Application of Health Promotion Theories and Models for Environmental Health

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The field of environmental health promotion gained new prominence in recent years as awareness of physical environmental stressors and exposures increased in communities across the country and the world. Although many theories and conceptual models are used routinely to guide health promotion and health education interventions, they are rarely applied to environmental health issues. This article examines how health promotion theories and models can be applied in designing interventions to reduce exposure to environmental health hazards. Using the Community Action Against Asthma (CAAA) project as an example, this article describes the application of these theories and models to an intervention aimed at reducing environmental triggers for childhood asthma. Drawing on the multiple theories and models described, a composite ecological stress process model is presented, and its implications for environmental health promotion discussed.

Keywords: *asthma; health promotion theory; environmental health; community-based participatory research*

Environmental health promotion, defined as "any planned process employing comprehensive health promotion approaches to assess, correct, control, and prevent those factors in the environment that can potentially harm the health and quality of life of present and future generations" (p. 433),[1] has gained new prominence in recent years as awareness of environmental stressors and exposures increased in communities across the country and the world.[2,3] As communities become aware of, and sometimes alarmed about, their exposure to environmental hazards, calls for action to reduce or mitigate

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The funding sources for this study were NIEHS R01 ES010688 and NIEHS/EPA P01-ES09589. Community Action Against Asthma (CAAA) is a community-based participatory research project of the Michigan Center for the Environment and Children's Health (MCECH) aimed at investigating the influence of environmental factors on childhood asthma. The partners involved in this collaborative effort since its inception are the Detroit Health Department; the Michigan Department of Agriculture, Plant and Pest Management Division; the University of Michigan Schools of Public Health and Medicine; the Henry Ford Health System; nine community-based organizations in Detroit (Butzel Family Center; Community Health and Social Services Center

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these exposures have increased. Oftentimes, reduction or mitigation of exposure requires a change in behavior of an individual exposed or of a policy maker who can enact laws to reduce the exposure. Health promotion and health education theories and conceptual models can be extremely useful in guiding interventions that require behavior changes to reduce exposure to environmental hazards. However, the many theories and conceptual models used routinely to guide health promotion and health education interventions[4-7] are rarely applied to environmental health issues.

This article examines how health promotion theories and models can be applied in designing interventions to reduce exposure to environmental health hazards. Using the Community Action Against Asthma (CAAA) project as an example, this article describes the application of selected theories and models to an intervention seeking to reduce environmental triggers for childhood asthma. Drawing on these theories and models as well as the ecological framework, this article also presents a composite ecological stress process model and discusses its implications for environmental health promotion.

CAAA: OVERVIEW OF ENVIRONMENTAL HEALTH INTERVENTION CASE EXAMPLE

The CAAA intervention is one component of a community-based participatory research partnership, the Michigan Center for the Environment and Children's Health (MCECH). MCECH's overall goal is to investigate the environmental, pathophysiological, and clinical mechanisms of childhood asthma and to implement and evaluate comprehensive interventions aimed at reducing asthma-related environmental threats to children, families, and neighborhoods. The CAAA project combines an exposure assessment component, assessing the effects of outdoor and indoor air quality on exacerbation of asthma in children, with an intervention component. The intervention component, which includes household and neighborhood/policy-level interventions to reduce environmental triggers for childhood asthma, is the focus of this article.[8,9]

CAAA is guided by a steering committee (SC) composed of representatives of community-based organizations, the local health department, a health care system, and academic researchers (see acknowledgment section for a list of partners involved). The SC members jointly decide the research and intervention methods for CAAA in accordance with a set of community-based research principles that the partnership has adopted.[9] CAAA just completed its final year of a 5-year initial funding period. Results of the exposure assessment and the household intervention component are forthcoming. The neighborhood/policy-level intervention is in the 4th year of a 5-year funding period.

[CHASS]; Detroiters Working for Environmental Justice; Detroit Hispanic Development Corporation; Friends of Parkside; Kettering/Butzel Health Initiative; Latino Family Services; United Community Housing Coalition; and Warren/Conner Development Coalition); and one community member at large. MCECH is affiliated with the Detroit Community-Academic Urban Research Center (URC), a collaboration among partners from academia, the local health department, community-based organizations, and an integrated health system. The Detroit URC was originally funded by the Centers for Disease Control and Prevention. (Please refer to www.sph.umich.edu/urc for more information.)

THE CAAA INTERVENTION: PROJECT DESIGN AND METHOD

Participants

Participants in the household intervention were drawn from households of English- or Spanish-speaking children, ages 6 to 11, who attended Detroit public schools in the project intervention areas (Southwest and Eastside Detroit) and were identified as having persistent asthma through an asthma-screening questionnaire completed by their caregiver. More than 9,000 screening questionnaires were mailed or hand delivered to caregivers, and 3,067 of them were returned. Seven hundred and eight of the returned questionnaires had responses concerning a child consistent with persistent asthma as determined by National Asthma Education and Prevention Program (NAEPP) guidelines. Of these 708, the caregivers of 510 were successfully contacted and invited to participate. The children identified and members of their households were invited to participate in the intervention study. Of the 510 eligible to participate, 331 children and their families enrolled in the CAAA project.

Evaluation Design and Data Collection Method

The CAAA household intervention project used a staggered research evaluation design. One-half of the households (Wave 1) were randomized into the group receiving the household intervention beginning in the 2nd year of the project (immediately after the collection of baseline data), and the other half of the households (Wave 2) were randomized into the group receiving the intervention beginning in the 3rd year of the project. Wave 2, therefore, served as a control group for Wave 1 in the 1st—and most intensive—year of the intervention.

To better tailor the intervention, each child was skin tested during the baseline data collection period to determine the allergens to which they were sensitized. The major outcome variables and measurement procedures for the intervention were pulmonary function (measured by the digitized AirWatch® peak flowmeter), health care utilization, average symptom frequency, asthma severity, and asthma-related quality of life (all measured by annual surveys administered by trained interviewers of both caregivers and children with asthma). The intermediate outcome variables were cleaning behaviors, smoking behaviors, caregiver social support and depressive symptoms, neighborhood social and environmental stressors, and protective factors (all measured by annual surveys of caregivers that were administered by trained interviewers); the presence of cockroach, dust mite, cat, dog, or mice/rat allergens in the household dust (measured by annual dust samples); and changes in the home environment (measured by annual household observational walk-through surveys).

Intervention Activities

The household intervention consisted of a minimum of 12 visits by a community environmental specialist (CES), a trained community outreach worker, to the homes of the families enrolled during a 2-year period. The 1st year of the intervention was an intensive intervention period with a minimum of 9 visits to each household. The 2nd year was less intensive, with a minimum of 3 visits. During the home visits, the CESs conducted activi-

ties that included providing education, materials, and services related to the reduction of exposure to asthma triggers and providing referrals for a range of issues, such as medical care and tenant rights. The CESs also provided items such as mattress covers, vacuum cleaners, and other cleaning materials. In addition, the CESs also coordinated integrated pest management services—providing services and education themselves and working with professional exterminators on homes with major infestations. To tailor the activities to each family's circumstance, the families were given the information from the baseline questionnaire, the skin test, and dust samples along with a suggested action plan. The CES and the caregiver discussed this information and worked together to determine which environmental triggers to focus on.

The neighborhood and policy components of the intervention involve community organizers working with community residents, organizations, and decision makers to increase community awareness and knowledge of factors associated with the environment and asthma, and to reduce neighborhood-level physical and psychosocial stressors associated with childhood asthma.

APPLICATION OF THEORIES IN CAAA: USING AN ECOLOGICAL FRAMEWORK APPROACH

Theories and frameworks are widely valued and used in the field of health education because of their usefulness in explaining influences on the health of individuals (including, but not limited to, behavior) and in suggesting ways to achieve necessary change to aid individuals to lead healthy lives. Theories and frameworks can be thought of in terms of their focus on explaining a problem or guiding the development of an intervention. "Theories of the problem" are explanatory theories that help to describe and identify why a problem exists, whereas "theories of action," or change theories, are used to guide the development of interventions.[9,10]

McLeroy and colleagues[10] suggest an ecological framework when considering behavior change in health promotion programs. Central to the ecological framework is the consideration of the interaction of the individual with his or her social environment as well as the physical environment.[10-13] As described by McLeroy and colleagues, the ecological framework includes a range of individual and environmental factors that can influence behavior (and ultimately health). These factors are organized into the following levels of influence: intrapersonal/individual (e.g., knowledge, attitudes, and behaviors), interpersonal (e.g., family, social networks), institutional (e.g., voluntary organization, workplace), community (e.g., relationships between organizations, institutions, and informal networks), and public policy (e.g., local, state, and national laws and policies). By using levels of analysis, researchers and practitioners can draw on what social and behavioral sciences know about factors affecting specific health problems at these different levels. They can then apply theories and organize studies and interventions as appropriate.

Designing interventions simultaneously at all levels within an ecological framework is daunting and may be logistically unrealistic. Goodman[14] suggests focusing on high-impact "leverage points" at two or three levels within the broader model of how the health outcome manifests itself and staging the intervention components to focus all activities on meeting long-term health promotion goals.

CAAA used an ecological framework in the planning and design of its intervention component. For CAAA, the use of the ecological framework suggested the following considerations in designing the intervention. First, the actual assessment of environmen-

tal exposures needed to consider not only the physical environmental (e.g., particulate matter, dust mites, and indoor tobacco smoke) but also the social environmental factors (e.g., social support and stressors such as violence). Second, the CAAA intervention needed to consider the targets of change at each of the ecological levels and include extensive intervention strategies at as many of these levels as resources would allow such as skill development, provision of social support, organization and community development, community coalitions, and media advocacy. A number of relevant theories and models were useful in guiding the CAAA interventions across these multiple levels, and they are discussed in the following sections. Table 1 provides a list of these theories and models within the ecological framework and their application to CAAA.

APPLICATION OF THEORIES AND MODELS AT THE INTRAPERSONAL LEVEL IN CAAA

The Health Belief Model

Given that environmental health issues are often beyond the control of an individual, intervening only at the intrapersonal level is often of limited value. Nevertheless, individuals can take actions to reduce their risk of environmental exposures. Intrapersonal-level theories and models can be helpful in planning interventions to increase such actions.

In designing the household intervention, CAAA staff members applied some of the concepts of the Health Belief Model (HBM). The key dimensions of the HBM are *perceived susceptibility*—how much an individual perceives himself or herself to be at risk of getting a condition; *perceived severity*—an individual's perception of how serious the condition actually is; *perceived benefits*—an individual's judgment of the effectiveness of a suggested course of action in reducing the risk of either getting the condition or reducing the seriousness of the impact of the condition; *perceived barriers*—the individual's opinion of the costs (both material and psychological) of the suggested action; and *cues to action*—the presence of a cue that activates the person's "readiness" to take the action. Strecher and colleagues[15,16] have added to the HBM the dimension of *self-efficacy*—one's confidence in one's ability to successfully perform a behavior.

Because the CAAA project involved caregivers of children who either had a doctor's diagnosis of asthma or had symptoms consistent with a diagnosis of asthma, it was expected that the caregivers already *perceived the susceptibility* of their children to asthma and the *severity* of asthma for their children and that these perceptions needed to be reinforced. Therefore, to change the behavior of caregivers in ways that would result in a reduction of environmental triggers, the CESs' activities included educational messages aimed at (1) increasing the caregivers' perceived susceptibility of their children to asthma exacerbation related to environmental triggers and (2) increasing the caregivers' perceived severity of asthma exacerbation in terms of their children's morbidity and potential mortality. For example, the CESs spoke with caregivers about the different types of indoor environmental allergens and irritants, such as dust mites, cockroaches, and environmental tobacco smoke and explained how these allergens can affect children sensitive to them and how the irritants can affect all children who have asthma. Later, individualized information was shared with each caregiver about their child's sensitization to specific indoor allergens. The CESs further reinforced the knowledge of the child's susceptibility to asthma exacerbation if the child came into contact with a specific trigger to which the child was sensitized.

Table 1. Factors Being Assessed or Intervened On in Community Action Against Asthma (CAAA) by Ecological Level and Examples of Theory or Model Used

Levels of the Ecological Framework	Use of Theory or Model at This Level	Factors Being Assessed or Intervened On in CAAA	Examples of Theories Used in Community Action Against Asthma
Intrapersonal/individual	Understanding and changing individual behavior (such as cleaning behavior or smoking) Understanding and changing behavior of a policy maker or an elected official	Caregivers' knowledge of, and attitudes about, asthma in general, environmental triggers for asthma, cleaning behavior, and smoking behavior	Health Belief Model
Interpersonal	Understanding and addressing the influence of interpersonal interactions on health-related behavior and health status	Increasing provision of social support through community environmental specialists (CESs)	Social Cognitive Theory Social Support and Social Networks
Organizational	Understanding and addressing the role organizations play in supporting or inhibiting behavior change and environmental exposures	Organizations, including workplace and voluntary, and their characteristics and rules, regulations, and norms for operation	Interorganizational Theory
Community	Understanding and addressing the role of the community in supporting or inhibiting behavior change and environmental exposures	Relationships between organizations and informal networks, face-to-face primary groups, relationships among organizations within a defined area, and community as geographic unit	Community-organizing models: locality development and social action
Policy	Understanding how policy is made, analyzing effects of policy on the environment and health, methods for policy advocacy and change	Local, state, and national laws and policies	Community-organizing models

To increase caregivers' *perceived benefits* of reducing indoor environmental triggers, the CESs explained the link between exposure to indoor allergens and irritants and asthma exacerbation. They also explained how allergens and irritants could be reduced through cleaning behaviors and by preventing the child from being exposed to tobacco smoke.

For many caregivers of children with asthma, competing life demands, such as worries about food, shelter, and day care, mean that caring for their child's asthma is not their only priority concern. These demands can present barriers for undertaking suggested actions. To address *perceived barriers*, the CESs spent time with caregivers to identify what those barriers might be and engaged in strategies designed to overcome them. To address barriers such as lack of access to resources to obtain cleaning supplies or materials, the project provided each participant with household vacuum cleaners, cleaning supplies, and mattress and pillow covers. For other barriers specific to the individual family, such as those competing life demands previously mentioned, the CESs referred families to agencies that could assist them in addressing the barriers.

The CESs met with the caregivers and provided them with general information to explain the importance of actions to reduce environmental triggers, such as cleaning to prevent dust mites, reducing garbage and clutter (along with integrated pest management) to decrease cockroaches, and reducing children's exposure to indoor tobacco smoke. To provide the *cues to action*, the CESs shared the results of data collected from the baseline data collection (e.g., dust sample findings and information from the household observational walk-through such as the directly observed presence of cockroaches in the kitchen or mold in a child's sleeping area) and gave the caregivers recommendations from the project physician about the most appropriate trigger to act upon. The caregivers and the CES then discussed the issues and together decided which trigger to focus on first.

As mentioned previously, the CESs shared data collected from the baseline assessments to enable the caregivers to make wise choices about which triggers to prioritize for action. To increase the caregivers' *self-efficacy*, the CESs had the caregivers set small, obtainable goals for actions they would take in between their visits (a period of 6 to 8 weeks). The CESs reinforced behavioral changes with verbal encouragement and support.

APPLICATION OF INTERPERSONAL-LEVEL THEORIES AND MODELS IN CAAA

Social Cognitive Theory

Social Cognitive Theory (SCT)[17] focuses on both the underlying determinants of behavior and methods of promoting change. Key to social cognitive theory is the idea of *reciprocal determinism* or the continuing interaction among the characteristics of a person, the behavior of that person, and the environment within which the behavior is performed. The key concepts within SCT are categorized into major determinants of behavior, including *environment*, *outcome expectations*, *self-efficacy*, *behavioral capability*, and methods for behavior change, including observational *learning* and *reinforcement*.[5,17]

Environment refers to the objective factors physically external to that person, such as social environmental factors (e.g., family members, friends, and peers) or physical envi-

ronmental features (e.g., ambient temperature, presence of clean and safe exercise areas, or the availability of certain foods). *Outcome expectations* are the judgments of the likely consequence of a certain behavior. *Outcome expectancies* are the values that individuals place on a certain outcome. *Behavioral capability* consists of the knowledge and skills necessary to perform a specific behavior.

The suggested methods for behavior change are closely linked to the determinants of behavior. For example, *observational learning*, which occurs when a person observes the actions of another person, provides models for behavior and is thought to increase the behavioral capability of the observer as he or she gains valuable knowledge and skills concerning how the behavior is conducted. Behavioral capability can in turn contribute to the self-efficacy about the intended behavior. Reinforcements can also contribute to an individual's behavioral capability and self-efficacy about a behavior. Reinforcements can be external, such as receiving money or feedback about an action or observing someone else model a behavior and receive reinforcement for that behavior, or internal, such as doing something that is perceived as right.

CAAA incorporated SCT in the following ways. To ensure the caregivers had appropriate *behavioral capability*, the CESs spent time on each visit sharing the knowledge and skills needed to perform the required behavior such as cleaning. As mentioned, the CESs worked to improve the caregivers' *self-efficacy* about performing the required actions to reduce indoor environmental triggers for asthma (e.g., reinforcing behavioral changes with verbal encouragement and support).

A key educational method for the CESs was the use of *observational learning* through modeling all desired actions (e.g., vacuuming, dusting and cleaning, using the mattress covers, and using integrated pest management) to the caregivers. This modeling helped to ensure that the caregivers understood and felt efficacious about performing these actions correctly.

In designing the intervention, project planners took into consideration the SCT's definition of *environment*. For example, understanding that the ability of caregivers to reduce indoor environmental exposures may be limited because they rent their homes and landlords may not be willing to invest in changes, a tenant-advocate organization was added to the project's SC to help the caregivers with issues of tenant rights.

Social Support and Social Networks

Social support is the functional content of relationships that can be categorized into the following types of supportive behaviors: *emotional support*, which involves the provision of empathy, love, trust, and caring; *instrumental support*, which involves the provision of tangible aid and services that directly assist a person in need; *informational support*, which involves the provision of advice, suggestions, and information that a person can use to address problems; and *appraisal support*, which involves the provision of information useful for self-evaluation, such as constructive feedback, affirmation, and social comparison.[18] A social network is the web of social relationships that surround individuals and can be thought of as the linkages between people that may or may not provide social support.[19]

The CAAA project incorporated the concepts of emotional, instrumental, informational, and appraisal support through the work of the CESs. Like other environmental health promotion interventions,[20] CAAA employed community health workers to provide different types of social support including providing information, empathy, caring,

tangible materials such as cleaning supplies and bed covers, along with constructive feedback aimed at reducing participants' exposure to environmental triggers associated with negative health outcomes. CAAA also focused on enhancing social networks to increase both the individual's coping resources and the amount of resources in the community in which the individual lived. To increase the individual's coping resources, the CESs matched caregivers with community resources that would help gain resources and solve problems (e.g., the CESs referred persons with mental health needs to appropriate mental health services). To increase community resources, the community organizers (who will be described later in the sections on organizational and community-level theories and models) undertook neighborhood and community organizing strategies to increase the community's ability to be supportive to families of children with asthma and the community's ability to reduce environmental triggers for those children.

APPLICATION OF THEORIES AND MODELS AT THE ORGANIZATIONAL LEVEL IN CAAA

Organizational-level theories focus on either change in an individual organization (e.g., organizational development theory) or change in the way organizations interact (e.g., interorganizational theories) with each other. Given that CAAA uses a partnership approach in which a number of organizations are involved, it is not focused on individual organizational change. Therefore, organizational development theory[21,22] has not been applied to the CAAA intervention design. However, CAAA used the interorganizational relations (IOR) theory when designing the CAAA neighborhood and community organizing intervention.

IOR Theory

IOR theory focuses on how organizations work together, including stages and levels of collaboration.[23] The first stage is an *obligational network*, in which the collaboration among organizations consists of information exchange and communication and is dependent on personalized communication among staff members (called boundary spanners). The next stage is the *promotional network*, which occurs when organizations are willing to contribute individual resources to the coalition, dependent in some way on the coalition's collective output. A *systemic network* is the final stage in which the coalition has evolved to address common problems that are so complex that resources from more than the coalition's structure are needed and are established. Given the crucial role of partnerships and coalition building in environmental health promotion, application of this theory can be most helpful.

In the CAAA neighborhood intervention, the community organizers have identified priority environmental concerns through data collected as part of the CAAA exposure assessment component and through interviews with key groups and organizations. They also established an interorganizational network to address the priority concerns identified through the data-gathering processes. CAAA chose to establish an obligational network, instead of a more formal partnership, in recognition of the fact that many of the community-based organizations contacted are not primarily environmentally focused and might not be interested in a formal partnership around environmental issues. However, the organizations were interested in being part of a much less formal information-

sharing network around environmental issues affecting children's health, particularly those related to asthma.

APPLICATION OF THEORIES AND MODELS AT THE COMMUNITY LEVEL IN CAAA

Models of Community Organizing

The most widely recognized models of community organization are locality development, social planning, and social action.[24,25] *Locality development* stresses consensus and cooperation. It is aimed at building group identity and a sense of community and is heavily process oriented. *Social planning* stresses rational-empirical problem solving (usually done by an outside expert) and is primarily task oriented. *Social action* is concerned with achieving changes to redress imbalances of power and privilege while at the same time increasing the community's ability to work together to solve problems borne of the imbalance of power and privilege. As such, social action is both task oriented and process oriented. Although these models are often viewed as separate, it is also acknowledged that persons engaged in community organizing frequently use a mixing or phasing of two or more of these models.[24,26] Two key concepts and outcomes related to community organizing and community building include sense of community and community empowerment.

Sense of community is often characterized as caring and sharing among the people in a community and is related to residents' sense of identity with the community in which they live. Sense of community has been called "a critical dimension of community structure."[27] Sense of community is described as a mechanism for stimulating the health development of the environment and the people who inhabit it by enabling collective action to address local concerns and produce desired change.[28-30]

Community empowerment is defined as a social action process that promotes participation of people, organizations, and communities toward the goals of increased individual and community control, political efficacy, improved quality of life, and social justice.[31] Empowerment has been linked to health and social outcomes at the individual, organizational, and community levels.[31-33] Few studies have explored the relationship between individual health outcomes and empowerment at the organizational or community level, although measures to assess perceived empowerment at multiple levels do exist.[33-36]

The CAAA project's neighborhood and community-level intervention uses a community-organizing approach to reduce physical environmental hazards in the neighborhoods involved. The CAAA organizers employ a mix of locality development and social action in their organizing work. Consistent with locality development, the community organizers work with neighborhood members, block clubs, and community-based organizations in order to increase neighborhood social support and sense of community to reduce environmental triggers associated with asthma. In keeping with the social action model, the community organizers bring community members and community-based organizations together to assess and address the power differentials that exist between them and decision makers related to issues concerning environmental exposures. These activities are aimed at enhancing community empowerment and reducing environmental stressors.

APPLICATION OF THEORIES AND MODELS AT THE POLICY LEVEL IN CAAA

Within the context of public health, policy can be thought of as health directed (e.g., national health policy) or health related (e.g., economic, housing, public safety).[37] Agenda-building theory describes ways to ensure a specific issue is placed on the policy agenda.

Agenda-Building Theory

Agenda-building theory[38] suggests that methods to influence the policy process must be matched to where the issue is in the policy process. For example, if a group wishes to get a certain issue on the policy agenda, it needs to gain media attention as well as the support of opinion leaders and political leaders. If the issue of interest is already being considered by policy makers, then the interested group should ensure that communication is happening directly with the policy makers to ensure the issue is being framed as having high and long-term social relevance and being unique. Cobb and Elder[38] propose three models for agenda building—the outside-initiative model, the inside-initiative model, and the mobilization model. In the outside-initiative model, public support for an issue brings the issue first to the attention of policy makers and then to a more serious consideration of the issue by the policy makers. In the inside-initiative model, the initiative comes from within the government system and does not involve the larger public. In the mobilization model, policy proposals are developed within government, and then support is sought among the public for formal policy passage and successful implementation.

The CAAA project has policy change as one of its desired outcomes and, in following the outside-initiative model, to date has applied community-organizing models to generate public support for creation and/or enforcement of policies supportive of better asthma-related health status. To date, CAAA has held two community forums and has begun meeting with local elected officials to share results from both the exposure assessment and the intervention and to discuss the potential policy implications of the results.

ECOLOGICAL STRESS PROCESS MODEL FOR ENVIRONMENTAL HEALTH PROMOTION

CAAA has relied on a number of health promotion theories and models in the design and implementation of its intervention activities. The use of the ecological framework ensured that CAAA considered determinants of children's asthma health at various levels of analysis and practice. Yet, CAAA's intervention could have benefited from the use of a more comprehensive model that would allow for even greater guidance in understanding the complexity of factors associated with environmental health issues.

One such model that could, with some additions, be applicable for environmental health promotion is the Stress Process Model.[18,39-43] This model focuses attention on stressors, conceptualized as "environmental demands that tax or exceed the adaptive capacity of an organism resulting in psychological and biological changes that may place persons at risk of disease" (p. 3).[44] These environmental demands may be physical environmental stressors or social environmental stressors. The Stress Process Model[6,21,45-48] draws on work from multiple disciplines to provide a comprehensive and integrated theoretical framework that can be used to guide the conduct of public health interventions.

This model has usually been applied at the individual level[18,39,43,49-53] with some applications at the community level.[33] Using the Stress Process Model along with the ecological framework and many of the theories and models discussed in this article, a composite model is proposed here: the Ecological Stress Process Model for Environmental Health Promotion (see Figure 1). Given this article's focus on the CAAA project and childhood asthma, the following discussion of the proposed model emphasizes examples relevant to childhood asthma. However, it is important to note that this model is applicable for other environmental health-related illnesses, and hence, some additional examples are also mentioned later and in Figure 1.

The model suggests that there are five categories of stressors: *ambient environment*, *major life events*, *daily hassles*, *chronic strains*, and *cataclysmic events*.[39] *Ambient environmental stressors* are the continuous conditions that exist in the physical environment that can affect an individual. Examples of ambient environmental stressors may include exposure to hazardous materials; high lead levels; high noise levels; or, for childhood asthma, high levels of particulate matter or high levels of indoor allergens. *Major life events* are discrete events that occur and disrupt or threaten to disrupt normal activities. Major life events, whether seemingly positive in nature, such as the birth of a child, or seemingly more negative in nature, such as the death of a loved one or a divorce, can be sources of stress due to their disruption of normal activities. *Daily hassles* are the ongoing minor events that may be perceived as bothersome, for example, meeting deadlines, or daily traffic commute. *Chronic strains* are challenges that people experience over time, such as poverty, unemployment, racism, or economic disinvestment. Major life events, daily hassles, and chronic strains are important to consider in environmental health promotion programs because they can be sources of stress that might hamper an individual's ability to undertake suggested behaviors to reduce exposure to a stressor. For example, in CAAA, the CESs reported that they often had to help caregivers who had suffered a major life event to adjust to that event before they could begin to implement the suggested behavior changes to reduce environmental triggers for asthma. Similarly, for families living in poverty or dealing with unemployment, the caregiver's priority may be focused on obtaining food, shelter, or day care, and therefore the child's asthma may not be their priority concern. In some cases, the CESs first spent time matching families with general resources, such as food shelters, housing referrals, and emergency assistance for electricity and heating bills, before they were able to focus on ways to reduce environmental triggers for childhood asthma. *Cataclysmic events* are sudden physical environmental disasters that necessitate major adaptive responses, for example, tornadoes, toxic spills, or major fires. Cataclysmic events are rare in nature, but when they occur, environmental health practitioners are often brought in to assist communities in these crisis situations.

Although exposure to some objective stressors (e.g., exposure to an allergen for asthmatic children sensitized to that allergen) may directly affect health, the health effects of exposure to other stressors depend in part on the extent to which those exposed to them perceive them to be stressful. The amount of perceived stress may be affected by many of the concepts identified in the HBM, such as perceived susceptibility and perceived severity of the stressor. Both direct environmental exposures and perceived stress concerning exposure to environmental and other stressors may lead to short-term responses. These short-term responses may occur at different levels of the ecological framework and include the following: *physiological short-term responses* (e.g., wheezing episodes in asthmatic children, elevated blood pressure), *psychological short-term responses* (e.g., anxiety attack of asthmatic child, minor depression), *behavioral responses* (e.g., smoking of caregiver, alcohol use), *physical/structural responses* (e.g., residents relocate to

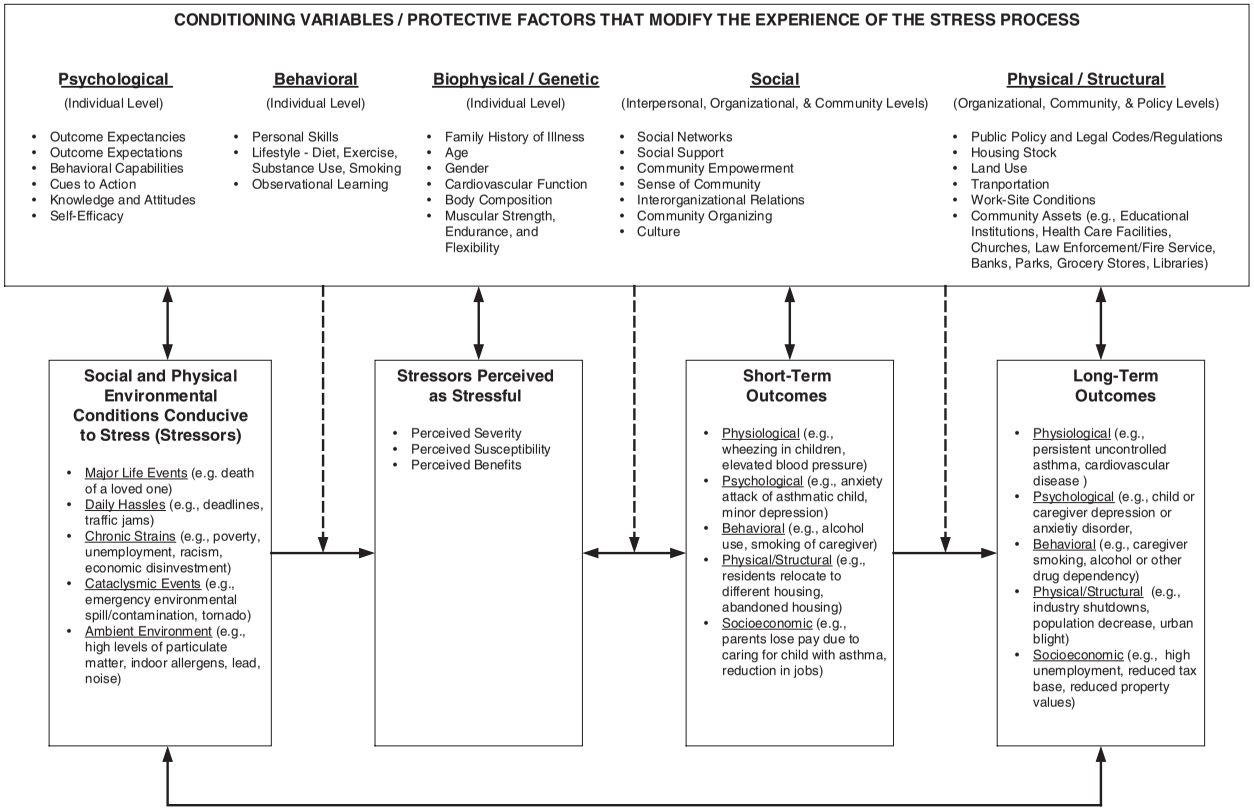

Figure 1. Ecological stress process model for environmental health promotion.
SOURCE: Adapted from House (1981),[18] Israel and Schurman (1990),[39] Katz and Kahn (1978),[42] and Israel et al. (1996).[43]
NOTE: Solid lines between boxes indicate presumed relationships. Dotted lines indicate hypothesized buffering effects of the modifying variables on the relationship between stressors and perceived stress, between perceived stress and short-term responses, and between short-term responses and long-term responses to stress.

different housing, abandoned housing), and *socioeconomic responses* (e.g., parents lose pay due to caring for child with asthma, reduction of jobs).

In situations where stressors, perceived stress, and short-term responses continue over time, they may affect long-term outcomes at the following levels: *physiological* (e.g., persistent uncontrolled asthma, cardiovascular disease), *psychological* (e.g., child or caregiver depression, anxiety disorder), *behavioral* (e.g., caregiver smoking, alcohol or other drug dependency), *physical/structural* (e.g., industry shutdowns, population decrease, urban blight), and *socioeconomic* (e.g., high unemployment rate, reduced tax base, reduced property values). Both short-term responses and long-term outcomes can be affected by an individual's and/or a community's outcome expectancies and reinforcements for specific actions (as outlined in SCT).

A number of conditioning variables or protective factors may affect any of these components directly or the relationship of these components to each other. These protective factors are categorized as *psychological*, *behavioral*, *biophysical/genetic*, *social*, and *physical/structural*, and, as with stressors, may occur at different levels of the ecological framework. Of particular relevance to environmental health promotion is the research evidence indicating that *social conditioning variables* that occur at the interpersonal, organizational, and community levels such as social support[19,39,54,55] and perceived control[33,45] can mediate the effects of stressors on health outcomes and influence health-related behaviors. In addition, aspects of community social dynamics, such as perceived control and sense of community, have been shown to be directly associated with mental and physical health outcomes[46,47] and can be catalysts for community action.[29,48] The model adds IOR theory to the social-protective-factor category. *Psychological conditioning factors* that occur at the individual level include those psychological characteristics that affect behavior and in our composite model include self-efficacy, behavioral capability, cues to action, and changes in knowledge or attitudes. *Behavioral conditioning factors* that occur at the individual level include those actual behaviors that influence health, such as personal skills, self-management behavior, exercise, nutritious diet, and observational learning. The *biophysical* and *genetic conditioning factors* that occur at the individual level are less amenable to change and include age, gender, and family history of illness, such as asthma. The *physical/structural conditioning factors* that occur at the organizational, community, and policy levels include the availability of safe housing, adequate medical care, and neighborhoods where children can play safely without being exposed to air pollutants.

IMPLICATIONS OF THE ECOLOGICAL STRESS PROCESS MODEL FOR ENVIRONMENTAL HEALTH PROMOTION

There are several implications for the application of this composite model to environmental health promotion.

First, the Ecological Stress Process Model for Environmental Health Promotion incorporates analysis of physical and psychosocial environmental stressors and intervening factors at multiple levels, suggesting that interventions designed to reduce excess morbidity and mortality due to physical environmental exposures need to address multiple and interrelated risk and protective factors. While considering the importance of the individual, interventions should be designed with the realization that stressors, conditioning variables, and short-term and long-term outcomes may affect, and be experienced by, communities as well as individuals. Thus, as with CAAA, environmental health promo-

tion activities using this model should move beyond the individual level to identify targets of change at multiple levels of the ecological framework and collect additional evaluation data to assess changes at these levels.

Second, the contextual nature of exposure to stressors suggests that research and interventions will be more effective if they are context specific.[43] A critical implication of this model is the assessment of stressors and protective factors as they are experienced within a given community, and tailoring interventions accordingly.[56,57] This calls for a collaborative process in which community members are actively involved in tailoring the risk assessment research and subsequent interventions to the cultural context of their respective communities and are therefore involved in developing appropriate interventions and evaluation research activities (including culturally appropriate assessment instruments).

Third, the Ecological Stress Process Model for Environmental Health Promotion suggests that the factors that contribute to environmental exposures, especially among urban populations, are complex and linked to larger social and political processes that affect access to economic, political, and social resources. Many stressors in the model, such as exposure to indoor allergens as a result of poor housing stock, unemployment, ethnic discrimination, and poverty, are beyond the ability of any one individual to control or change and require policy action. The model highlights the importance of collective action aimed at broad-scale community and policy change to reduce many of the stressors associated with poor health status.[43] Furthermore, given the research evidence concerning the role of control as a protective factor, interventions that actively engage participants and encourage participant control over program planning, implementation, and evaluation, have the potential to be health enhancing in and of themselves. This participation can be extremely important in communities of color, which have sometimes suffered disproportionate exposure to environmental stressors.[58,59] As Kuehn[60]notes, environmental justice is not just about distributional equity but also about procedural equity and the right to participate as equal partners in the assessment of risk and exposure. This implies that environmental health promotion interventions should engage individuals and organizations from within the community as well as from academic and service-providing organizations, enabling the intervention to mobilize resources to increase community capacity and community empowerment, and to address the complex set of factors associated with health.

CONCLUDING REMARKS

This article has described how several health promotion theories and models were applied at each of the levels of the ecological framework in the CAAA project. Through the development of the Ecological Stress Process Model for Environmental Health Promotion, this article has sought to combine these theories and models into a dynamic framework that has implications for environmental health promotion. The model aims to systematically embed prominent health promotion theories and models and their key constructs within an ecological framework and the stress process. As noted earlier, it would be logistically unrealistic and of little value to attempt to include all relevant health promotion theories and models directly in this model. Instead, the Ecological Stress Process Model should be used as a heuristic for possible links between theoretical constructs across ecological levels in the stress process. Depending on the environmental health issue, the model would need to be tailored to emphasize constructs shown (or not shown) in the model itself.

It is important to recognize that environmental health promotion, perhaps more often than general health promotion, is sometimes involved in a type of crisis management approach, where, for example, environmental scientists and health educators are called in to respond to an already engaged community's request for information and action about a perceived or real environmental threat. Although such situations may not lend themselves to extensive up-front planning of interventions based on theory, if environmental health practitioners are well versed in health promotion theories and models, they will be able to incorporate them into their everyday responses, be they primary prevention programs or secondary or tertiary crisis management. An understanding and application of the theories and models presented here, as applied to the Ecological Stress Process Model, can foster collaborative approaches involving environmental scientists, health educators, community members, community-based organizations, and health and human service agencies in strategies aimed at reducing environmental stressors, strengthening protective factors, and improving health and quality of life.

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