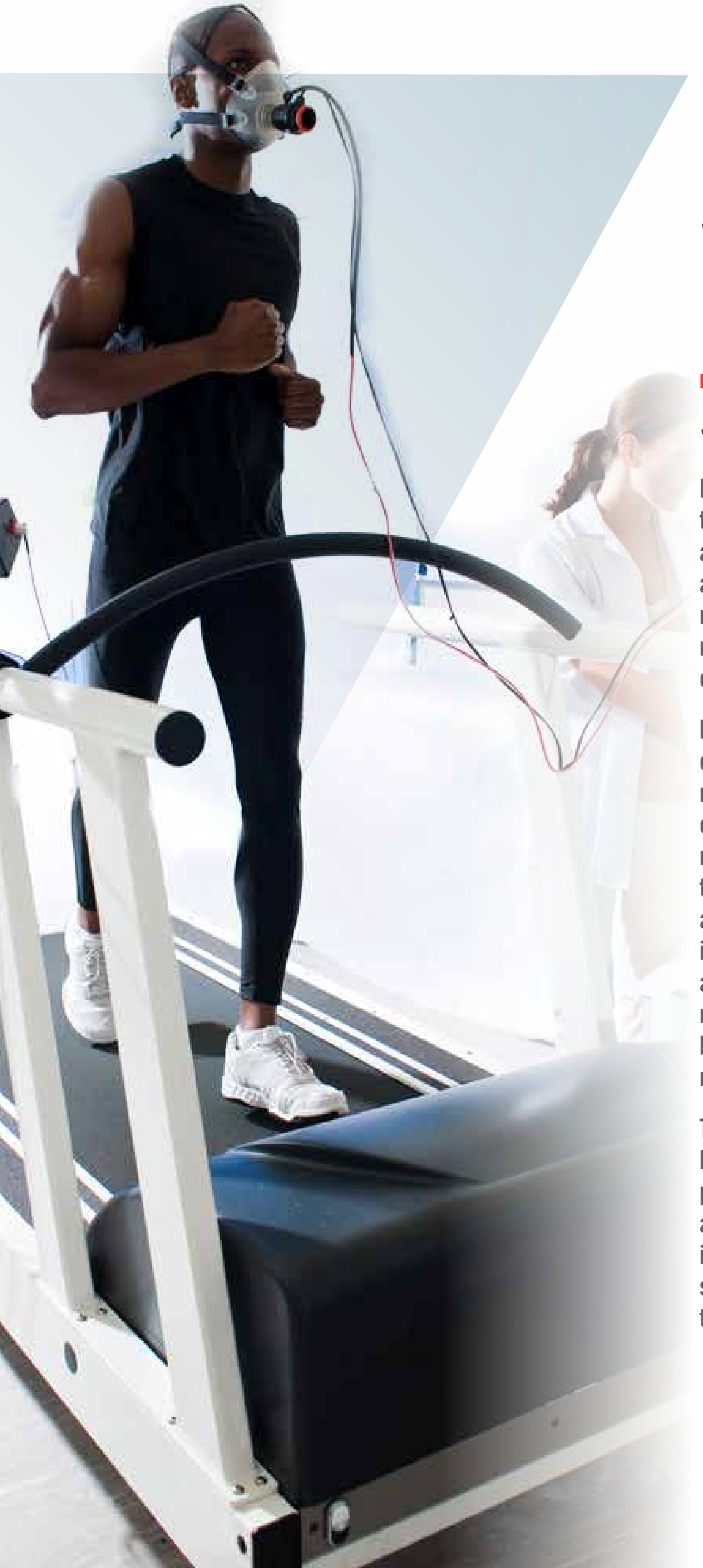

INTEGRATING SCIENCE WITH PRACTICE

RESEARCH FROM THE SCIENTIFIC ADVISORY PANEL

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Health and fitness professionals who stay current with the latest research findings in the areas of health and fitness are more likely to be aware of the best approaches to exercise training for helping clients meet their goals. Keeping up-to-date with fitness-related information involves deciphering the quality and context of published research in the field.

Merging science and practice in fitness takes commitment to reading published data and scrutinizing research, and then applying that information to clients on an individual basis dependent on their goals and needs. Critical thinking is a skill that is developed over time through practice and continued learning. Health and fitness professionals must carefully choose which information they use when making important decisions about training their clients. In addition to knowing how research studies are conducted, professionals should be aware of factors that either support or detract from reported evidence, including bias and logical fallacies.

The investment in time and the effort of gaining this knowledge is crucial, as it will allow health and fitness professionals to recognize high-quality evidence and avoid unfounded or fraudulent claims. Ultimately, it is the clients who benefit from professionals who are savvy consumers of fitness information, as they reap the rewards of safe and effective training practices.

The science of exercise is rooted in the foundations of anatomy and physiology, which explore the structure and function of the human body.

KEY POINTS

- Scientific research is a systematic process that attempts to establish differences, relationships or causality among different variables.
- The scientific method is a systematic investigation of scientific theories and their resultant hypotheses.
- Science involves both inductive and deductive reasoning, and the difference is important in understanding the generalizability of research results.
- One way to determine the merit of research claims is to look for general scientific consensus on the matter.
- Distinguishing between quantitative and qualitative data can help the reader decide how well the results of a study match the type of information the reader wants to know.
- Health and fitness professionals should understand the following terms and how they impact the value of research results: validity, reliability, sample size, study limitations and peer review.
- Health and fitness professionals must carefully choose which information they will utilize when making important decisions about training their clients. In addition to knowing how research studies are conducted, professionals should be aware of factors that either support or detract from reported evidence, including bias and logical fallacies.

HEALTH AND FITNESS professionals are tasked with marrying the principles of exercise science with the art of crafting safe and effective exercise programs that take into account individuals' needs, goals and personal preferences. Successfully integrating scientifically supported practices into fitness routines should lead to greater benefits for program participants.

The science of exercise is rooted in the foundations of anatomy and physiology, which explore the structure and function of the human body. The primary purpose of exercise physiology is to study the specific challenges to the body's interrelated systems as experienced through the stress of acute bouts of exercise and chronic physical training.

In the field of exercise physiology, hypotheses are tested by scientists who conduct both basic and applied research. Basic researchers attempt to determine mechanisms involved in various processes. Typical studies focus on cellular and molecular processes, such as how organ systems respond to various factors (e.g., the stress of different types of exercise). Applied researchers usually conduct studies with a focus on more practical issues that can be applied in current practice, such as ways to increase athletic performance or improve health and reduce disease.

Most exercise science researchers are employed in universities and clinical settings. These types of jobs typically require the scientists to obtain terminal degrees, such as PhDs, which involve at least four to five years of study beyond the undergraduate level. While continued research in the exercise sciences is crucial for the advancement of the field, exercise physiologists are not necessarily practitioners. Fitness practitioners are individuals who may or may not hold a college degree in a related area of study, but nonetheless can benefit from being informed consumers of scientific research.

According to the U.S. Department of Labor,[1] employment of practitioners is projected to increase by 13 percent between 2012 and 2022. Currently, the barrier of entry into the field is relatively low, as there is no consensus on established standardized credentials for health and fitness professionals, nor are there nationwide regulations governing the practice of fitness instruction. A formal education and/or degree in

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exercise science is not necessary to become a health and fitness professional, though there are many resources available to help interested individuals gain the knowledge and skills they need to do so. Some resources are more reputable than others; health and fitness professionals may struggle with discerning credible facts from superfluous or even potentially harmful material. The low barrier for entry into the profession, coupled with access to a virtually limitless stream of fitness content on the internet, has set the stage for this information overload.

Certainly, conducting scientific research is not a prerequisite for exercise instruction. Leading and implementing fitness programs is based on applied science, and yet health and fitness professionals are not scientists. However, practitioners do have a responsibility to regularly read and comprehend exercise-related research, as well as published guidelines and consensus statements regarding best practices for the safe and effective implementation of exercise programs. Understanding what the evidence supports (and does not support) will help professionals navigate through the seemingly endless amounts of information that are available on health and fitness. This skill can be useful when scrutinizing common industry practices, but is not necessarily helpful to clients. A good example of this can be found when researching the relationship between stretching and injury during exercise/sport performance, which shows that there is no scientific consensus on the types of stretching to reduce injury risk, or if stretching is even a factor in injury prevention.[2,3] Yet, there are many health and fitness professionals who promote stretching as a way to prevent injury.

Staying current with the latest findings in the areas of health and fitness reveals the best approaches to exercise training for helping clients meet their goals. Keeping up-to-date with fitness-related information involves deciphering the quality and context of published research in the field. This paper reviews strategies for health and fitness professionals who are seeking to better understand the scientific method and how to apply it in practice.

BASIC CONCEPTS IN INTERPRETING SCIENTIFIC RESEARCH

Scientific research is a systematic process that attempts to establish differences, relationships or causality among different variables. Learning to analyze a scientific paper takes time and practice. Researchers often use unfamiliar terms, which require the reader to look up definitions. Studies often involve methodologies that may require several readings to fully grasp, as what is done in research is often very different than the way fitness professionals implement training in practice. Comprehending scientific research requires a basic understanding of several concepts used in science. What follows is a review of important principles that will help advance a basic understanding of research methods. A detailed discussion of the scientific method and the use of statistics is beyond the scope of this paper, and the reader is encouraged to further investigate these concepts in the material listed in the reference list.

Scientific Method

In its simplest form, the scientific method is a step-by-step process that researchers use to discover answers to questions:

- Forming a testable hypothesis
- Devising a study and collecting data
- Examining the data and reaching conclusions
- Reporting the findings of the study

It is a systematic investigation of scientific theories and their resultant hypotheses. A research **hypothesis** is an educated guess that is offered to test something that has yet to be explained, whereas a **theory** is the result of repeated observations and testing of hypotheses that lead to an explanation about something that is assumed to be true. The distinction between a hypothesis and a theory is an important one, as a theory has been extensively tested and may be generally accepted, while a hypothesis is a speculative guess that remains untested. An example of a research hypothesis is the statement, "A strength-training program of progressive resistance exercise leads to increased muscle strength." After repeated testing, a scientist can move to change a hypothesis to

a theory, based on evidence. So, the same statement above can be considered a theory after it has passed the requisite testing. Further testing of a theory can build support for its accuracy. It is also possible for an existing theory to be challenged and determined wrong by new research. A theory cannot be proven because it is simply an interpretation of the available evidence. Science tries to determine the probability that an idea should be accepted or rejected based on the evidence. A program of scientific research often involves both inductive and deductive approaches to understanding data. Inductive reasoning involves collecting data and testing hypotheses to build theories, an exploratory approach. Induction is the process of moving from specific observations to general statements. Deductive reasoning involves testing hypotheses based on existing theory, a confirmatory approach. A good scientific theory makes predictions that can be tested in the form of hypotheses. Thus, deduction is the process of moving from general statements to see if specific observations support them. Science generally relies on both processes, and it is important to distinguish between these approaches when understanding the generalizability of results.

Quantitative versus Qualitative Research

Objective, formal research is quantitative in nature, as it sets out to use numerical data to obtain information or, as the name implies, quantify results. Quantitative research involves samples of participants from whom numeric data are collected. These data are then used to generalize about a larger population of individuals. An example of **quantitative research** is a study designed to test a hypothesis comparing two modes of exercise (e.g., running and cycling) with a metric of intensity (e.g., percentage of $\dot{V}O_2$max). **Qualitative research** involves variables which are more difficult to quantify, such as interviews, journals, and other subjective pieces of information. Qualitative research usually involves relatively small samples of participants from whom detailed, but non-numeric information is collected. Qualitative studies often investigate variables such as feelings, opinions and emotions, and generally use words rather than numeric data. For example, a study that interviews a few participants about their feelings about the difficulty of a task (e.g., asking marathon runners about their mood and perceptions of fatigue at different points along the race route) would fit into the qualitative category. Qualitative information can also be transformed into quantitative data by assigning it numerical labels (e.g., recording the frequency with which marathon runners responded as having feelings of irritability during a race).

> ***A good scientific theory makes predictions that can be tested in the form of hypotheses.***

Distinguishing between whether the data collected in a study are quantitative or qualitative can help the reader decide how well the results match the type of information that the reader wants to know. For example, if the reader is searching for data on the extent to which different running paces elicit various intensity responses as represented by percentage of VO_2max, he or she will be looking for quantitative information about a physiological variable. On the other hand, if the reader is interested in learning about the subjective experiences of marathoners after running their first race, the results will be in the qualitative realm.

Validity

When a study successfully measures what it sets out to measure, it has **validity.** Two key types of validity are internal and external. **Internal validity** applies to the treatments and outcomes within the study itself, whereas **external validity** involves the extent to which the study's results can be applied to the real world.

Research with internal validity means that no variables other than the ones that were assessed in the study are responsible for causing the result. For example, researchers concerned with comparing the performance of a specific lower-extremity exercise program with quadriceps strength outcomes want to be sure that the treatment (i.e., the exercise program) caused the difference in quadriceps strength (not changes in diet, extraneous leisure time physical activity, competition or

motivation levels). When unintended factors influence the results of a study, the data have been confounded, or clouded. These factors are called **confounding variables.** The best research designs try to eliminate the possibility that anything other than the treatment variable caused the changes in outcome.

Because the goal of most research is to generalize findings to the greater population, working to enhance external validity is important. Using the quadriceps strength example above, if the subjects in the treatment group were a sample of 19-year-old collegiate volleyball players who agreed to participate in an exercise study during their postseason break, it would be erroneous to infer that their results would apply to the greater population as a whole. The external validity of a study based solely on athletic, young women is low because those results do not translate well to other conditions or other groups.

Reliability

Another important concept in scientific research is **reliability.** A test is reliable when it has been shown to produce repeated, consistent results. Consider, for example, a researcher who measures a subject's body weight using a standard scale. The first time the subject is weighed, the scale reads 200 lb. A few seconds after the first weighing, the researcher assesses the same subject again and gets a reading of 180 lb. One more weighing results in a reading of 195 lb. Clearly, the scale being used is not a reliable instrument of measurement.

In addition to equipment-related issues, there are two other types of reliability to consider in research: inter-researcher and test-retest. Good **inter-researcher reliability** results when different researchers perform the same experiment and get the same or similar results. An example of good inter-researcher reliability is when several researchers assess the same subject's body composition using skinfold calipers and all come up with the same or very similar body-fat percentage. **Good test-retest reliability** occurs when the same test is performed on the same subject on different occasions and results in the same or similar score. For example, when a researcher measures a subject's blood pressure at the same time every day for seven days and gets a similar reading, there is good test-retest reliability.

> *Good inter-researcher reliability results when different researchers perform the same experiment and get the same or similar results*

Sample Size

In research, scientists prefer to study large sample sizes. The larger the sample size, the closer the distribution of sample proportions is to a normal distribution, as long as there is no bias in the selection of the sample. In addition, a larger sample size means a lower margin of error. If the sample size is large, and the sample is representative of the target population (meaning randomly selected), the information tends to be more accurate. Be wary of research that finds results based on sample sizes smaller than about 30 subjects.

Study Limitations

Many research studies discuss the limitations of the study. This informs the reader of hindrances to the research such as what could not be investigated, what other factors could not be considered or controlled, what problems occurred along the way or to what extent the findings can be generalized. Whenever possible, getting access to the full paper and reading the study limitations will aid in understanding how the evidence applies (or does not apply) to the population as a whole or to other groups.

Peer Review

In scientific research, the peer review process is held up as the gold standard for ensuring that studies are worthy of publication. This process occurs when a journal sends a submitted scholarly paper to a group of experts in the same field to ensure that it meets certain standards prior to its acceptance. Academic journals use peer review as a means to confirm that a research paper is acceptable and worthy of publication.

RESEARCH DESIGNS

Scientists use a variety of research designs when structuring their studies. Research designs are basically categorized as either experimental or observational.

Experimental

In experimental designs, researchers are investigating the effect that one variable has on another, such that the **independent variable** affects the **dependent variable.** Scientists are looking for a cause-and-effect relationship. For example, in a study that tests the effect of cardiorespiratory exercise on blood pressure, the treatment (cardiorespiratory exercise) is the independent variable and the outcome (blood pressure) is the dependent variable.

Observational

In an observational study, the researcher simply observes the subject or subjects and makes note of the information. No treatment or changes are introduced and no controls are used. The researcher is viewing the subject and then making connections based on his or her observations. Observational studies are not as powerful as experimental studies because they are not controlled and they cannot identify a cause-and-effect relationship between variables, as is done in experiments. Cross-sectional, case study and longitudinal research designs are all types of observational studies.

Cross-sectional

When researchers want to learn information about a range of participants with different backgrounds, ages and genders, they perform a cross-sectional study. An example of cross-sectional research would be a questionnaire sent out to a variety of people with the intent of surveying their physical-activity preferences. The researchers could then produce some descriptive statistics about the types of activity people enjoy (e.g., 75 percent of men enjoy lifting weights, 20 percent of men enjoy aerobic activities and 5 percent have no preference).

Case Study

The case-study approach involves looking at a particular case (e.g., an individual or a team) over time. The case study takes into account the independent variable as it affects the dependent variable over a specific period and the environment in which the research takes place. An example of a case study would be to investigate the effects of a rehabilitative exercise program on one individual throughout the different phases of injury healing. The results of a single case study could then be put forth as a suggestion for the direction of future research on a larger scale.

Longitudinal

Longitudinal research investigates a set of variables over time. The researchers measure the variables at set intervals, typically to observe developmental issues over time. For example, researchers who want to know about the potential for the development of hypertension could follow the same sample of individuals over a lifetime and assess their blood pressure at ages 20, 40, 60 and 80. An obvious drawback of this type of research is the time investment and resources required to conduct such studies.

CAREFUL CONSIDERATION OF SCIENTIFIC EVIDENCE

Understanding the scientific method and learning about the basic types of research is only the beginning of integrating science into practice. Perhaps the most challenging part of this process is realizing how to scrutinize the research and then apply it in everyday situations. It is important to keep in mind that science does not have all the answers. In fact, scientific conclusions are always provisional, meaning that scientists follow wherever the evidence leads. Science is based on the principle that any established idea could be overturned tomorrow if the evidence warranted it. Because scientists are continuously conducting research, there are times when theories that were once generally accepted are abandoned or modified because a new body of evidence has emerged. This unending search for getting at the truth is one of the major benefits of science—it asks questions and then works to verify the answers.

The Miasma Theory of Disease: A Scientific Consensus Challenged and Then Replaced

The miasma theory of disease is an example of an established medical concept developed in 6th century B.C. that was later updated and replaced with the modern germ theory. In the early days of medicine, physicians believed that air became contaminated with "miasmas," or poisonous vapors produced by putrefying organic matter, and that a person could become infected when miasmas invaded the body and disrupted normal function. The miasmatic position proffered that environmental factors such as contaminated water, foul air and poor hygienic conditions—all identifiable by a foul smell—caused disease. Miasmas were, in effect, inhaled and ultimately resulted in illness. For example, malaria was attributed to "bad air" and influenza was associated with the "influence of bad conditions." As scientists continued to investigate disease throughout the centuries, and utilized advances in technology—such as those suitable to study microbiology—they began to replace their once firmly held beliefs based on the new evidence.[4] Disease transmission and contagion were established medical principles well before microorganisms were identified. In modern medicine, infectious diseases are diagnosed and treated based on principles of the germ theory, which holds that microorganisms (rather than foul air) enter the body and produce illness. The medical community's progression from the miasma to germ theory is a lucid demonstration of how the scientific process results in enhancing our understanding of the environment.

As practitioners in a science-based field, health and fitness professionals must carefully choose which information they will utilize when making decisions about training their clients. In addition to knowing how research studies are conducted, professionals should be aware of factors that either support or detract from reported evidence. This section details some common pitfalls that can stand in the way of getting a clear picture of what scientific evidence really shows.

Bias

When reading health and fitness information, whether it is from a peer-reviewed academic journal or an expert posting a blog about a science-based fact, the first issue to consider is the potential for bias. In statistics, bias is an error that either underestimates or overestimates true value. There are many examples of bias in research and reporting. The following list represents three common sources of bias-related error.

Instrument Bias

When an instrument used to measure a variable in a research study malfunctions, it can lead to measurements that are systematically off. An example of instrument bias is a researcher using a weight scale that adds 5 lb to each subject's body weight. Hence, prior to initiating research, scientists carefully assess and calibrate their equipment as a way to minimize bias due to instrument error.

Researcher Bias

Scientists are people, and as such are prone to human error. A human quality that persists in science is the fact that all individuals are biased. A person's bias is the sum of his or her beliefs, experiences and emotions, which leads to a preference for certain ideas and explanations prior to openly considering new information. A specific type, called **confirmation bias,** can occur when an investigator seeks out evidence that supports only his or her belief or opinion on a subject to the exclusion of all other data that might refute it. Scientists have to be careful that their own interests do not influence their study results or the reporting of the conclusions.

Researchers have a vested interest in their study outcomes. One way to account for researcher bias in an experiment is to conduct a double-blind study, wherein the researcher and the subjects are unaware of which treatment is given to each subject group. In the double-blind approach, it is more likely that scientists will treat and interact with all subject groups the same way because they do not know which subjects are receiving a treatment and which subjects are the controls.

Subject Bias

When researchers conduct an experiment on subjects, they take a sample of people and divide them into groups. The subjects are assigned to either a **treatment group,** which receives the treatment being studied, or a **control group,** which receives either no treatment or a fake (placebo) treatment. The way in which subjects are assigned to their groups plays an important role in how biased or unbiased the results will be. Take, for example, a study on the effects of exercise on heart rate. The researchers want to investigate how a 16-week program of walking for 30 minutes, four days a week affects the subjects' resting heart rate. The researchers recruit volunteers for the study and then have the task of assigning them to the exercise treatment group or the control group (no structured exercise). If the investigators left it up to the volunteers, individuals who are already physically active and enjoy exercising might sign up for the treatment group. The control group, on the other hand, might consist of subjects who are sedentary. In this scenario, the results would be biased because the researchers would be looking at the effects of exercise on an already fit and active group of people, to the exclusion of the subjects in the control group who are presumably unfit. To avoid this type of subject bias, researchers employ random assignment to the treatment/control groups, which leads to more fair and balanced groups and results that are more credible.

Minimizing Bias through a Randomized Controlled Trial

A randomized controlled trial (RCT) is a quantitative, comparative, controlled experiment in which investigators study various treatments and subjects are assigned to experimental and control groups in a randomized order. A double-blinded RCT is one of the simplest and most powerful tools used in health research. RCTs are often referred to when supporting claims for evidence-based arguments, as they are known for minimizing bias. Again, the larger the sample in a RCT, the more powerful the study.

Scientific Flaws and Logical Fallacies

After researchers finish collecting their data, they draw conclusions about the evidence. Drawing conclusions is one of the biggest areas where scientists can make mistakes in research. An even larger problem occurs when an individual who has a large social following or who is a respected leader in a field offers the public his or her interpretation of published research. Sometimes, that interpretation misses the mark. This section covers common errors made in drawing conclusions.


A double-blinded RCT is one of the simplest and most powerful tools used in health research.

Overstating the Results

When researchers make big claims about the results of their study, or when headlines make a big deal about the latest research, be sure to look very closely at the details of the study. This means reading the entire study, not just the abstract. Often, the results are not as grand as what the headlines would lead us to believe.

Ad Hoc Explanations

Some researchers may use *ad hoc,* or after-the-fact, explanations to draw conclusions about their results. *Ad hoc* is a Latin phrase that means "for this," as in when a person justifies an explanation specifically "for this purpose." *Ad hoc* explanations should be viewed skeptically when they exist for no other reason but to save a preferred hypothesis. This can occur when a person's attempt to explain an event is effectively disputed, so the speaker reaches for some way to salvage his or her claim. Often, *ad hoc* explanations are simply not supported by the study at hand because the structure of the study was not originally intended to test the question answered by the *ad hoc* explanation.

Ad hoc explanations have been used by individuals who claim to have conducted tests on paranormal experiences, such as extra-sensory perception (ESP). Consider, for example, the case of an ESP researcher who wants to test a person he believes has ESP by asking him to guess the number written on an unseen card. If the investigator does not get the results he was hoping for, he might blame the hostile thoughts of onlookers for unconsciously influencing the ESP connection between the subject and the card. This *ad hoc* explanation has nothing to do with the experiment at hand and therefore cannot be tested or verified.

Overgeneralizing

The conclusions drawn about the results of a study can be generalized only to a larger population that is represented by the sample used in the study. Often, true representative samples of a population are difficult to get, so researchers may try to draw conclusions that have a broader scope than their sample. Using the earlier example of research conducted with collegiate volleyball players, suppose an expert claims that his strength-training program will result in massive strength gains for anyone who attempts it. Upon further questioning, the expert reveals that his claims are based on a quadriceps strength study of a sample of 19-year-old collegiate volleyball players. Clearly, if this is the only evidence on which the expert is basing his program, he is making the error of overgeneralizing the results of one study based on a specific population to all individuals. Would a 55-year-old sedentary man receive the same benefits from the quadriceps strength study as did the 19-year-old women? Would a 30-year-old competitive body builder enjoy massive overall strength gains using a program targeted at training the quadriceps for a group of volleyball athletes? The evidence does not support the claim that the training program used in the study could impart massive strength gains to all individuals.

Misinterpreted Correlations

In statistics, a correlation is a relationship between two numerical values, and it depends on how closely the data resemble a certain pattern. In a positive linear correlation, the numerical values rise or fall together, and in a negative linear correlation, ones set of values increases while the other decreases. For example, during exercise, heart rate increases as physical exertion increases. There is a positive linear correlation between heart rate and exercise intensity (up to the point where intensity approaches maximal exertion). A negative correlation is found when the same absolute weight becomes a lower relative percentage of maximal strength as maximal strength rises with training. There are times when one of the variables being studied causes the other to change, but this is not always the case. Take, for instance, the observation that a sharp rise in ankle sprains is reported during the months of May, June and July. At face value, this information could mean that people are more prone to injuring their ankles as the heat index rises. However, no one would argue that a rise in outdoor temperature directly causes ankle sprains. A more likely explanation is that when the weather gets warmer during the summer months, people spend more time outdoors being active, which leads to more opportunities to twist an ankle compared to other seasons when people are more inclined to remain indoors being less active. The two values, number of ankle sprains and degrees Fahrenheit or Celsius, demonstrate a positive linear correlation, but one variable does not cause the other. That is, correlation does not imply causation.

Anecdotal Evidence

An anecdote is a story or a narrative, typically about a person or an incident. Often, anecdotal evidence is offered as a story told by a single person about his or her experience. Although anecdotal evidence has a strong influence on public opinion and behavior, it has no basis in science or statistics. With an anecdote, there is no information with which to compare the story and no statistics to analyze. There is just a single story. When making decisions about evidence-based practice, health and fitness professionals are better off relying on scientific studies and statistical information based on large random samples of individuals who represent their target populations (not just a single situation).

> *When making decisions about evidence-based practice, health and fitness professionals are better off relying on scientific studies and statistical information based on large random samples of individuals who represent their target populations (not just a single situation).*

Selective Reporting

Selectively offering evidence that supports only one point of view is known as selective reporting or "cherry picking." When a researcher investigates a specific topic, he or she might uncover an impressive mass of data. In some cases, the literature may reveal evidence that is equivocal, meaning that there is a comparable amount of data supporting both sides of an issue, or it may show that only a few studies support one side of the issue, while a vast amount of literature supports the opposing side. If an investigator presents only the data that confirms his or her preferred view, and rejects any evidence to the contrary, the reader is not getting a true and accurate picture of the body of literature. Be wary of professionals who offer examples of evidence that support only their preference or opinion. Sound information is based on the total available evidence and the quality of that evidence, not just the data that is used to win an argument or debate.

Ad Hominem

The *ad hominem* (Latin for "to the man") fallacy occurs when, during a debate, one individual launches personal attacks on another individual rather than addressing the argument at hand. The attacker often resorts to name-calling and labeling, which typically means that the aggressor does not have a logical counter-argument. An example of an *ad hominem* attack is a debater who claims, "You can't believe that this fitness trainer will actually come through on his claim to help you get in shape. He's a pathological liar!"

The current state of social media allows a variety of platforms in which individuals can argue their beliefs and opinions about all sorts of topics, including health, fitness and nutrition. When these types of public debates devolve into a state of *ad hominem* attacks, it is often the case that the people launching those attacks do not have quality evidence to back up their claims, or they lack an understanding of how to read and evaluate the data on a particular subject.

> *The current state of social media allows a variety of platforms in which individuals can argue their beliefs and opinions about all sorts of topics, including health, fitness and nutrition.*

EVIDENCE-BASED PRACTICE IN THE FITNESS SETTING

To benefit from critically evaluating scientific research, health and fitness professionals must take what they learn and apply it in their everyday practice. Because designing and implementing fitness programs requires that multiple factors be considered (e.g., the client's personal goals and abilities and the trainer's skills and experience level), the possible approaches to delivering fitness services are countless. Given that there are a variety of ways to help clients achieve their goals, the best approach for offering quality programs is to draw from as much evidence-based information as possible. This section offers strategies to help health and fitness professionals seek out the best information available so that they can make sound decisions in their dealings with clients.

Find Scientific Consensus

One of the challenges of finding high-quality, evidence-based information is that the media often give equal air time to concepts that oppose each other, even when one side of the argument is not supported by good data. When a few outlying studies or experts make a claim, the media reports on it—especially if the claim is sensational or controversial—making it seem as if the debate is equally weighted (or that a debate even exists), when in fact, the overwhelming scientific consensus is at odds with the outlying claims. In addition, the troubling occurrence of well-respected authorities in health and fitness making bogus claims has become commonplace. A recent example of this occurred when Congress required Dr. Mehmet Oz, the host of "The Dr. Oz Show," to answer questions posed by senators on Capitol Hill about the promotion of weight-loss products on his show. The following is an excerpt of remarks made by Dr. Oz on his show in November, 2012: "Thanks to brand new scientific research, I can tell you about a revolutionary fat buster. No Exercise. No Diet. No Effort. It's called Garcinia cambogia." The scientific evidence for Garcinia cambogia is lacking, yet when Dr. Oz, a well-known public figure and successful cardiothoracic surgeon, promotes this supplement, people are encouraged to buy it.[5]

One way to determine the merit of research claims is to look for general scientific consensus on the matter. When scientists in a particular field of study share a collective opinion or judgment, a scientific consensus exists. The consensus may be based on repeated research, peer review and communication at scientific conferences. To find consensus, look for position statements issued by scientific institutes that communicate a summary of the science for people outside of the scientific community. For example, the article, "AHA Scientific Statement: Supervision of Exercise Testing by Nonphysicians: A Scientific Statement from the American Heart Association," is a position paper offered to health and fitness practitioners as a means to summarize the American Heart Association's consensus on the topic.[6] If an expert's views strongly contradict the current scientific consensus on a subject, it is likely that his or her views are not backed by high-quality scientific evidence.

Look for Research Reviews

Sifting through the all of the scientific research available on a topic and then reading the most relevant papers about that topic is the best approach to understanding the weight of the evidence. However, for many busy practitioners, having the time to read large volumes of research or gaining access to full papers is impractical. In these instances, a good amount of knowledge can still be obtained by reading reviews written by scientists in the field.

When researchers write a scientific paper, they perform a **literature review,** which consists of examining the existing published literature on a subject and then writing a summary of their findings. The literature review is an important part of every research paper, as it lays the foundation for what is already known about the topic. A literature review should not be confused with a type of study called a **systematic review,** which provides an exhaustive summary of current literature relevant to a particular topic. A systematic review uses a complex process to study the studies published on a topic. In evidence-based practices, such as medicine and exercise, systematic reviews of high-quality RCTs are crucial to the development of recommendations and guidelines for the practitioners. As such, if a systematic review can be found on a specific subject, it would be a good place to start when looking for persuasive, high-quality evidence.

Scrutinize Controversial or Sensational Claims

The adage, “If it sounds too good to be true, it probably is,” applies to claims made by anyone who makes statements that are contrary to the scientific consensus. In such cases, it would be wise to systematically scrutinize the claim by practicing the following steps:

- Look for bias on the part of the claimant. Does he or she have anything to gain by promoting this point of view or product?
- Determine if there are any logical fallacies committed by claimant.
- If research is cited, read the full research paper—if possible—to get an idea of the sample size, discover if the subjects were randomly assigned, see the methodology, look at the conclusions and limitations and check for validity and reliability.

SUMMARY

Merging science and practice in fitness takes commitment to reading published data and scrutinizing research, and then applying that information to clients on an individual basis dependent on their goals and needs. Critical thinking is a skill that is developed over time through practice and continued learning. The investment in time and the effort of gaining this knowledge is crucial, as it will allow the health and fitness professional to recognize high-quality evidence and avoid unfounded or fraudulent claims. Ultimately, it is the clients who benefit from professionals who are savvy consumers of fitness information, as they reap the rewards of safe and effective training practices.

ABOUT THE AUTHOR

Sabrena Jo, M.S., has been actively involved in the fitness industry since 1987. An ACE Certified Group Fitness Instructor, Personal Trainer, and Health Coach, Jo teaches group exercise, owns and operates her own personal-training business, has managed fitness departments in commercial facilities, and lectured to university students and established fitness professionals. Jo serves as Senior Exercise Scientist for the American Council on Exercise (ACE), developing and delivering educational content in the form of textbooks, articles, videos, and online courses. She has a bachelor's degree in exercise science, as well as a master's degree in physical education from the University of Kansas, and has numerous certifications in exercise instruction. Jo acts as a spokesperson for ACE and is involved in curriculum development for ACE continuing education programs. Additionally, Jo presents lectures and workshops to fitness professionals internationally and has authored chapters in numerous ACE texts.

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