ELSEVIER

Translating Epidemiology Into Policy to Prevent Childhood Obesity: The Case for Promoting Physical Activity in School Settings

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Childhood obesity is a serious public health problem resulting from energy imbalance (when the intake of energy is greater than the amount of energy expended through physical activity). Numerous health authorities have identified policy interventions as promising strategies for creating population-wide improvements in physical activity. This case study focuses on energy expenditure through physical activity (with a particular emphasis on school-based physical education [PE]). Policy-relevant evidence for promoting physical activity in youth may take numerous forms, including epidemiologic data and other supporting evidence (e.g., qualitative data). The implementation and evaluation of school PE interventions leads to a set of lessons related to epidemiology and evidence-based policy. These include the need to: (i) enhance the focus on external validity, (ii) develop more policy-relevant evidence on the basis of "natural experiments," (iii) understand that policy making is political, (iv) better articulate the factors that influence policy dissemination, (v) understand the real-world constraints when implementing policy in school environments, and (vi) build transdisciplinary teams for policy progress. The issues described in this case study provide leverage points for practitioners, policy makers, and researchers as they seek to translate epidemiology to policy.
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KEY WORDS: Epidemiologic Methods, Health Policy, Humans, Policy Making, Public Health, Research.

INTRODUCTION

This case study addresses the pressing public health issue of obesity prevention, illustrated through a policy approach for promoting physical activity among youth (i.e., school-based physical education [PE]). The case provides the rationale for addressing this issue, an overview of important policy approaches and their linkage with epidemiologic data, approaches for promoting physical activity in youth on the basis in part of the work of the Guide to Community Preventive Services (the *Community Guide*), and practical lessons for implementing and evaluating school PE policy.

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CONTEXT

Childhood Obesity and Physical Inactivity

Childhood obesity is a serious public health problem. During the past three decades, obesity rates have increased threefold among U.S. children and adolescents (1, 2). Approximately 16% of children and adolescents aged 2 to 19 years are obese (3, 4), yet there is a hopeful sign in that no significant change in the prevalence of obesity was noted from 2003 to 2006 (3). Childhood obesity is associated with increased risk of cardiovascular disease risk factors, such as hypertension and high cholesterol (5), and increased incidence and prevalence of type 2 diabetes (6, 7). When one is obese as a child, it increases the likelihood of one being an obese adult, and related health problems tend to track into adulthood (8–12). If the current obesity epidemic is not reversed, the current generation of children may be the first to have a shorter life expectancy than their parents (13).

Obesity is the result of an energy imbalance, caused when the intake of energy, through the consumption of food and drink, is greater than the amount of energy expended. For children and adolescents, energy is expended through

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Selected Abbreviations and Acronyms

PE = physical education

growth and development, metabolism, and physical activity. In this case study, we focus on energy expenditure through physical activity. Data from the 2007 Youth Risk Behavior Surveillance System report that nationwide only one third of high school students had met the recommended levels of physical activity (moderate-to-vigorous activity for a minimum of 60 minutes a day) (14, 15).

The Importance of Policy Approaches for Promoting Physical Activity

When implementing interventions to improve population health, multilevel (ecological) frameworks are often useful (16, 17). These frameworks have been applied across a variety of settings and public health issues, including physical activity (18). There are often four levels (Fig. 1):

1. *Intrapersonal* factors include characteristics of the individual such as a person's genetic make-up, skills, and developmental history.
2. *Social and cultural* factors are formal and informal social networks and social support systems, including family and friends.
3. *Physical environmental* factors include improving access in the physical environment (e.g., building sidewalks so children can walk to school).
4. *Policy* factors include local, state, and national laws, rules, and regulations.

Regarding levels 3 and 4, numerous health authorities have identified environmental and policy interventions as promising strategies for creating population-wide improvements in healthy eating, physical activity, and obesity, including reports by the U.S. Surgeon General, World Health Organization, Centers for Disease Control and Prevention, and the Robert Wood Johnson Foundation (19). In this case study, we focus on level 4, policy variables.

Policy Needs and Process

Policy makers and their staff face the dueling battle of experiencing information "overload" while, at the same time, attempting to become "experts" on an issue for which they may have little background or expertise. For any given issue, policy makers and their staff will receive both solicited and unsolicited information from individuals and organizations that represent both sides of an issue as well as from groups trying to achieve a common ground (20, 21). Interpreting the extensive amount of information can be challenging even for the most experienced policy maker.

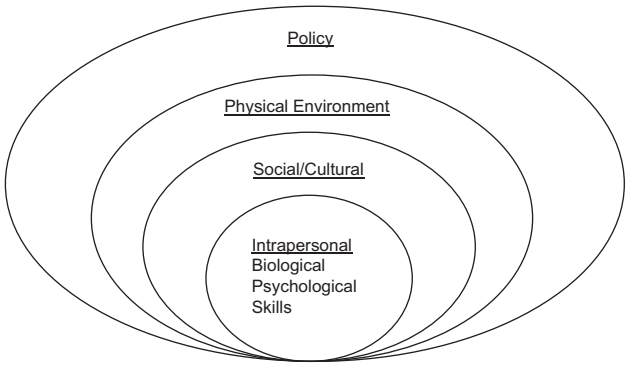

FIGURE 1. Four-level ecological framework for promoting physical activity.

Epidemiologists, however, can play a critical role in helping policy makers to make sense of all the information by providing objective, straightforward, and relatively simple data that are packaged in a way that informs the policy debate (22–25). Unlike many settings in which epidemiologic evidence is used, complex statistical analyses or lengthy academic papers or reports often are not the sources to which policy makers or their staff turn for evidence (26–28). Most useful to policymakers are data that show public health burden and are relevant for the given jurisdiction of interest (e.g., federal-congressional, state, county/municipal, school district) (22, 29).

At the same time, policy making is not a static endeavor. Rather, it is constantly in flux, subject to numerous constraints, including multiple aspects, participants, and competing demands that will likely shift priorities on the governmental agenda (30). Furthermore, due in part to political and other constraints, policy making is largely an incremental process (31), with policies on a given subject or issue changing over time (30). As a result of these realities, different types of epidemiologic evidence will be required at different stages of the policy-making process or at different points in time. For example, recognizing that PE is a key component of a comprehensive school physical activity program for children (32), state legislators may want to enact legislation that focuses on the relationship between PE and overall physical activity. Some states may choose to focus their efforts on ensuring that students receive the nationally recommended amount of PE per week (150 minutes in elementary schools and 225 minutes in middle/high schools), whereas other states may find that option politically infeasible or impractical and, instead, may choose to focus on requiring that at least 50% of PE class time be devoted to moderate-to-vigorous physical activity or focus on teaching students about the skills necessary for lifelong physical activity (32, 33).

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A Framework for Understanding Policy Making to Address Physical Activity. Policy making related to promotion of physical activity is a complex process. The stages model of public policy making (20, 34) can be used to examine the link between epidemiologic data and the policy process for promoting physical activity. The stages include policy agenda, policy formulation, policy adoption, policy implementation, policy evaluation, and decisions about the future or the feedback loop (Table 1) (20, 34). As Table 1 indicates, epidemiologic data are important at each stage of the process, but they are especially relevant and useful in the early and late stages of the process—basically when the problem is identified, when policy options are considered, and when the outcome of the policy is being evaluated and decisions are being made as to the future of the given program. The stages are presented sequentially in Table 1 for explanatory purposes; however, it is important to note that policy making is not a linear process and does not typically follow the orderly nature of the stages model (20).

The Nature and Availability of Evidence

Policy-relevant evidence for promoting physical activity in youth may take numerous forms. The epidemiologic and other supporting evidence (e.g., qualitative data) needed to understand and affect obesity and physical activity in youth can be viewed in three categories, shown in Table 2 (35–37). Type 1 evidence defines the causes of obesity-related diseases and the magnitude, severity, and preventability of obesity-related risk factors. It suggests that "something should be done" about the obesity/inactivity epidemic. Type 2 evidence describes the relative impact of specific interventions that do or do not improve health, adding "specifically, this should be done." Type 3 evidence (of which we have the least) shows how and under what contextual conditions interventions were implemented and how they were received, thus informing "how something should be done."

A key set of questions can be posed to weigh the evidence across these three categories. A Type 1 question is: "How important is the problem of obesity in terms of morbidity and mortality?" A Type 2 question is: "Are there effective school-based interventions to promote physical activity in youth?" A Type 3 question is: "As I implement the intervention how do I take into account issues such as feasibility and sustainability?"

Evidence hierarchies that rate study designs are often used for summarizing literature on clinical and population-level interventions. These rating schemes place a high value on experimental (randomized) designs because of their ability to address selection bias (38, 39). Such hierarchies can be problematic for policy interventions because it is often impossible to assign the exposure (policy). This has been termed the "inverse evidence law" by which interventions most likely to influence whole populations (e.g., policy change) are least valued in an evidence matrix emphasizing randomized designs (40, 41).

Because policy cannot wait for perfect information, one must consider actions wherein the benefit outweighs the risk. This was summarized by Szklo (42) as: "How much do we stand to gain if we are right?" and "How much do we stand to lose if we are wrong?" In the case of child obesity and physical activity, the future disease burden and high rates suggest that type 2 actions should be taken due to the magnitude of type 1 evidence. Models that weigh risks and benefits are a first step. For example, one could be readily convinced that if walking were associated with weight loss in nonexperimental studies, a walking campaign with the use of pedometers and goal-setting would be safe to implement without conducting a randomized trial. The risk is low and the accessibility, feasibility, and sustainability are high, so that even modest results would be all "gain." Evaluation after implementation might be enough to inform policy makers about the effectiveness of such an intervention, bolstering chances for ongoing support.

On the other hand, a campaign of mandating universal, rigorous and intensive physical activity, such as full participation by all school-age children in team sports (e.g., soccer, football), might require more evidence as such an intervention may be more risky, less feasible, less sustainable, and more costly. In the end, one must consider harm from inaction as well as harm from action.

Analytic Tools to Inform Policy Interventions for PE in Youth. Numerous analytic tools are useful in measuring risk, assessing intervention effectiveness, and weighing costs and benefits. Among these are systematic reviews, economic evaluations, and health impact assessments (35). This section briefly describes evidence from one systematic review, the *Guide to Community Preventive Services* (the *Community Guide*). Systematic reviews like the Community Guide are consensus document and are valuable because they provide an efficient way to identify relevant research findings, assess their quality, and present them to users in ways that are understandable and useful (43, 44).

The Community Guide provides guidance on evidence-based interventions to address physical inactivity in youth. The *Community Guide* seeks to answer three questions: (i) "What has worked for others and how well?" (ii) "How can I select from among interventions of proven effectiveness?" and (iii) "What might this intervention cost and what am I likely to achieve through my investment?"(44). The Community Guide uses a transparent, seven-step process that relies on multidisciplinary teams to conduct reviews (44). The *Community Guide* reviewed 13 qualifying studies related to PE and found strong evidence that

TABLE 1. Stages of the policy process: Application to promoting physical activity in youth

Stage	Description	Example from physical activity policy making	Relevance of epidemiologic data
Policy agenda	Identifying an issue as a problem worthy of governmental attention.	Documenting the prevalence of physical inactivity and increased childhood obesity in a given state helps to frame the extent to which the lack of physical activity among young people is a concern worthy of attention by state legislators.	High
Policy formulation	Alternative policy options are generated and considered.	Data examining various aspects of the relationship between physical activity, overweight, obesity, and other related behaviors are used as the foundation for various policy options/proposals being considered by the policy making body (e.g., Congress, state legislature, school district). Different or contradictory studies may be used as supporting documents for different policy options.	High
Policy adoption	Legislators adopt a particular course of action or solution among the alternatives generated to a problem.	A state law is adopted that encourages school districts to devote a minimum of 50% of physical education class time to moderate-to-vigorous physical activity. This law is based on scientific evidence provided during the policy formulation stage which documented the importance of moderate-to-vigorous physical activity.	Limited
Policy implementation	Implementation of the policy by executive branch agencies (federal, state, school district).	School districts implement law requiring that elementary students be given at least 20 minutes of daily recess based on scientific evidence provided during the policy formulation stage which illustrated the minimum amount of time needed to enable students to engage in PA during recess.	Limited
Policy evaluation	Assessment of how the policy is being implemented and whether it is achieving its purpose/intent.	Data are collected to respond to legislative requirement that school districts report on the amount of daily physical activity provided to students by grade.	High
Decisions about the future/ feedback loop	Decision to continue, modify or terminate the program.	Data from the evaluation stage are used to assess whether students throughout the state are meeting the state standard for the amount of time spent in active physical activity throughout the school day.	Moderate to high

Source: Adapted from Anderson (20) and Ripley (34).

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TABLE 2. Typology of the types of evidence

Characteristic	Type 1 issues	Type 2 issues	Type 3 issues
Typical data/relationship	Size and strength of preventable risk—disease relationship (measures of burden, etiologic research)	Relative effectiveness of public health interventions	Information on the adaptation and translation of an effective intervention
Examples	• Obesity causes diabetes • Physical inactivity contributes to obesity • Rates of physical inactivity are high among U.S. youth	• Access to places for physical activity reduces the risk of inactivity • Interventions to promote school-based physical education are effective	• Understanding the political challenges of obtaining funding for new physical activity facilities • Constraints to implementing school-based physical education (e.g., time, funding) need to be addressed
Quantity of available evidence	More	Less	Least
Action	Something should be done.	This particular intervention should be implemented	How an intervention should be implemented

Source: Adapted from Brownson and colleagues (35).

school-based PE programs increased physical activity among school children (45). A similar review was conducted in Latin America that involved five qualifying studies and reached similar conclusions to the U.S. review (46, 47). On the basis of these reviews, the core components of effective school-based PE are:

- an increase in minutes of PE;
- the inclusion of moderate or vigorous activity in PE class;
- specification of PE teacher certification or professional development;
- inclusion of environmental enhancements (physical facilities, equipment); and
- adaptation of interventions to specific target populations.

There are numerous challenges in implementing the recommendations in the *Community Guide*. Among these are the lack of intervention research for some risk factors, difficulty in translating scientific results to different communities and policy settings, lack of training for public health practitioners in finding and using evidence, and scarce resources (35, 48, 49).

LESSONS LEARNED

Sound public health practice should be based on a broad assessment of the strengths, weaknesses and gaps in the epidemiologic evidence (35, 39). It is both a science and an art. Drawing on the literature and practical experience related to school-based PE, this section presents a brief set of lessons—some more general to epidemiology and evidence-based policy and others specific to the school setting.

Enhance the Focus on External Validity

Often, epidemiologic and intervention research has tended to overemphasize internal validity (i.e., whether the observed results be attributed to the risk factor being studied or intervention being implemented) while giving sparse attention to external validity (i.e., the degree to which findings from a study can be generalizable to and relevant for other populations, settings, and times) (50–54). As an example, Klesges and colleagues (55) reviewed 19 childhood obesity studies to assess the extent to which elements of external validity were reported (55). They found the median rate of reporting across all elements was 34.5%, with a mode of 0% and a range from 0% to 100%. Importantly, the work of Klesges shows that some key contextual variables (e.g., cost, program sustainability) are missing entirely in the peer-reviewed literature on obesity prevention. This suggests a greater attention to Type 3 evidence is needed (how to adapt, implement, and sustain a particular

intervention) (37, 50, 52). This type 3 evidence is likely to be both quantitative and qualitative.

Develop More Policy-Relevant Evidence on the Basis of "Natural Experiments"

Ideally, scientific evidence (often using epidemiologic methods for evaluating policy effects) drives policy decisions (56, 57). However, sometimes real-world observation and "best thinking" need to drive policy because rigorous science may not yet exist as the result of lack of interest, timing, or funding (29, 58). A "natural experiment" involves naturally occurring circumstances where different populations are exposed or not exposed to a potentially causal factor (e.g., a new school policy on minutes of PE per day) such that it resembles a true experiment in which study participants are assigned to exposed and unexposed groups (59). When new policy is put in place, a need to evaluate its implementation and effect emerges; thus, the policy itself becomes the catalyst for a natural experiment. Attempts to evaluate natural experiments are being made through the recent Active Living Research and Healthy Eating Research Rapid-response grants.

Understand That Policymaking Is Political

The policy making process is inherently political (21, 60). According to Kingdon (21), the key factors that influence the politics of policy making include but are not limited to public opinion; pressure/interest groups; election results; partisan or ideological distributions in Congress (or state legislatures/county or city councils); and changes of administration. Thus, if epidemiologists want to engage in the policy making process, they need to understand the politics involved and be prepared to work with policy champions, advocates and other groups that may support the given issue of interest. For example, epidemiologists may provide scientific evidence to advocacy organizations to use in highlighting for congressional staffers the relationship between physical activity and academic achievement.

Better Articulate the Factors That Influence Policy Dissemination

The evidence base on how to best accomplish widespread dissemination of effective programs and policies for promoting physical activity is in an early stage (61). When the dissemination of new discoveries is studied, characteristics of an innovation (e.g., an intervention or policy) known to influence adoption include the (i) relative advantage (the extent to which the innovation is superior to current practice), (ii) complexity (the extent to which the innovation is perceived as difficult to teach, adopt, or implement), (iii) compatibility (the extent to which the innovation is consistent with the adopter's characteristics), (iv) trialability (the degree to which the innovation can be experimented on a limited basis without a large investment, and (v) observability (the degree to which the results of an innovation are visible to others) (62, 63). Although these factors are increasingly studied for behavioral interventions, there is lack of knowledge on the relative importance of these variables in policy dissemination (64). In a four-city (76-school) study of the implementation and maintenance of a school-based diet and physical activity trial (65), it was shown that policies could be maintained when adequate attention was paid to compatibility of the intervention with local conditions and staff training. Another key to success in policy dissemination involves finding better ways to communicate epidemiologic data to policy makers (25, 66).

Understand the Real-World Constraints When Implementing Policy in School Environments

Schools are subject to federal, state, and local (school district) policy. Although they may be required by law or other regulation to implement a particular policy, there are real-world constraints to adoption—most commonly this boils down to time and money (67, 68). The motivation of a school to overcome the constraints may be directly related to the strength of accountability provisions accomplished through monitoring and enforcement. Specific to policy addressing PE in school settings, currently one of the most significant constraints is the intense pressure on schools for students to perform well on standardized tests in reading and math so that the school will make adequate yearly progress as defined by the federal No Child Left Behind Act of 2001.

In a study by the Council for Basic Education, three-quarters of all principals surveyed said that instructional time for reading, writing, and math is increasing somewhat or greatly, and they reported decreases in time for social studies (29%) and arts (25%) (69). It is also likely that No Child Left Behind is causing decreases in time for school PE and elementary school recess. In fact, less than one third of all students nationwide were in a school district during the 2007 to 2008 school year with a wellness policy that even suggested specific time requirements for PE, with only 3% to 4% of students in a district with a policy that required a minimum amount of time for PE that met the National Association for Sport and Physical Education recommended standards of 150 minutes/week for elementary students and 225 minutes/week for middle and high school students. Additionally, only 18% of elementary students were enrolled in a school district that required daily recess as part of their wellness policy, with an additional 22% in a district that suggested but did not require daily recess for all elementary grade levels (70).

Another major challenge to implementation of school PE policy is lack of understanding about the relationship between student health and academic performance. Policy makers need to be provided with data showing that physical inactivity and other health risk behaviors (substance use, violence) are consistently linked to academic failure and often affect students' school attendance, grades, test scores, cognitive functioning, and ability to pay attention in class (71, 72).

Build Transdisciplinary Teams for Policy Progress

There are many benefits of transdisciplinary collaboration to improve population health (73, 74). For example, effective physical activity promotion requires a comprehensive view from different disciplines, which are no longer limited to public health but also include areas like education, urban planning, transportation, environmentalism, and recreation. Tobacco control efforts have been successful in facilitating cooperation among disciplines, such as advertising, policy, business, epidemiology, medicine, and behavioral science. Research activities within these multidisciplinary tobacco networks try to fill the gaps between scientific discovery and research translation by engaging a wide range of stakeholders (75–77). A transdisciplinary approach has also shown some evidence of effectiveness in obesity prevention (78, 79).

At all levels (federal, state, and local), the odds of successful passage and implementation of policy are greatly increased when a transdisciplinary team of advocates work together. For example, at the local (school district) level, the overall goal might be to implement a comprehensive school physical activity program that encompasses physical activity programming before, during, and after the school day. Such a program includes quality PE, school-based physical activity opportunities (e.g., elementary school recess, physical activity breaks, walking/bike to school, before- and after-school physical activity clubs/intramurals), school employee wellness and involvement, and family and community involvement (80). Thus, various stakeholders need to be included in advocacy and implementation such as PE teachers, other teachers, administrators, parents, students, travel engineers, city planner, and community members (80). To support the transdisciplinary team, epidemiologic data can be used to conduct a needs assessment, identify potentially effective policy interventions, and track progress in meeting objectives. Epidemiologists need to play a stronger role in policy development and advocacy (57).

CONCLUSION

It is long known that policy has a profound impact our daily lives and on population-level indicators of health status (22). Many of the public health approaches now being recommended to address childhood obesity and physical inactivity have a significant focus on policy change (81). To better understand the content, process, and outcomes of these policy interventions (including the role of epidemiologic data), the lessons described in this case study illustrate key issues for practitioners, policy makers, and researchers as they seek to translate epidemiology into policy.

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