do effectiveness studies (or outcomes research).

Intervention research is not as simple as saying “let’s try a diet low in _____ to decrease the risk of _____ in patients with _____.” Planning an intervention study is a lengthy specialized process, starting with an in-depth understanding of the problem and working with a team to develop a theory to guide the research. Only then can the team conceptualize a research design and go through many steps, such as talking with patients who may benefit from the research and doing pilot studies, before implementing the intervention study.

OUTCOMES RESEARCH

Before talking about outcomes research, let’s take a look at what outcomes are. Outcomes can be defined as changes in a client’s health or quality of life that result from health/nutrition care. Outcomes look at how a patient does after treatment; in other words, what the consequences (outcomes) are. According to Splett (2008), outcomes can be grouped into these categories.

1. *Direct Nutrition Care Outcomes.* These outcomes are due directly to a nutrient intervention such as medical nutrition therapy or counseling. For example, a client who is counseled on eating changes to reduce LDL levels may improve her nutrient intake and reduce her LDL levels (two outcomes).
2. *Clinical Outcomes.* These outcomes look at changes in the progression or severity of a disease or condition, such as a reduced risk of heart attack after implementing appropriate lifestyle changes. Clinical outcomes may also look at whether a complication was avoided.
3. *Patient Outcomes.* Patient outcomes look at what is important to the patient. Were symptoms relieved? Has the quality of life improved or gotten worse? Is the patient more confident about treatment or the future? Is the patient better able to complete the activities of daily living?
4. *Cost Outcomes.* As health care costs climb, cost outcomes have become more and more important. You can think of health care costs as coming from two places: the actual cost of the intervention (such as the cost of enteral nutrition) and the costs associated with the health effects (outcomes) of the intervention. If the intervention decreases the length of a patient’s stay, that is an outcome that saves money. However, keep in mind that sometimes an intervention has outcomes that do not save money.

Table 1.3 gives an example of how researchers might look at an intervention (a weight management program) and the chain of possible outcomes. Note that Splett (2008) groups clinical, cost, and patient outcomes together as health care outcomes. Depending on the exact nature of the study, only certain outcomes are chosen to be measured.

Whereas intervention research looks at whether the intervention works under controlled conditions, **outcomes research** is undertaken to test the **effectiveness** of an intervention; that is, whether it works under *usual* circumstances. Just because an intervention worked in a hospital-based RCT does not mean that it will work equally well in a community setting such as a physician’s office. Outcomes research is the crucial building block for evidence-based nutrition practice.

Outcomes research is also used to test the **cost-effectiveness** of a new treatment with the standard treatment, and whether it is a good value. Cost-effectiveness analysis tells us how much an intervention will cost to extend life by a given amount, enabling

Table 1.3 Chain of Outcomes Resulting from Weight Management Program (12-Month Period)

Direct Nutrition Care Outcomes			Health Care Outcomes			
	Nutrition-related behavior and environment outcomes	Food and nutrient intake outcomes	Nutrition-related physical sign and symptom outcomes	Clinical outcomes	Cost outcomes	Patient outcomes
	→	→	→	→	→	→
12-week group weight management program leads to	<ul style="list-style-type: none"> • Knowledge of food choices • Awareness of eating cues and responses • Self-efficacy • Increased physical activity 	<ul style="list-style-type: none"> • Reduced energy intake • Healthful eating pattern consistent with Dietary Guidelines 	<ul style="list-style-type: none"> • 12-week weight loss • 12-month weight loss • Reduced weight circumference • Decreased serum cholesterol 	<ul style="list-style-type: none"> • Improved blood pressure 	<ul style="list-style-type: none"> • Reduced hypertension medication 	<ul style="list-style-type: none"> • Increased quality of life • Improved self-confidence

© Academy of Nutrition and Dietetics, "Outcomes research and economic analysis," by P. L. Splett, in *Research: Successful Approaches*, p. 283, by E.R. Monsen and L. VanHorn (Eds.), 2008. Reprinted with permission.

us to compare the costs and outcomes of two interventions. Along with other methods such as cost-benefit analysis, cost-effectiveness analysis is useful evidence of a treatment's value for reimbursement by insurance companies and others.

The **Academy of Nutrition and Dietetics Health Informatics Infrastructure (ANDHII)** collects data, such as outcomes data, from practitioners using easy-to-use formats and standardized terminology so that the data can be selectively analyzed in research projects and the results added to the nutrition evidence base. One component of ANDHII is a **Dietetics Outcomes Registry (DOR)**. The DOR makes anonymous data available for outcomes research and QI projects. The database includes data related to nutrition assessment, diagnosis, interventions, monitoring, evaluation, and outcomes.



TIP

Intervention studies test the *efficacy* of an intervention (whether it can work under very controlled conditions, often a RCT). Outcomes research tests the *effectiveness* (whether it achieves the desired treatment goal in a real-world setting) or the *cost-effectiveness* of an intervention. Intervention studies and outcomes studies both use quantitative research designs. Most outcome studies do not randomly assign patients to treatment or control groups, as is done in RCTs.

EPIDEMIOLOGICAL RESEARCH

Epidemiology is a discipline within public health that looks at the rates of health-related states (such as disease) in different groups of people and why they occur. Originally, epidemiology looked at communicable diseases, but now it includes noncommunicable

diseases, chronic diseases, injuries, birth defects, environmental health, and other areas. Epidemiologists, sometimes called disease detectives, try to connect the dots between risk factors (sometimes called exposures) and health or disease outcomes. The studies have provided the crucial link between, for example, cholesterol and heart attacks.

Nutrition epidemiology is a subdiscipline of epidemiology. Epidemiology includes descriptive and analytic areas of study.

1. **Descriptive epidemiology** provides information about who has a disease in a population and the frequency of the disease in that population. In addition, it can tell us about the pattern of the disease, describing the time, place, and personal characteristics of those with the disease (such as age, race, socioeconomic status, or behaviors). Descriptive epidemiology is vital to assess the health of a population or a community, and it provides clues about possible contributing factors and causes of diseases and other health-related states.
2. **Analytic epidemiology** digs deeper to determine the strength of the association between a risk factor and the health-related state. For example, let's look at soda drinking by obese children. As a child drinks more soda, studies have found that the odds (or risk) of becoming obese increase. Finding an association, in this case between soda drinking and obesity, does not necessarily make it a causal relationship. Intervention studies may also be used to prove or disprove causality. Criteria for causality for epidemiological studies are discussed in Chapter 7.

Some epidemiologists work in the field of **applied epidemiology**. They address public health issues regarding control and prevention of disease in the community using data from descriptive and analytic epidemiological research.

TRANSLATIONAL RESEARCH

Translational research generally can be described as a systematic process of transforming findings from basic science or clinical studies into practical applications and evidence-based practice that improves the health of individuals and populations. That's quite a mouthful, so some people refer to it as research that *goes from the researcher's bench to the patient bedside and then to the community*.

Translational research got its start in the medical field because of impatience with the length of time it took for discoveries in the lab to translate into changes in health practices or treatments. The National Institutes of Health (NIH) funds a number of centers and institutes for translational research. Social scientists also are now getting involved in this type of research.

A model of the stages of translational research for RDNs is summarized in **Table 1.4**, and described below. Each stage builds on and informs the others. Translational research involves aspects of basic research, preclinical research, clinical research, effectiveness studies, evidence-based practice guidelines, and population health.

1. Basic research helps researchers learn about the pathophysiology of a disease or the potential for intervention. Animal models of human disease or other experimental methods may be used. Preclinical research starts to connect basic science with human medicine. Research at this point is usually not ready to be done in humans, but scientists use basic research findings to increase their understanding of a disease and ways to treat it. A hypothesis may be tested using animal models, computational models, or samples of human tissues.

Table 1.4 Translational Research Phases, Definitions, and Examples for Registered Dietitian Nutritionists

Research phase	Definition	Type of research	Research question
T1	Identification of disease mechanisms and health problem	Basic research, animal research, preclinical, and preintervention studies	What is the mechanistic action of dietary fiber sources on serum lipids?
T2	Discovery of application to human health and clinical settings	Human clinical studies, efficacy studies, and controlled observational studies	Among patients with cardiovascular disease, what is the effect on serum lipids from dietary fiber from whole foods as compared to dietary supplements?
T3	Health applications to evidence-based practice guidelines, practice guidelines to health practices, and practice to population health impact	Effectiveness research, dissemination research, implementation research, scale-up and spread research	What is the degree to which registered dietitian nutritionists in community health clinics can adopt, implement, and maintain an evidence-based nutrition program to improve cardiovascular risk factors?

Reproduced from "What Is Translational Research? Concepts and Applications in Nutrition and Dietetics," by J. Zoellner, L. Van Horn, P. M. Gleason, and C. J. Boushey, 2015, *Journal of The Academy of Nutrition and Dietetics*, 115, p. 1065. Copyright 2015 by the Academy of Nutrition and Dietetics. Reprinted with permission.

2. Both basic and preclinical studies then inform and shape the next steps, which will now involve clinical studies, perhaps starting small with case studies and then moving to larger clinical trials (early phase clinical trials are smaller). Clinical trials will test clinical efficacy and safety, as well as identify knowledge gaps. Controlled observational studies are also used.
3. Next, the results from the efficacy studies are tested and refined using effectiveness research, which tests how an intervention works under usual circumstances. Effectiveness research findings are used to develop evidence-based practice guidelines, which can be used in hospital and other settings, and with small and large populations. Scientists continue to do research to determine whether the evidence-based interventions engage the participants for optimal impact (dissemination research), are well integrated within a specific setting (implementation research), and can be successfully disseminated and implemented with large populations (scale-up and spread research) (Zoellner, Van Horn, Gleason, & Boushey, 2015).

Table 1.4 shows the three research phases designated in translational research: T1, T2, and T3.

A number of models are used for translational research within the medical field, and they may include from two to five research phases. Many researchers use two-phase models, in which case T1 refers to applying basic lab research findings to preclinical and clinical trials (T1 and T2 in Table 1.4), and T2 refers to applying clinical research findings in practice settings and communities (T3 in Table 1.4). In **Figure 1.3**, T1 is



FIGURE 1.3 Research Continuum from Laboratory to Practice Settings and Communities

the shaded area between Laboratory research and Clinical research, and T2 is the shaded area between Clinical research and Research in practice & community settings.

Table 1.5 summarizes the types of research just discussed. Keep in mind that a research study may very well fit into more than one of the categories. Also, although these types of research are often clinical, you will see research on nonclinical topics such as management and economic research, sensory evaluation research, and consumer research.

Doing research requires you to maintain certain ethical standards and to protect the rights of others. Institutions engaged in research involving human participants must

Table 1.5 Types of Research in Nutrition		
Type of research	Definition	Example
Intervention Research	Research involving development and testing of an intervention. Often uses clinical trials. Tests efficacy of an intervention.	A randomized clinical trial evaluates whether eating less fat (target 15% from fat) influences breast cancer recurrence in early stage breast cancer patients receiving standard cancer care.
Outcomes Research	Research designed to document nutrition-related, clinical, and patient outcomes (end results). Undertaken to test the effectiveness of an intervention under normal circumstances and its cost-effectiveness.	An experimental study evaluates whether psyllium fiber improves glycemic control in clinic patients with type 2 diabetes.
Epidemiological Research	Research that focuses on the frequency and pattern of disease in a population and on identifying possible risk factors.	An epidemiological study evaluates whether increased body weight/central obesity is related to asthma in children.
Translational Research	A systematic process of transforming findings of basic science or clinical studies into practical applications and evidence-based practice that improves the health of individuals and populations. Research that goes “from bench to bedside to community.”	Preclinical animal studies are performed to determine the optimal dose of tea polyphenols needed for maximum osteoprotective effects, which will then be tested in postmenopausal osteopenic women. Results will be used to inform randomized controlled trials, which will inform effectiveness research.



APPLICATION 1.4

Using the title of these research studies, identify whether each study is an example of intervention, outcomes, epidemiological, or translational research.

- A. "Association between inflammatory potential of diet and mortality among women in the Swedish mammography cohort" (Shivappa et al., 2015).
- B. "Effect of nutrition intervention on food choices of French students in middle school cafeterias, using an interactive educational software program (Nutri-Advice)" (Turnin et al., 2015).
- C. "Persistent effects of early infant diet and associated microbiota on the juvenile immune system" (Narayan, Mendez-Lagares, Ardeshir, Lu, Van Rompay, & Hartigan-O'Connor, 2015).
- D. "In-hospital hyperglycemia: Effects of treatment protocol on glycemic control and clinical outcome" (Clinical Trials.gov NCT00302874).

satisfy an **Institutional Review Board (IRB)**, a group of people who review and monitor biomedical research. They have the authority to approve, require modifications, or disapprove research. The purpose of IRB review is to ensure that appropriate steps are taken to protect the rights and welfare of human participants. IRBs and research ethics are discussed in Chapter 3.

PRACTICE-BASED RESEARCH NETWORKS

Practice-based research networks (PBRNs) are "groups of primary care clinicians and practices working together to answer community-based healthcare questions and translate research findings into practice" (Agency for Healthcare Research and Quality, 2016). PBRNs link practicing clinicians with each other to create and run studies, which is useful because each clinician will likely only have a small sample. PBRNs also link clinicians with researchers experienced in clinical research. Primary care practitioners are well positioned to do effectiveness (outcomes) research and comparative effectiveness research (comparing the effectiveness of one treatment with another) with the assistance offered by PBRNs.

The Academy of Nutrition and Dietetics created the Dietetics Practice-Based Research Network (DPBRN) in 2003. Membership is open (and free) to all academy members, and DPBRN members include researchers, practitioners, and students. As a DPBRN member, you can be involved with any of these functions:

- Participate in research in varying capacities, such as collecting data, analyzing data, or being the investigator.
- Propose research questions.
- Serve on an advisory group to select studies to pursue.
- Take part in disseminating results (poster, research publication).
- Get help to design or carry out a study.

The DPBRN has been involved in a number of research projects, such as outpatient care, evidence-based guidelines for diabetes care, and the *Guide for Effective Nutrition Interventions and Education* (Stein, 2016).



RESEARCHER INTERVIEW Translational Research

Wahida Karmally, Dr.PH, RDN, CDE, CLS, FNLA

Associate Research Scientist and Director of Bionutrition Research Core for the Irving Center for Clinical and Translational Research, Columbia University Medical Center, New York, NY

1. Briefly describe the areas in which you do research.

The mission of Columbia University Medical Center's Clinical and Translational Science Award (CTSA) is to transform the culture of research to hasten the discovery and implementation of new treatments and prevention strategies. In October 2006, the Irving Center for Clinical Research joined a national consortium created by the National Center for Research Resources (NCRR) branch of the NIH to energize the discipline of clinical and translational research, ultimately enabling researchers to provide new treatments more efficiently and quickly to patients.

My interest in research began when I was a graduate student in India conducting experiments on hundreds of albino rats to study bioavailability of iron from green leafy vegetables that grow on the roadside and are accessible to anyone who desires to pick them. This research was of public health significance because iron is a shortfall micronutrient in many populations. The results showed that the greens provide nutritional benefits that were cost-effective.

My interest in research continued during my postgraduate studies in London, UK. As an intern, I helped with clinical research at the Middlesex Hospital in London. I started working in research studies at the Mount Sinai Medical Center in New York with Dr. Virgil Brown in the early 1980s in the Diabetes Demonstration Project and on studies examining the effectiveness of statins.

I moved to Columbia University in 1987 as the director of nutrition in the General Clinical Research Center, and in 2006 the center became the Irving Institute for Clinical and Translational Research. In my current position as director of the Bionutrition Research Core, I had the opportunity to run the diet component of a multicenter landmark study: DELTA (Dietary Effects on Lipoproteins and Thrombogenic Activity). This study in essence determined that one standard macronutrient distribution in the diet does not "fit" all sections of the population. In individuals with insulin resistance, the results suggested that the replacement of dietary saturated fatty acids with monounsaturated fatty acids rather than carbohydrate is preferred because of associated smaller reductions in high-density lipoprotein cholesterol (HDL-C) and a trend toward reduction in fasting triglycerides (TG). Diets lower in saturated fat and higher in monounsaturated fat may benefit individuals with normal HDL-C levels or with high TGs. DELTA's results added to the body of evidence for the Therapeutic Lifestyle Changes (National Cholesterol Education Program), which stated that rather than relying on a single dietary recommendation for all, individualized nutrition counseling ("personalized nutrition") should be provided based on risk factors for the treatment and prevention of coronary artery disease.

I have been an investigator on several diet-related studies, including examining the effects of different intakes of dietary cholesterol in young men and women, beta-glucan from a ready-to-eat cereal on LDL-C in Hispanic Americans, the effects of diacylglycerol on TGs, very low calorie diets on insulin sensitivity and beta cell function in patients with type 2 diabetes, and studies on lipoprotein metabolism. The bionutrition core has supported protocols on energy homeostasis and osteoporosis as well as several pharmacokinetic studies, to name a few.

A collaboration with the National Heart, Lung, and Blood Institute (NHLBI) on the Latino and African American Initiatives resulted in the development of materials with culturally appropriate heart-healthy recipes for Latino and African Americans based on evidence-based recommendations for the prevention and treatment of cardiovascular risk factors. This was a "translational" strategy to improve the health of minority communities.

I am very interested in obesity and diabetes prevention. I initiated the anti-overweight campaign “Be Fit to Be ne’Fit” at the New York Presbyterian/Columbia University Medical Center campus to increase awareness of obesity-associated diseases and provide tools and motivational messages for behavior modification.

The Community Engagement Resource (CER) at the Irving Institute provides another opportunity to engage the community with managing dietary risk factors, incorporating healthy eating patterns, and preventing disease. I have given lectures to the community on management of obesity, lipid disorders, and diabetes.

2. With your experience in translational research, what should students/practitioners know about this area of research?

Translational research is a multidirectional and multidisciplinary integration of basic research, patient-oriented research (bedside research), and population-based research, with the goal of improving the health of the public in a cost-effective manner.

The NIH has traditionally supported the training of basic and clinical scientists in a variety of disciplines. More recently, it has supported the training of scientists in translational research through the K30 and Clinical and Translational Science Award (CTSA) programs.

NIH defines translational research to include “two areas of translation. One is the process of applying discoveries generated during research in the laboratory, and in preclinical studies, to the development of trials and studies in humans. The second area of translation concerns research aimed at enhancing the adoption of best practices in the community. Cost-effectiveness of prevention and treatment strategies is also an important part of translational science (NIH, 2007).”

According to this definition, translational research is part of a unidirectional continuum in which research findings are moved from the researcher’s bench to the patient’s bedside and community. In the continuum, the first stage of translational research (T1) transfers knowledge from basic research to clinical research, and the second stage (T2) transfers findings from clinical studies or clinical trials to practice settings and communities, where the findings improve health.

Several nutrition studies have been “translational.” Understanding the role of nutrition to health began as early as 400 BCE when Hippocrates stated: “Food is medicine, medicine is food.” We began to learn about micronutrient deficiencies that led to fortification of foods to improve health. The policy for the removal of trans fatty acids from foods was fast tracked to lower risk for cardiovascular disease: this was translational. Both DELTA and DASH (Dietary Approaches to Stop Hypertension) are examples of translational research studies.

3. What do you enjoy most about the research process?

Each day comes with an opportunity to learn and contribute to research in different areas of medicine. My work includes helping with research design, implementation, data collection, and analysis for a variety of studies. The work is never routine. I also introduce dietetic interns to nutrition research methodology during their rotations, and I teach in the medical and dental schools at Columbia University.

I have been inspired by a number of nutritionists in research such as Audrey Cross, Penny Kris-Etherton, Judith Wylie-Rosett, Theresa Nicklas, Linda Delahanty, Cynthia Thomson, Linda VanHorn, Linda G. Snetselaar, and my fantastic colleagues in the National Association of Bio-nutritionists. I had the opportunity to work with outstanding RDs on the Academy of Nutrition and Dietetics Evidence Analysis Library (EAL) projects on Disorders of Lipid Metabolism and chaired the expert committee. My research interests gave me opportunities to serve on the Research Committee and Evidence-Based Practice Committee. As a national spokesperson for the Academy of Nutrition and Dietetics for 11 years, I had an extraordinary opportunity to translate research findings to the American public through television, print, and radio.

4. What tips do you have for practitioners who want to do practice-based research?

The advice I would give to a young researcher looking to develop a successful line of research is that the research process begins with ideas generated through a review of literature in the area of interest. These ideas lead to the development of research questions and hypotheses. Also, young researchers need to find mentors in their areas of interest.

Research is the backbone of our profession. Research gives credibility to the profession. RDNs have the responsibility to make evidence-based diet and lifestyle recommendations to their patients, clients, and fellow Americans. Nutrition research provides the tools for practice and provides an understanding of the role of diet in the prevention of disease and promotion of health. In the past two decades, nutrition research has clearly demonstrated that diet is the cornerstone in the prevention and lowering of risk for several chronic diseases.

RDNs interested in getting involved in research can learn about the Dietetics Practice Based Research Network (DPBRN). This network is a membership benefit and gives practicing RDNs access to researchers who can mentor them to use practice settings to conduct research. Prior research experience is not necessary to participate in the DPBRN. You can start with this web page: <http://www.eatrightpro.org/resources/research/projects-tools-and-initiatives/dpbrn/>

SUMMARY

1. Research is a systematic process of collecting, analyzing, and interpreting information/data to answer questions to extend knowledge. A systematic process means that research is completed using a system; that system is usually the scientific method.
2. The scientific method (see Figure 1.1) is a step-by-step process involving defining the problem, reviewing the literature, developing a research question (or hypothesis) and objective, developing the research design and methods to be used, collecting and analyzing data, interpreting results, drawing conclusions, and disseminating findings.
3. Study variables are any characteristic that can take on different values (such as BMI or social support) and are measured, controlled, or manipulated in research. Variables can be categorical or continuous. In an experimental study, the hypothesis shows a relationship between an independent variable (what the researcher manipulates, such as diet) and a dependent variable (what the researcher measures, the outcome measure).
4. Quantitative research designs are used to look at causal relationships as well associations or relationships between variables.
5. One way to classify research is according to its purpose: studies may explore, describe, analyze, or predict. Exploratory studies are often qualitative research. Descriptive research describes a wide variety of phenomena. Analytic research tries to quantify the relationship between an intervention on an outcome (an experimental study) or an exposure on an outcome (such as in a prospective cohort study).
6. Quantitative research uses the scientific method to describe and examine relationships among variables (descriptive studies) and examine cause-and-effect relationships (analytic studies). Control is used to prevent outside factors from influencing the results.
7. Qualitative research does not manipulate variables or put a group through an intervention. The qualitative researcher gets into the shoes of the study participants to capture information not conveyed in quantitative data, such as values, beliefs, or motivations behind behaviors. Qualitative research uses a systematic process.
8. The differences between quantitative and qualitative research spring from the researcher's paradigm on how the world works—either a positivist paradigm or a constructivist paradigm. Both types of research have advantages and uses (see Table 1.2).
9. Intervention studies test the efficacy of an intervention (whether it can work under controlled conditions, often using randomized controlled trials). Outcomes research tests the effectiveness (whether it achieves the desired treatment goal in a real-world setting) and cost-effectiveness of an intervention. Intervention studies and outcomes studies both use quantitative research designs. Outcomes may include direct nutrition care outcomes, clinical outcomes, patient outcomes, and cost outcomes.

10. Epidemiology is a discipline within public health that looks at the rates of health-related states (such as disease) in different groups of people (descriptive) and why they occur (analytic). Nutrition epidemiology is a subdiscipline.
11. Translational research is a systematic process of transforming findings of basic science or clinical studies into practical applications and evidence-based practice that improves the health of individuals and populations. In brief, it is research that goes “from bench to bedside to community.”
12. The Dietetics Practice-Based Research Network (DPBRN) links practitioners with each other and with researchers to do effectiveness (outcomes) research and additional types of research and projects.

REVIEW QUESTIONS

1. A statement of the problem:
 - A. is the same as a research question
 - B. includes a hypothesis
 - C. explains the context for why the research is needed
 - D. includes the research design
2. Most research:
 - A. uses the scientific method
 - B. involves finding answers to a question
 - C. includes variables
 - D. all of the above
3. An experimental study is an example of what type of research?
 - A. qualitative
 - B. analytic
 - C. descriptive
 - D. associative
4. A randomized controlled trial is an example of a research:
 - A. design
 - B. question
 - C. problem
 - D. control
5. In an experimental study looking at the effects of a weight loss drug on weight loss, which is the independent variable?
 - A. weight loss
 - B. drug
 - C. physical activity
 - D. all of the above
6. A study examined two variables: the density of fast-food restaurants in communities and the BMI of the residents. What type of relationship are the researchers looking at?
 - A. association
 - B. relative risk
 - C. causation
 - D. confounding
7. Qualitative research is most likely to have what type of research purpose?
 - A. explore
 - B. describe
 - C. analyze
 - D. predict
8. A prospective cohort study, such as the Nurses’ Health Studies is a(n):
 - A. experimental study
 - B. quantitative study
 - C. qualitative study
 - D. exploratory study
9. A study that uses focus groups and in-depth interviews with participants is likely to be a(n):
 - A. experimental study
 - B. quantitative study
 - C. qualitative study
 - D. analytic study
10. Which type of study is more likely to use animals?
 - A. qualitative
 - B. applied
 - C. basic
 - D. action
11. List and briefly describe the steps in the scientific method.
12. List five differences between quantitative and qualitative research. Name an advantage and a disadvantage for each type of research.
13. What is mixed methods research?

14. Compare and contrast a prospective cohort study with an experimental study. Are they both analytic studies?
15. The National Health and Nutrition Examination Survey (NHANES) assesses the health and nutritional status of about 5,000 adults and children each year in different locations. Find an example of a study using NHANES data and explain its research objective.
16. Describe a research question for which a qualitative study would be most useful. Also describe a research question for which a quantitative study would be most useful.
17. Compare and contrast intervention research with outcomes research.
18. List five examples of outcomes that you might find in a study.

CRITICAL THINKING QUESTIONS

1. Read this study and answer the following questions. (Open-Access Article) Fildes, van Jaarsveld, Wardle, & Cooke. (2014). Parent-administered exposure to increase children's vegetable acceptance: A randomized controlled trial. *Journal of the Academy of Nutrition and Dietetics*, 114, 881–888. doi: 10.1016/j.jand.2013.07.040
 - A. Why was this study done? In other words, define the problem(s).
 - B. In your own words, what was the purpose of the study.
 - C. What was the hypothesis?
 - D. The research design was a randomized controlled trial. What elements of the study methods indicated that it was a RCT? Describe them briefly.
 - E. What were the independent and dependent variables?
 - F. Explain the tasting game that the intervention group played.
 - G. What does Figure 1.2 tell us about the intake and liking of vegetables in the intervention versus the control group from T2 to T3?
 - H. Summarize the study findings in two sentences or less.
2. **Study Summary:** The objective of the study was to interview current vegetarians and former vegetarians to explore their perceptions of the vegetarian diet and whether their perceptions had changed over time. The instruments used were semistructured interviews and focus groups. The study was a cross-sectional study, meaning that the study took place at the same point in time in the given population (Barr & Chapman, 2002).
 - A. Is the study quantitative or qualitative?
 - B. Is the study basic or applied?
 - C. Is the primary purpose of the study to explore, describe, analyze, or predict?
 - D. Is the study experimental? If so, name the independent and the dependent variables.
 - E. Is the study a randomized controlled trial? Could it be an intervention or outcomes study?
 - F. Is the study epidemiological or translational in nature?
3. **Study Summary:** The objective of the study was to test whether adding a dietitian to a hospital discharge team for geriatric patients would improve the nutritional status of those patients over 6 months. Geriatric patients were randomly assigned to either the regular discharge team or the discharge team with the dietitian. All patients were at least 70 years old and determined to be at nutritional risk. The dietitian gave each discharged patient three home visits within 8 weeks of discharge. Nutritional status was measured using weight, muscle strength, and other measures. Adding a dietitian to the discharge team did improve the nutritional status of geriatric patients (Beck et al., 2015).
 - A. Is the study quantitative or qualitative?
 - B. Is the study basic or applied?
 - C. Is the primary purpose of the study to explore, describe, analyze, or predict?
 - D. Is the study experimental? If so, name the independent and the dependent variables.

- E. Is the study a randomized controlled trial?
 F. Describe the intervention.
 G. Is the study epidemiological or translational in nature?
4. **Study Summary:** The researchers examined the association between consumption of coffee with the risk of mortality in the Nurses' Health Study over a 25-year period. Results showed that higher consumption of coffee was associated with a lower risk of total mortality (Ding et al., 2015).
 A. Is the study quantitative or qualitative?
 B. Is the study basic or applied?
 C. Is the primary purpose of the study to explore, describe, analyze, or predict?
 D. Is the study experimental? name the independent and the dependent variables.
 E. Is the study epidemiological or translational in nature?
5. **Study Summary:** This study aimed to determine whether vitamin D supplementation can reduce the risk of developing type 2 diabetes in adults (30 or older) with prediabetes. Participants were randomly assigned to receive either a vitamin D pill or a placebo. The study was double-blinded and ran long enough to determine whether vitamin D made a difference (Pittas et al., 2014).
 A. Is the study quantitative or qualitative?
 B. Is the study basic or applied?
 C. Is the primary purpose of the study to explore, describe, analyze, or predict?
- D. Name the independent and dependent variables.
 E. Is the study a randomized controlled trial?
 F. Describe the intervention.
6. **Study Summary:** The aim of the study was to feed fruit flies (in the very young larval stage) a control diet or a high-sugar diet to see whether they became insulin resistant and obese, risk factors strongly associated with type 2 diabetes. Results showed that larvae on the high-sugar diet became insulin resistant, hyperglycemic, and fat (Palanker Musselman et al., 2011).
 A. Is the study quantitative or qualitative?
 B. Is the study basic or applied?
 C. Is the primary purpose of the study to explore, describe, analyze, or predict?
 D. Is the study experimental? name the independent and the dependent variables.
7. **Study Summary:** The aim of the study was to see if there is a link between children being overweight or obese and developing asthma. Using results from 48 previously published studies, the researchers found a significant, but weak, association between high body weight and asthma (Papoutsakis et al., 2013).
 A. Is the study quantitative or qualitative?
 B. Is the study basic or applied?
 C. Is the primary purpose of the study to explore, describe, analyze, or predict?
 D. Is the study experimental? If so, name the independent and the dependent variables.
 E. Is the study epidemiological in nature?

SUGGESTED READINGS AND ACTIVITIES

1. Zoellner, J., Van Horn, L., Gleason, P. M., & Boushey, C. J. (2015). What is translational research? Concepts and applications in nutrition and dietetics. *Journal of the Academy of Nutrition and Dietetics*, 115, 1057–1071. doi: 10.1016/j.jand.2015.03.010
2. To learn more about descriptive and analytic epidemiology, visit the Centers for Disease Control and Prevention (CDC) website for Self-Study Course SS1978, “An Introduction to Applied Epidemiology and Biostatistics.” Sections 6 and 7 in Lesson One cover descriptive and analytic epidemiology.
3. To learn more about evidence-based practice, go to the Evidence Analysis Library (www.andeal.org). Read “Methodology” and “Why Use Evidence-Based Practice” under the Methodology tab.
4. To learn more about the Dietetics Practice-Based Research Network, go to the DPBRN page at eatrightpro.org and listen to the recorded presentation.

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