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# Preventing Childhood Obesity

## A Solution-Oriented Research Paradigm

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**Abstract:** Past research has identified social and environmental causes and correlates of behaviors thought to be associated with obesity and weight gain among children and adolescents. Much less research has documented the efficacy of interventions designed to manipulate those presumed causes and correlates. These latter efforts have been inhibited by the predominant biomedical and social science problem-oriented research paradigm, emphasizing reductionist approaches to understanding etiologic mechanisms of diseases and risk factors. The implications of this problem-oriented approach are responsible for leaving many of the most important applied research questions unanswered, and for slowing efforts to prevent obesity and improve individual and population health. An alternative, and complementary, solution-oriented research paradigm is proposed, emphasizing experimental research to identify the causes of improved health. This subtle conceptual shift has significant implications for phrasing research questions, generating hypotheses, designing research studies, and making research results more relevant to policy and practice. The solution-oriented research paradigm encourages research with more immediate relevance to human health and a shortened cycle of discovery from the laboratory to the patient and population. Finally, a "litmus test" for evaluating research studies is proposed, to maximize the efficiency of the research enterprise and contributions to the promotion of health and the prevention and treatment of disease. A research study should only be performed if (1) you know what you will conclude from each possible result (whether positive, negative, or null); and (2) the result may change how you would intervene to address a clinical, policy, or public health problem.

(Am J Prev Med 2005;28(2S2):194–201) © 2005 American Journal of Preventive Medicine

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### Introduction

The modest effects of past health education interventions<sup>1</sup> have increased interest in environmental and policy approaches to increase physical activity, decrease sedentary behavior and/or reduce dietary energy intake to prevent obesity. These approaches attempt to alter the social, regulatory, or physical environments resulting in individuals adopting more healthful behaviors, whether or not they are aware of their "decisions" to adopt those behaviors. Environmental and policy approaches may be particularly attractive for helping to shape child and adolescent behaviors because (1) most children and adolescents spend a large part of their days in a relatively small number of settings that are susceptible to environmental and policy changes (e.g., home, school, transportation to/from school, child care, and after-school programs); (2) children and adolescents are often

considered unable to make responsible behavioral decisions for themselves; and (3) presumed child and adolescent vulnerabilities justify both preemptive and remedial "protective" actions by parents, institutions, and policy-makers. These approaches have been adopted for other health-related behaviors, and take many forms, such as seat belt and car seat laws, taxes on alcohol and tobacco and prohibitions on sales to minors, prohibitions on television advertising for cigarettes, school immunizations policies, drinking water fluoridation, speed limits, background checks for school employees, and many others.

While interest has rapidly grown in using environmental and policy approaches to prevent childhood obesity, the research needed to inform which specific actions should be implemented is lagging behind. Unfortunately, we are facing an epidemic of child and adolescent obesity among U.S. children and adolescents, in both boys and girls, across all socioeconomic strata and all ethnic groups,<sup>2,3</sup> accompanied by a similar increase in adult obesity,<sup>4</sup> and extending worldwide.<sup>5,6</sup> Of particular concern is the chronic disease burden expected to accompany this epidemic. Approximately 60% of 5- to 10-year-old overweight children manifest at least one physiological cardiovascular disease (CVD) risk factor,<sup>7</sup> and it has been estimated that more than one third of all

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**Table 1.** Contrasting the problem-oriented and solution-oriented research paradigms

<b>Problem-oriented research paradigm</b>	<b>Solution-oriented research paradigm</b>
Focus on causes and correlates of diseases and risk factors.	Focus on solutions, including causes of health, positive outcomes, and reduced risks.
Past orientation—identifies what caused the existing problem. Identifying cause considered a necessary first step in determining solutions.	Future orientation—identifies solutions to move forward. Knowledge of causes for existing problems may be helpful but not necessary or sufficient to identify solutions.
Outcome is understanding causes of problems. Knowledge of causes may inform hypotheses for solutions but may not be any closer to knowing how to treat and/or prevent it. May have indirect relevance to policy and practice.	Outcome is understanding what works and what does not work to solve problems—testing specific treatment and prevention methods—regardless of result, answers may directly inform policies and practices. Direct relevance to policy and practice.
Limits treatment and prevention hypotheses to previously identified and documented causes of adverse outcomes.	Frees investigators to generate and test innovative, theory-based, cross-disciplinary treatment and prevention hypotheses to improve health.
Emphasis on experimental and quasi-experimental studies—capable of proving causality—but in practice, predominantly observational (epidemiologic) studies—incapable of proving causality, more limited by measurement error, and identified moderators and mediators may not be in causal pathway.	Emphasis on experimental and quasi-experimental studies—capable of proving causality—in theory and practice; exposure manipulated so less influenced by measurement error, better estimate of effect size, and identified moderators and mediators known to be relevant to treatment or prevention.
Does not exclude cause or correlate studies with low likelihood of advancing science or informing policy and practice.	Limited to research with a greater direct relevance for policy and practice—meets ethical responsibility to perform research with a high likelihood of advancing science and/or informing policy and practice.
Generally considered easier and less expensive studies.	Generally considered more difficult and more expensive studies, but greater potential to improve health.

U.S. children will develop type 2 diabetes at some point in their lives.<sup>8</sup> In the United States, obesity is second only to smoking as a cause of death,<sup>9</sup> and costs the economy more than \$100 billion per year.<sup>10,11</sup> This crisis demands rapid action. Any delays in knowing which strategies are most useful result in a greater and greater burden of obesity-related morbidity and mortality, and financial and social costs.

Environmental and policy solutions to prevent obesity are enticing to many policymakers at all levels of society, from parents to international agencies. However, when they ask researchers, “What works?” the most responsible answer is, with only a few exceptions,<sup>12,13</sup> “We don’t yet know.”<sup>14</sup> But implementing new strategies and policies without evidence of efficacy or effectiveness may lead to large investments of resources, effort, and time that may or may not result in any benefits.

This paper suggests that the predominant, problem-oriented (i.e., disease-oriented) biomedical and social science research paradigm is responsible for slowing research progress in obesity prevention. There is the fear that if the current paradigm does not evolve, obesity rates will continue to climb, the population’s health will rapidly decline, and a decade from now we will still be depending on “expert” panels to make policy recommendations in the absence of relevant evidence.<sup>15</sup> In response, an alternative, “solution-oriented” research paradigm is proposed to accelerate advancement of the science base supporting environmental and policy interventions. A more timely and

relevant science base would, in turn, inform more effective and efficient strategies to prevent obesity at both the individual and population levels.

### **Contrasting Research Paradigms: Problem Oriented Versus Solution Oriented**

Contrasts between these two research paradigms are summarized in [Table 1](#). The most basic difference between these two research approaches is a focus on problems versus a focus on solutions. The familiar problem-oriented research paradigm focuses on identifying etiologies and correlates of diseases and risk factors. The underlying assumption is that identifying the causes of an adverse outcome is a necessary first step to developing effective prevention and treatment interventions. There is no doubt that this has been, and will continue to be, a productive approach for improving many aspects of human health, leading to—for example—the development of antibiotics targeting specific infectious organisms, chemotherapy and radiation for many cancers, and cholesterol lowering to prevent coronary artery disease and stroke. The vast majority of past and current basic science, translational, clinical, and public health research follows this paradigm.

A contrasting research paradigm is proposed that emphasizes identifying solutions to improve health, rather than causes of poor health. On the surface, this may sound like just the converse of the problem-oriented

paradigm, for isn't health just the absence of diseases and risk factors? In fact, however, this subtle conceptual shift from a problem orientation to a solution orientation has significant implications for generating research questions and hypotheses and designing and implementing studies. The underlying assumption for the solution-oriented research paradigm is that it is not always necessary, or even helpful, to identify causes and correlates of diseases and risk factors before being able to develop effective interventions to prevent and treat them. Very little past or current biomedical research follows this paradigm, and thus it is much less familiar to researchers, which presents a barrier to its adoption. However, the solution-oriented paradigm is the predominant paradigm for practicing medical and public health professionals. Although they are trained with the products of problem-oriented research, medical and public health professionals are often required to intervene before knowledge of the cause or problem is certain. They make informed hypotheses about the efficacy of potential solutions for a given patient or public health problem, implementing those hypothesized solutions, and measuring the effects. As a result, a solution may be implemented successfully and a disease prevented or cured without knowledge of the actual cause. This is the approach taken by John Snow when he removed the handle from the Broad Street pump to stop the spread of cholera in London in the mid-19th century, often considered a seminal event in public health research and practice.<sup>16</sup>

This paper does not refute the value of problem-oriented research, or suggest that it be wholly replaced by solution-oriented research. Instead, it is argued that a better balance between the two would more efficiently advance both scientific inquiry and human health. The current near absence of solution-oriented research in comparison to problem-oriented research, however, makes advocacy for a solution-oriented research paradigm necessary.

### **Past Versus Future Orientation: Phrasing Research Questions**

One of the major conceptual differences between these two research paradigms is that problem-oriented research has a past orientation while solution-oriented research has a future orientation. Because problem-oriented research is focused on etiologies and risk factors for disease, its emphasis is on the causes and processes that lead to a state of poor health or unhealthful behaviors, and thus causes of problems must precede problems, by definition. The outcome of problem-oriented research is knowledge of what to blame for the problem, that is, the factors that produce poor health. Research questions under the problem-oriented paradigm take the form of: Are children who live in neighborhoods with fewer parks and play-

grounds less physically active? Does advertising on children's television lead to increased childhood obesity? Does lack of sidewalks and bike paths lead to less physical activity? Does neighborhood crime lead to physical inactivity? These may be important questions, but their answers may not necessarily lead to effective solutions. Knowing a cause of a problem, while sometimes a helpful first step, does not directly translate into knowing how to intervene to solve that problem.

Solution-oriented research is forward looking, and concerned with what interventions will prospectively promote health and prevent disease. Solution-oriented research may build from prior problem-oriented research but not necessarily, and this approach does not require knowledge of the actual causes of diseases and risk factors before testing potential solutions. The solution-oriented research paradigm leads investigators to phrase their research questions in a forward-looking manner, such as: Does adding parks and playgrounds to a community increase physical activity levels? Does eliminating advertising on children's television reduce obesity? Does adding sidewalks and bike paths lead to more physical activity? Do neighborhood watch programs decrease inactivity? The answer to a solution-oriented research question (whether positive or negative) can be translated directly into an intervention strategy or policy.

### **Is Knowledge of Cause Necessary and/or Sufficient?**

In the current problem-oriented research paradigm, identifying the cause is the necessary first step to identifying a solution. In contrast, in the solution-oriented research paradigm, it is not necessary to first prove that a factor caused the current problem before intervening on that factor to successfully resolve the problem. In the examples above, whether or not too few parks and playgrounds "caused" low levels of physical activity, or advertising on children's television "caused" obesity, adding parks and playgrounds and eliminating advertising on children's television may increase physical activity levels and reduce obesity, respectively, providing effective solutions.

As those examples demonstrate, knowledge of the cause of a problem is not always necessary to identify solutions. Similarly, even when the cause of a problem is discovered, it still may not lead to a solution. If and when we identify the causes of the current obesity epidemic, biological, psychological, social, and/or environmental, will that information tell us how to intervene to reverse the trend? It will certainly help generate hypotheses, some new but the majority likely already thought of, and we will still be required to test them before we know what works and what does not. Under the solution-oriented research paradigm, hypotheses about actual solutions (treatments and preventive interventions) are tested, directly indicating what does and does not work to improve health.

Both paradigms share a focus on cause-and-effect questions, but the solution-oriented paradigm focuses on the causes of positive health rather than the causes of disease and other problems. Because causes and solutions are frequently related, however, greater adoption of a solution-oriented approach would also be expected to advance knowledge of the mechanisms of disease causation as well.

### **Relevance to Policy and Practice**

As illustrated above, a solution-oriented research paradigm leads most naturally to questions that have direct relevance to policy and practice, that is, solutions. The outcome of solution-oriented research is knowing what works and what does not work to solve problems—either way, answers may directly inform policies and practices.

### **Implications for Generating Hypotheses**

While the problem-oriented paradigm limits hypotheses to previously identified causes or correlates of poor health, the solution-oriented paradigm frees investigators to test innovative theory-based solutions that cross disciplines and philosophies. For example, under the problem-oriented paradigm, it is unlikely for an investigator to hypothesize that insufficient ecology education results in children's poor nutrition habits. However, under the solution-oriented paradigm, one can use one's knowledge of theory about motivation to hypothesize that education about sustainable environments and recycling will increase children's fresh fruit and vegetable intake. The solution-oriented researcher would move directly to testing that innovative, theory-driven hypothesis without having to wait for prior research documenting a link between poor environmental education and poor diets—which might never come, if it was ever studied at all. If treatment and prevention interventions are limited to those for which a cause of disease has been identified, the breadth of possible solutions is limited.

This is a particularly important advantage for environmental and policy research. It is likely to be more efficient to test the effects of many rational, theory-based environmental and policy interventions on reduced weight gain and obesity than to be required to first document that the targets of those environmental and policy interventions cause obesity, which is nearly impossible in many cases.

### **Example 1—Policy Research Question: Should Soft Drink Sales Be Allowed in Schools?**

There is substantial public debate over whether it is appropriate to allow soft drink vending machines in schools. A defense of selling soft drinks in schools is

that research has not yet proven that soft drinks cause obesity. Under the problem-oriented paradigm, researchers design studies to test whether soft drink consumption causes or is associated with obesity. Most commonly, one would perform cross-sectional or prospective epidemiologic studies of associations between soft drink consumption and weight gain. A more definitive problem-oriented study would test whether experimentally increasing children's soft drink consumption results in increased obesity in a randomized controlled trial. Although internally valid, results from such an experimental study still might not be generalizable to the question of soda vending machines in schools. Thus, even if soft drinks can be proven to cause obesity, it is possible that no amount of data will be sufficient to convince proponents of soft drink vending machines in schools.

Under the solution-oriented paradigm the relevant policy question can be addressed while avoiding the hurdle of first needing to prove that soft drink consumption causes obesity. Whether or not soft drink consumption causes obesity, we have long known that children drink large quantities of soft drinks and that soft drinks contain substantial "empty" calories, making it reasonable to hypothesize that eliminating soft drink sales from schools will help prevent obesity. Under the solution-oriented paradigm, an experimental trial of eliminating soft drink sales from schools tests both whether soft drink sales in schools causes obesity and directly addresses the most relevant policy question, whether eliminating soft drink sales in schools prevents and/or reduces obesity.

What is the justification for skipping over the requirement to prove soft drinks cause obesity and jump directly to an experiment testing elimination of soft drink sales? In the case of childhood obesity, it is universally accepted (and has been for at least eight centuries<sup>17</sup>) that energy imbalance results in changes in weight. Therefore, without knowing the true underlying cause(s) of any individual's or any population's obesity or risks for obesity, any intervention that produces a deficit in energy balance, by increasing energy expenditure and/or decreasing energy consumption, will lead to prevention or reduction in weight gain. As described, there is face validity to the hypothesis that eliminating soft drink sales in schools will result in a negative energy balance (future orientation) regardless of whether soft drink consumption was the cause of obesity (past orientation).

Although proven causes are not required before generating or testing new hypotheses under the solution-oriented research paradigm, adopting a solution-oriented approach does not give investigators license to pursue wild hypotheses on a whim. It would be simplistic and incorrect to interpret the solution-oriented approach in that way, and would negate the benefits described. Both the solution-oriented and the problem-oriented research



paradigms are similar in this respect. Both encourage hypotheses that are based in reason, theory-driven or conceptual model-driven, building systematically upon the results of past research, and/or with face validity, as in the example above. The basic principles of scientific inquiry apply under both paradigms.

### **Implications for Study Design**

The two paradigms also tend to lead to different study designs, at least in practice if not intentionally. Although the goal of the problem-oriented approach is to prove cause-and-effect relationships, requiring experimental studies, in practice most of this research is implemented as observational (epidemiologic) studies of the presence or absence of social or physical environmental characteristics or policies and their relationships to levels of physical activity, inactivity, eating behaviors, and body fat. Although these are not the only types of studies being performed, they are by far the most common, and the study design most frequently funded and published in the pages of medical and public health journals. The vast majority of these studies are cross-sectional, but even a prospective risk factor may not be part of the causal pathway.<sup>18</sup> As the goal of these studies is to better understand the causes of diseases and risk factors, it is somewhat ironic that the predominant study design used is incapable of proving cause.

Using observational research designs to identify potential causes and correlates also leads to additional limitations. One of the challenges plaguing obesity research is the difficulty in feasibly, reliably, and validly measuring many of the key “exposure” variables of interest: physical activity, sedentary behaviors, and energy intake, as well as the environmental and policy exposures that are hypothesized to determine them. As a result, any associations identified are subject to measurement error that, at best, weakens relationships that truly exist or, worse, introduces bias that leads to spurious conclusions. Prematurely putting the results of observational studies into clinical and public health policy and practice can lead to wasted resources or worse, excess morbidity and mortality.<sup>19,20</sup> In contrast, in experimental research the investigator manipulates the exposure and then directly assesses the changes in outcomes that result, making these results less sensitive to measurement error, especially if the outcome is objectively measured, as is the case with directly measured height and weight. This design also produces the most relevant estimate of an effect size attributable to the causal factor and intervention. These same strengths of experimental designs hold true for research under both the problem-oriented and solution-oriented paradigms.

Because the solution-oriented research paradigm emphasizes hypotheses about solutions, it naturally leads investigators toward experimental and quasi-experimental designs. Hypothesized solutions usually take the form of

some type of policy or practice intervention. Testing those interventions generally requires an experimental manipulation of some sort, allowing causal inferences to be made.<sup>18</sup> However, performing solution-oriented research is not limited to highly controlled randomized trials where internal validity is at its greatest. It may not be possible and it may not be desirable to perform a randomized controlled trial of all potential interventions.<sup>21</sup> This may be particularly true of some large-scale environmental and policy interventions, involving changes in urban design, state or national tax policies, or social and political movements, for example. In cases like these, solution-oriented research would include creative use of “natural experiments” and “quasi-experiments” where the changes associated with purposeful interventions made in one school, neighborhood, community, county, state, region, and so on, are contrasted with those in other comparable samples. Studies such as these are subject to multiple threats to internal validity,<sup>22,23</sup> moderating their conclusiveness, but because they represent purposeful interventions in their natural units and settings, they provide greater generalizability and policy relevance than simple observational studies of existing variations and their correlations with physical activity, inactivity, diet, and obesity. Therefore, at least in practice, a solution-oriented research paradigm tends to promote study designs that generate higher-quality (more conclusive) evidence of cause and effect.<sup>24</sup>

Although the majority of the current problem-oriented public health childhood obesity research is observational, the distinction between the problem-oriented research paradigm and the solution-oriented research paradigm is not simply a distinction between observational and experimental research. As noted above, both paradigms aspire to document cause-and-effect relationships, and thus, both emphasize experimental research.

### **Example 2—Environmental Research: Television Watching and Childhood Obesity**

Problem-oriented observational studies were important in defining television viewing as a correlate and risk factor for childhood obesity. However, epidemiologic observations consistently find only weak associations (i.e., small effect sizes) between time spent watching television, physical activity, dietary intake, and obesity or weight gain.<sup>25,26</sup> Some might conclude from these studies that television watching is not a very important factor with regard to childhood obesity. Alternatively, the same results could be explained by the poor validity of measuring time spent watching television leading to attenuated associations and/or bias and spurious results.<sup>27</sup> To avoid this limitation, one must apply an experimental design where the exposure (television watching) is manipulated. Under the problem-oriented paradigm, one would design an experiment to test

whether increasing television watching causes weight gain and obesity. If the answer to this question is affirmative, it resolves the issues of cause and effect and estimating the effect size, but does not bring us any closer to a solution—what to do about the cause, and how, once it is identified. In contrast, under a solution-oriented paradigm, the above studies are unnecessary. Instead, one experimentally tests the effects on weight gain and obesity of interventions to reduce television watching. The results address the question of causality, provide a valid effect size estimate, and specify methods that either work or do not work to reduce weight gain and obesity.<sup>12</sup>

### **Implications for Studying Moderators and Mediators**

There is no doubt that experimental problem-oriented studies of disease causes and risk factors can contribute to better understandings of etiologic mechanisms. Even in these studies, however, identified moderators and mediators in the causal pathway may or may not be relevant to methods to treat or prevent the disease and improve health. In observational problem-oriented studies, one cannot even conclude whether the identified moderators and mediators are in the causal pathway.<sup>28</sup>

In contrast, in experimental solution-oriented research, moderators and manipulated mediators are directly tested for their relevance to treatment or prevention. Solution-oriented moderator and mediator studies can help identify population subgroups (moderators) that are more or less responsive to the intervention, and therefore define which subgroups of the population should be targeted with the intervention, and help identify the parts of the intervention (mediators) that are most critical to producing the observed outcomes.

### **Complementary Research Paradigms**

There is no all-or-nothing choice between the problem-oriented and the solution-oriented research paradigms. In addition to a history of success advancing scientific knowledge and contributing to medical care and public health, problem-oriented research provides an important source of hypotheses for solution-oriented research. However, the current overwhelming focus on problem-oriented research, to the near exclusion of solution-oriented research, has slowed the process of finding solutions to the obesity epidemic and many other pressing medical and public health problems, as well as most other major social, economic, and political problems, where evidence relating to causes and correlates of the problems is much more abundant than evidence regarding potential solutions. Presently, there is a need to provide more balance between these two paradigms.

It is concerning that such large amounts of resources and investigator effort continue to be applied to problem-

oriented studies that are classified as clinical and public health research, but are unable to directly inform potential solutions. Why do investigators choose to perform these studies? Some suggest that this research is easier and less expensive to perform, helping to build investigators' bibliographies to help them meet the expectations of university appointments and promotions committees. However, it is the population's health and pocketbook that bear the burden of the true costs of these studies, by not having timely answers to the question, "What works?"

### **Proposed "Litmus Test" for Research Studies**

To apply the principles of the solution-oriented research paradigm, and also improve the relevance of problem-oriented research, a "litmus test" is proposed to help identify the specific research questions, hypotheses, and study designs and methods that are most likely to contribute to improving individual and population health. Because the solution-oriented approach is more familiar to medical care and public health practice, it should not be surprising that this guideline is borrowed from clinical medicine. When educating medical students, interns, and residents about ordering screening and diagnostic tests, they are taught that a test should only be ordered if (1) you know what you will conclude from each possible result, and (2) the result may change the care of the patient. (We are not aware of the origin of this guideline, but TNR attributes his source as Halsted Holman, MD, professor of medicine emeritus at Stanford University, an esteemed teacher, clinician, researcher, leader and role model.) If the potential results and how they would be interpreted are not known beforehand, and the results would not change any action, then the test should not be ordered. If a test is ordered when it is not indicated, the error that is associated with all tests, no matter how accurate, may be manifest as a false-positive or false-negative result, potentially misleading the clinician and harming the patient.<sup>29</sup>

For the same reasons, an analogous guideline, consistent with the solution-oriented research paradigm, is proposed to help decide whether to perform a research study. It is proposed that all research questions and study designs be examined according to this guideline. If a study fails this "litmus test" the study does not need to be performed. A research study should only be performed if (1) you know what you will conclude from each possible result (whether positive, negative, or null); and (2) the result may change how you would intervene to address a clinical, policy, or public health problem.

Many hypothesis-testing research studies, including many of those conceived within the problem-oriented research paradigm, pass this litmus test. However, many others do not. We contend that if all research studies were to be subjected to this litmus test before they were

started, there would be dramatic increases in the contributions of research to human health.

### **Example 3—Applying the Litmus Test to a Study of Neighborhood Safety, Physical Activity, and Obesity**

It is commonly believed that fears of neighborhood crime encourage parents to keep their children indoors, reducing the amount of time spent playing outside, reducing physical activity, and promoting weight gain. Under the current, problem-oriented research paradigm, an investigator performs either a cross-sectional or prospective observational study to test the association between measures of objective and/or perceived neighborhood safety and physical activity and obesity. Subjecting this study to the litmus test, what would be concluded from each possible result? Would any of the results change how one would intervene to increase physical activity and/or prevent obesity? If the result is null (no association), it is unlikely to convince many investigators and policymakers that neighborhood safety is irrelevant to levels of physical activity, and that attempts to reduce neighborhood crime should not be pursued. Therefore, the null result will probably be explained away as due to the effects of measurement error or inadequate sample size, and the beliefs of the investigators will not be changed. If the result is statistically significant but counter to the hypothesized direction, it is unlikely to convince many investigators that neighborhood crime is a good thing and that interventions to increase physical activity and prevent obesity should include attempts to reduce neighborhood safety. Again, the results will probably be explained away as due to biased measurement error or a sampling problem. Finally, if the result is statistically significant in the hypothesized direction, it will likely serve to confirm the investigators' a priori beliefs that neighborhood crime reduces physical activity and increases risk of obesity, but a specific recommended action will not be identified. Even before doing the study there were good reasons to promote neighborhood safety (including but hardly limited to beliefs about effects on physical activity and obesity). Because the study result does not suggest the most effective way to increase neighborhood safety, one is no closer to knowing what interventions will work (or not work) to increase physical activity and prevent obesity. Therefore, none of the possible results would change how one would choose to intervene.

Under the solution-oriented paradigm, one first uses theory, formative research, and previous research, if it is available, to form hypotheses about the most effective methods to increase actual and/or perceived neighborhood safety and how to implement them, whether it be community policing, a neighborhood watch, block parties, neighborhood beautification projects, and so on.

Then one designs and performs an experimental study of the effects of the chosen neighborhood safety intervention on physical activity and obesity. If this study is adequately powered and the intervention successfully improves neighborhood safety (successfully manipulating the exposure), but the result is null, one can conclude that the chosen intervention and increased neighborhood safety are not effective. If the result is less physical activity and more obesity, then the chosen intervention produced adverse effects on physical activity and obesity, and should not be used for those purposes. If the result is increased physical activity and less obesity, then the hypothesis is confirmed (proving cause and effect) and the study has identified an effective intervention method that can be recommended for further use (a solution).

### **Ethical Implications**

Ethical considerations also favor the proposed solution-oriented research paradigm and litmus test for research studies. Investigators have an ethical responsibility to not devalue the contributions of research participants. Even if the risks of a particular research study are considered minimal, there are costs to participating in research, in time, effort, inconvenience, and accepting the possibility of unknown risks, among others. Participants contribute those costs with the minimal expectation that the study has the possibility to advance scientific knowledge, even if it may not benefit them directly. Additionally, a large proportion of research is supported by either public funds or private, not-for-profit sources. Because nonprofit sources do not pay taxes, their funding also represents, at least in part, public contributions. As a result, even if no human participants are directly involved and no public funds were directly contributed, investigators still have a responsibility to the public to perform research that will advance scientific knowledge and provide benefits to the public.

Adopting the solution-oriented paradigm and litmus test for research studies leads investigators to perform studies with a greater chance to both advance science and directly improve health and well-being, providing greater assurances that the research performed will meet these ethical responsibilities. This does not imply that problem-oriented research does not meet these responsibilities. However, as noted above, there are many studies that are performed under the current problem-oriented paradigm, intended to identify causes and correlates, which are unlikely to significantly advance science or inform policy and practice. As a result, the potential benefits of these studies may not justify the costs being contributed by the study participants and/or the public; therefore, they do not meet this ethical responsibility.

## Conclusion

This paper suggests that the predominant biomedical and social science problem-oriented research paradigm, emphasizing identifying causes and correlates of diseases and risk factors, is actively delaying the potential benefits of research to medicine and public health practice and policy, as well as benefits to population health. In contrast, a solution-oriented research paradigm, emphasizing experimental research, is proposed to identify the causes of improved health. This subtle conceptual shift has significant implications for phrasing research questions, generating hypotheses, designing studies, applying results to policy and practice, studying mechanisms, and ethical considerations. The proposed solution-oriented research paradigm encourages research with more immediate relevance to human health and a shortened cycle of discovery from the laboratory to the patient and population. It is not proposed that all problem-oriented research be replaced, but instead to establish more of a balance across these complementary paradigms. Finally, it is suggested that proposed research studies be subjected to a "litmus test" to maximize efficiency (in terms of resources and investigator effort) and contributions to the promotion of health and the prevention and treatment of disease.

This manuscript was commissioned by the Robert Wood Johnson Foundation Active Living Research Program, and an earlier draft was presented at the Annual Scientific Meeting of the Active Living Research Program, San Diego, CA, January 30, 2004. This work was also supported in part by U.S. Public Health Service grants from the National Heart, Lung, and Blood Institute, National Institutes of Health (R01 U01 HL062663), and the National Institute of Diabetes and Digestive and Kidney Diseases, National Institutes of Health (R01 DK62360), and a Robert Wood Johnson Foundation Generalist Physician Faculty Scholar Award to TNR. JRS is supported in part by a U.S. Public Health Service grant from the National Heart, Lung, and Blood Institute (5T32 HL07034). The views expressed are those of the authors, and are not intended to represent the opinions of the Robert Wood Johnson Foundation, the Active Living Research Program, or any of the agencies that have supported the authors in the preparation of this manuscript. We thank the anonymous peer reviewers and editors for their contributions to improving this manuscript.

No financial conflict of interest was reported by the authors of this paper.

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