Multilevel Interventions and Racial/Ethnic Health Disparities

Sherri Sheinfeld Gorin, Hoda Badr, Paul Krebs, Irene Prabhu Das

Correspondence to: Sherri Sheinfeld Gorin, PhD, SAIC, Outcomes Research Branch, Applied Research Program, Division of Cancer Control and Population Sciences, National Cancer Institute, Executive Plaza North, 6130 Executive Blvd, Bethesda, MD 20892-7344 (e-mail: sherri.gorin@gmail.com).

To examine the impact of multilevel interventions (with three or more levels of influence) designed to reduce health disparities, we conducted a systematic review and meta-analysis of interventions for ethnic/racial minorities (all except non-Hispanic whites) that were published between January 2000 and July 2011. The primary aims were to synthesize the findings of studies evaluating multilevel interventions (three or more levels of influence) targeted at ethnic and racial minorities to reduce disparities in their health care and obtain a quantitative estimate of the effect of multilevel interventions on health outcomes among these subgroups. The electronic database PubMed was searched using Medical Subject Heading terms and key words. After initial review of abstracts, 26 published studies were systematically reviewed by at least two independent coders. Those with sufficient data (n = 12) were assessed by meta-analysis and examined for quality using a modified nine-item Physiotherapy Evidence Database coding scheme. The findings from this descriptive review suggest that multilevel interventions have positive effects on several health behavior outcomes, including cancer prevention and screening, as well improving the quality of health-care system processes. The weighted average effect size across studies for all health behavior outcomes reported at the individual participant level (k = 17) was odds ratio (OR) = 1.27 (95% confidence interval [CI] = 1.11 to 1.44); for the outcomes reported by providers or organizations, the weighted average effect size (k = 3) was OR = 2.53 (95% CI = 0.82 to 7.81). Enhanced application of theories to multiple levels of change, novel design approaches, and use of cultural leveraging in intervention design and implementation are proposed for this nascent field.

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Across the continuum of cancer care, racial and ethnic minorities (ie, individuals who do not self-identify as non-Hispanic whites) continue to experience disparities in both health care processes and outcomes compared with majority populations (1–10). Gaps have narrowed over time for some health outcomes but not for all (7,11). By 2050, 50% of the US population is expected to be racial/ethnic minority underscoring the significance of disparities in cancer-related health outcomes (12).

The mechanisms underlying these racial and ethnic disparities are incompletely understood (3). A burgeoning body of research suggests that health disparities in cancer comprise a complex problem, with distal, intermediate, and proximal determinants (11,13–15). The most distal determinants include policies that affect the availability, receipt of, and quality of health care and shared social norms about health. Intermediate determinants include the social contexts, physical environments, and social relationships, such as neighborhoods or communities, in which the distal effects are experienced (14). Finally, proximal determinants are embedded in the individual and include genetic susceptibility, biologic markers of disease, socioeconomic status, race/ethnicity, gender, and cultural beliefs. They also include the capacity to address health-care needs, to perceive social support, and to engage in risk behaviors. Because multilevel interventions may be able to address multiple determinants within these complex contexts, they may be uniquely suited to reducing health disparities in racial and ethnic minorities (11).

The results from many large community-based interventions suggest that clinically meaningful changes in chronic disease risk factors, morbidity, and mortality are possible over time (16–34). Interest in culturally competent multilevel approaches to improve community health in areas such as nutrition, physical activity, and smoking prevention and cessation has grown (35–38). However, these approaches are often stronger in design than in implementation or evaluation (39).

There is a paucity of empirical research on the potential impact of multiple levels of national, community, organizational, and/or health-care provider interventions on reducing racial and ethnic disparities in health-care access, treatment quality, and outcomes (40–46). The results from a well-designed, multiyear, multietnic, multilevel community intervention trial to increase breast and cervical cancer screening reported inconclusive findings because of an imbalance in numbers of African Americans, Latinos, and Chinese Americans across the study arms (47). Beach et al. (40) examined interventions targeted to health-care providers to improve the quality of care to racial/ethnic minorities; they included only randomized controlled or concurrent controlled trials, limiting the applicability of their findings to this review. Fisher et al. (44) systematically reviewed 38 interventions designed to modify health behaviors, increase access to the existing health-care system, and/or modify the health-care system to better serve racial and ethnic subgroups and their communities. Although they uncovered interventions at multiple levels, they did not systematically evaluate the impact of three or more levels on health-care processes and outcomes [ie, “multilevel interventions” (48)]. Other reviews of health-care interventions to reduce ethnic and racial disparities have evaluated approaches to improve cultural competence in...
health-care systems (49), to a specific health condition, such as hemodialysis (50), or health organization change (51,52). An additional review of several Robert Wood Johnson Foundation–funded interventions to reduce racial and ethnic disparities in health care concluded that multilevel, multicomponent, culturally-tailored interventions that target different causes of disparities hold the most promise, but more research is needed on interventions and their implementation (53). None of the previous reviews compared ethnic and racial subgroups, perhaps due to a dearth of relevant empiric studies. To our knowledge, the study described here is the first systematic review of interventions comprising three or more levels on reducing health disparities among ethnic and racial minorities.

To examine the impact of multilevel interventions designed to reduce health disparities, we conducted a systematic review and meta-analysis of studies of three (or more)-level interventions for ethnic/racial minorities. We defined levels based on a model of human aggregation (individual, provider team, organization, community, etc.) consistent with Taplin et al. (48). The primary aims were to 1) synthesize the findings of studies evaluating multilevel interventions directed at ethnic and racial minorities to reduce disparities in their health care and 2) obtain a quantitative estimate of the effect of multilevel interventions on health outcomes among racial and ethnic minorities. In addition to relevant studies focused exclusively on cancer, we included multilevel studies in healthy populations or those with diseases other than cancer. We did this for the following reasons: 1) the effects of cancer, like cardiovascular disease, diabetes, and asthma, are mediated by social determinants, so the findings may be broadly applicable (11); 2) cancer shares some risk factors for mortality with cardiovascular disease, stroke, dementia, pulmonary disease, and infection (54); 3) preventive behaviors, such as smoking cessation, healthful eating, and physical activity affect multiple diseases (3,55); and 4) clinical interventions on one disease at a time often have limited effect and poor transportability (52,56). This is particularly so when interventions are directed at an ecology of health care (57–66). We also reasoned that a systematic review, including a description of the processes of intervention design, implementation, and/or dissemination across a number of studies, could provide a roadmap for future interventions focused specifically on cancer care.

Methods

Search Strategy

The electronic database PubMed (http://www.ncbi.nlm.nih.gov/pubmed/) was searched using Medical Subject Heading (MeSH) terms and key words for three-level studies that compared multiple groups, times, and/or interventions and that focused on ethnic or racial subgroups. To further refine the search, sentinel articles were added, and strategic snowball searches were conducted by the Scientific Consulting Group (SCG). The full search strategy along with search terms is described in Supplementary Appendix 1 (available online).

Selection Strategy

Three raters (S. Sheinfeld Gorin, H. Badr, P. Krebs) evaluated each full article (N = 85) for inclusion in the final review using the best sources for the relevant data. The selected studies were synthesized descriptively and/or with meta-analysis.

Studies published in English, using US (or Mexican border) populations, between January 2000 and July 2011 had to 1) specify ethnic and racial minorities in their study aims, populations, and/or interventions; 2) include at least three levels of intervention influence (48); and 3) describe an empiric study. For evaluation by meta-analysis, in addition, studies had to include a comparison group or time, baseline and follow-up sample sizes, and quantitative measures for study outcomes. Articles within the meta-analysis also were evaluated for quality using a modified nine-item Physiotherapy Evidence Database (PEDro) coding scheme, which was developed using a Delphi expert consensus technique (67). The scheme was designed to identify studies that are generalizable, internally valid, and that contain interpretable data.

Review Strategy

The list of studies identified for full-text review was divided among the three reviewers (S. Sheinfeld Gorin, H. Badr, P. Krebs), who independently reviewed and coded the studies in Microsoft Excel using a standardized form, summarized in Table 1 and Supplementary Appendices 2 and 3 (available online). Each article was reviewed independently by at least two reviewers. Any discrepancies were resolved by consensus, and final data were entered for each study.

Organizing Framework

The taxonomy for this review was a modified version of the organizing framework described by Taplin et al. (48) (see Figure 1). Our framework included multiple health outcomes (including cancer), critical factors (such as socioeconomic status), and resources (including community organizations, associations, and leaders; health workers; lay health advisors; and navigators) that are fundamental to community engagement among racial and ethnic subgroups (3–11,68–75). Community health workers, lay health advisors, and navigators were considered a unique type of resource because they are members of both the racial/ethnic target community and are part of the organization or intervention. These individuals communicate health information to the target group through their existing social networks, tailor messages to the cultural contexts of their communities, and broker resources for the individual (70,72,76). Because the source of influence on these individuals could be either their racial/ethnic community or the organization promoting the intervention, we categorized the source of influence depending on each study’s description of the worker’s role in the intervention, recruitment source, training, and supervision.

Statistical Approach to the Meta-Analysis

As described below, a subset of the 26 studies that were systematically reviewed met the additional criteria for meta-analysis (n = 12). Consistent with the reporting in many of the studies, we used odds ratios (ORs) as the effect size (ES) statistic. Studies that reported mean differences were transposed into the odds ratio format for consistency of analysis. For behavioral outcomes, we used the Lipsey and Wilson (77) method of examining distributions of
### Table 1. Summary description of 26 studies evaluating multilevel interventions to reduce health disparities among racial/ethnic minorities*

<table>
<thead>
<tr>
<th>Number of studies</th>
<th>Publication date†</th>
<th>Study design†</th>
<th>Intervention targets</th>
<th>Cancer continuum</th>
<th>Clinical areas</th>
<th>Race/ethnicity</th>
<th>Intervention model, theory, principles, or crosscutting concepts¶</th>
<th>Multiple clinical foci</th>
<th>Number of levels targeted by the intervention‡</th>
<th>Findings on outcome‡‡</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2000–2008</td>
<td>Randomized controlled trial</td>
<td>Individual, team/group/family, community</td>
<td>Prevention</td>
<td>Cancer’s</td>
<td>African American</td>
<td>Critical and Transformative Theory (individual empowerment)</td>
<td>3</td>
<td>Yes</td>
<td>Nutrition and/or physical activity change, BMI change, programs provided§§</td>
</tr>
<tr>
<td></td>
<td>2009–2011</td>
<td>Quasieperiment with control groups</td>
<td>Individual, provider, organization</td>
<td>Screening</td>
<td>CVD</td>
<td>Latino</td>
<td>Diabetic management</td>
<td>2</td>
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<td>Diabetic management</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Posttest only without a comparison group</td>
<td>Individual, organization, community</td>
<td>Screening</td>
<td>Diabetes</td>
<td>Multiracial/multiethnic</td>
<td>Risk factor modification to decrease CVD§§</td>
<td>4</td>
<td>Yes</td>
<td>Risk factor modification to decrease CVD</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Qualitative studies using semistructured interviews</td>
<td>Individual, team/group/family, organization</td>
<td>Screening</td>
<td>Asthma</td>
<td>African American</td>
<td>Asthma management¶¶</td>
<td>1</td>
<td>Yes</td>
<td>Asthma management</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mixed methods</td>
<td>Individual, provider, community</td>
<td>Screening</td>
<td>Mental illness/substance abuse</td>
<td>Latino</td>
<td>IV drug use perceptions¶¶, substance use##</td>
<td>1</td>
<td>Yes</td>
<td>IV drug use perceptions, substance use</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Case studies</td>
<td>Individual, provider, organization, community</td>
<td>Screening</td>
<td>Prenatal care and wellcare</td>
<td>Multiracial/multiethnic</td>
<td>Cancer screening##</td>
<td>1</td>
<td>Yes</td>
<td>Cancer screening</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Observational research</td>
<td>Provider, team/group/family, community</td>
<td>Screening</td>
<td>Occupational health</td>
<td>Multiracial/multiethnic</td>
<td>Prenatal management</td>
<td>1</td>
<td>Yes</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>Descriptive</td>
<td>Individual, community, policy</td>
<td>Screening</td>
<td>Environmental health</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Individual, team/group/family, organization, community</td>
<td>Screening</td>
<td>Multiple clinical foci</td>
<td>Multiracial/multiethnic</td>
<td>Knowledge about cumulative trauma disorder</td>
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<td></td>
<td></td>
<td></td>
<td>Individual, organization, community, policy</td>
<td>Prevention</td>
<td>Cancer continuum</td>
<td>Multiracial/multiethnic</td>
<td>Tobacco control***</td>
<td>1</td>
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<td>Prevention</td>
<td>Cancer continuum</td>
<td>Multiracial/multiethnic</td>
<td></td>
<td>1</td>
<td>Yes</td>
<td></td>
</tr>
</tbody>
</table>

* BMI = body mass index; CBPR = Community-Based Participatory Research; CVD = cardiovascular disease; IV = intravenous.
† This is an unduplicated count.
‡ Studies with less than three intervention levels were excluded.
§ The cancer clinical category includes relevant risk factor modification, such as nutritional or physical activity change and reducing obesity, if the authors did not list another focal disease.
¶ The aims, interventions, and/or populations described in these studies included racial and ethnic minorities.
¶¶ The categories are based on Sheinfeld Gorin (6). The targets of change as reported by the authors are listed in Supplementary Appendix 1 (available online).
# With the addition of a community construct to the Chronic Care Model.
** Intervention providers were connected to different levels, including the community (eg, lay health workers), the organization (eg, mail from a formal worksite program), groups (eg, peer groups); generally, interventions targeted change in individuals, patients, and/or consumers.
†† From Institute of Medicine (120).
‡‡ Outcomes are measured at the individual level, except where noted.
§§ Measured at the individual and/or the organizational levels.
¶¶ Measured at the family level as well.
## Measured at the provider level only.
### Table 1 (Continued).

<table>
<thead>
<tr>
<th>Number of studies</th>
<th>Individual-level targets</th>
<th>Individual-level targets</th>
<th>Intervention providers†,**</th>
<th>Process evaluation findings</th>
<th>Findings on outcome‡‡</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Critical and Transformative Theory</td>
<td>Theory of planned behavior</td>
<td>Health department staff/physician and health advisor/educators/researchers</td>
<td>Effectiveness††</td>
<td>Nutrition and/or physical activity change, BMI change, programs provided§§</td>
</tr>
<tr>
<td></td>
<td>(individual empowerment)</td>
<td>Health locus of control</td>
<td>Community health worker/lay health provider/patient navigator</td>
<td>Patient-centeredness††</td>
<td>Diabetic management</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Identity theory</td>
<td>External consultants</td>
<td>Efficiency††</td>
<td>Risk factor modification to decrease CVD§§</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No theory or model specified</td>
<td>Not specified</td>
<td></td>
<td>Asthma management¶¶</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>IV drug use perceptions¶¶, substance use##</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Cancer screening##</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Prenatal management</td>
</tr>
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<td>Vaccination for influenza</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Knowledge about cumulative trauma disorder</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Tobacco control***</td>
</tr>
</tbody>
</table>

(Table continues)
ESs from meta-analyses in which ES is categorized into tertiles: bottom tertile (OR ≤ 1.73), medium (OR = 2.50), and large (OR ≥ 3.41). By pooling variances, the ES statistic standardizes outcomes across studies and facilitates comparison among disparate outcome measures. Each ES was weighted by its inverse variance in calculating mean ESs. Heterogeneity was examined using the $I^2$ statistic, which represents the approximate proportion of total variability (0%–100%), in point estimates that can be attributed to systematic differences across studies (larger percentages reflect greater heterogeneity).

Consistent with the suggestion of Taplin et al. (48) that multilevel interventions include the individuals providing, seeking, and receiving health care, findings on study outcomes were grouped into two general categories: 1) individual (including clinical measures like blood pressure) or 2) provider team or organization-reported outcomes. An ES was calculated for both of these categories. When studies reported outcomes at more than one follow-up time point, the assessment closest in time to intervention completion was used. Individual ESs were examined to identify outliers for possible correction.

**Variance Modeling**

All pooled ES calculations used a random effects estimation model. A random effects estimate assumes additional variance beyond the set of studies and facilitates generalizability of results.

No moderator analyses were conducted as the studies were few in number, and outcomes were varied. We used the Comprehensive Meta-Analysis software package to conduct all statistical analyses (78).

**Findings**

Interest in interventions in racial/ethnic health disparities has grown rapidly in recent years, and the number of publications on these studies has increased fourfold per year since 2009. This finding suggests rapid growth in multilevel interventions of late (see Table 1).

We identified a total of 1097 study abstracts (see Supplementary Appendix 1, available online). Of these, 973 did not meet criteria for inclusion in the systematic review or meta-analysis. Full text was retrieved for the remaining 124 studies. Upon review of these studies, 98 were eliminated because they did not meet criteria for inclusion in either type of analysis or were duplicates. The remaining 26 were included in the systematic review. Of these, 12 provided sufficient data to compute an ES and were included in the meta-analysis (46,47,79–88). Four studies out of the 12 in the meta-analysis reported more than one outcome (85–88). The characteristics of the studies included in the systematic review are summarized in Table 1 and described more fully in the following sections, as well as in Supplementary Appendices 2 and 3 (available online).

**Models, Theories, Principles, or Crosscutting Concepts Guiding the Intervention Research**

Theories, models, and cross-cutting concepts (6,89) reported by the authors for all 26 studies are summarized in Table 1 (and reported in Supplementary Appendices 1 and 2, available online).

Seven studies did not report any conceptual underpinnings (47,82,83,85,87,90,91). In the remaining studies, the social ecologic or social contextual model (92,93), including its multiple and nested
targets of influence, was most frequently cited (six studies) as being the theoretical basis of the intervention (15,79,80,94–96). The nine principles of Community-Based Participatory Research (CBPR) (68,69) were also frequently incorporated into intervention design, particularly to enrich community engagement (across nine studies) (80,84,95–101). Critical and Transformative Theory, with its core concept of empowerment (102,103), was applied to community particularly to enrich community engagement (across nine studies) (68,69) were also frequently incorporated into intervention design, principles of Community-Based Participatory Research (CBPR) the theoretical basis of the intervention (15,79,80,94–96). The nine studies (47,80,83,88,90,96,117) focused on cancer influence are reported in Table 1. Only a small number of studies (80,101,117). These included the health belief model (97,117), social learning theory (including social cognitive theory) (80,101,117), identity theory (80), health locus of control (117), and the theory of planned behavior (117).

Racial and Ethnic Minorities
All of the 26 studies focused on minorities either in their overall study aims, populations, and/or interventions. Most (n = 16) of the studies reviewed included multiethnic and multiracial samples (46,47,79–81,83–88,95,96,98,99,101). Others focused on reducing health disparities for one ethnic racial group that faced specialized barriers to cancer prevention or screening or higher incidence or mortality from cancer or other diseases (119). These included seven studies of African Americans (45,82,90,100,104,107,117) and three of Latinos (15,91,97).

Interventions and Levels of Influence
Among the 26 studies included in the review, three levels of influence were the most common: the individual, team/group/ family, and community. All of the combinations of levels of influence are reported in Table 1. Only a small number of studies described interventions with four (45,82,98,100) or five levels (one study) (96), none used six levels of influence. All but one study targeted the individual for change (84). Seven studies (47,79,83,88,90,96,117) focused on cancer—primarily in the areas of prevention and screening. The remaining studies described interventions for diabetes [five studies (15,45,46,95,104)], asthma control [four studies (84,98,99,101)], cardiovascular disease [eg, reducing hypertension, four studies (85,87,97,104)], or to address mental illness [one study (100)], and substance abuse [eg, intravenous drug use, two studies (80,81)]. Less frequent were studies of infectious diseases [three studies; eg, interventions to reduce HIV (100,107) and influenza (86)], well-child care [one study (82)], and prenatal care [two studies (82,100)]. Least common were interventions for occupational health [eg, training of poultry farm workers about cumulative trauma disorders (91)] and environmental health [eg, a CBPR capacity–building approach to reduce trash and illegal dumping in the community; two studies overall (79,98)]. Finally, three studies had more than one disease focus (80,100,104).

Description of the Sample Sizes and Methods
The average intervention sample size was 567 participants (standard deviation [SD] = 430 participants). Participation retention from baseline to follow-up was a median 82.6% among the seven studies that reported these data.

Overall, six studies were randomized controlled trials (79,85– 88,97), and six were quasi-experiments with a control group or community (46,47,80–82,84). The remaining study designs were posttest designs without comparison groups (91); qualitative studies including semistructured interviews [five studies (90,95,97,101,104,117)], as well as case studies [three studies (15,45,96)]. One study used mixed methods (98); one used observational research with aggregate administrative records (83). Three were descriptive studies (99,100,107).

Among the 12 studies assessed through meta-analysis, the intervention arm averaged 580 participants (SD = 420); and the comparison group(s) had an average of 503 participants (SD = 374 participants). Eight of the 12 trials were compared with a usual care or no treatment control (47,79,81–83,85,86,88). Treatment arms in the remaining four studies were compared with other youth employment programs (80), screening and a brief intervention (87), an informational booklet (84), or a continuous quality improvement program (46).

Description of the Intervention
The multilevel interventions also were generally multicomponent. Education and training were conducted in 15 intervention studies (45,47,53,80–82,84,85,87,91,95–97,104,107). Partnership and/or intervention planning, development, and/or implementation, or capacity building was a component of the intervention in eight studies (15,79,86,98–101,117). Counseling (eg, nutrition and physical activity counseling for cardiovascular disease or cancer prevention) was less frequent as an intervention component (three studies) (87,88,90). Patient navigation and outreach were reported in two studies (see Table 1) (47,83).

Eight studies did not specify who provided the intervention (15,45,84,95,98–100,104). Among those that did describe the intervention delivery staff, professional health department, and other medical staff, as well as health advisors, educators, or researchers were the most common providers (six studies) (80,82,85,87,94,117). Lay health advisors, community health workers, or patient navigators provided the intervention in five studies (47,83,84,91,97). Peers, employees, housing residents, and coalition members and partners provided interventions in four studies (79,86,90,96). External consultants such as the Institute for Healthcare Improvement delivered the intervention in three studies (46,81,107). Interventions lasted a median 6.5 sessions.

Process Measures. Overall, 17 studies described the process of intervention implementation: its extent, fidelity, and/or quality (15,45–47,80,82,84,86,88,90,95,97,98,100,104,107,117). Quality of program implementation was coded using the six Institute of Medicine criteria for comprehensive quality-oriented health-care system processes (120): safety, patient-centeredness (one study) (86), effectiveness (six studies) (45,46,80,82,86,90), efficiency (one study) (88). None measured timeliness or equity. Overall, 11 studies
reported findings on the implementation process working as planned, and two cited remaining challenges; 13 studies reported no findings on the process of intervention-related change.

Three of the studies systematically measured the process of partnership development and implementation (101,104,107). For example, Parker et al. (101) conducted in-depth interviews with community steering committee members to examine the partnership’s accomplishments relative to the nine principles of CBPR.

**Measured Outcomes.** The majority (n = 16) of the multilevel studies measured outcomes. Of these, 15 reported positive outcomes (45,46,79–88,90,91,96) and one an inconclusive finding (47). Three studies reported no results, and the rest reported only process outcomes. Of those that measured outcomes, individual measures of behavior were most frequent, followed by provider and organizational outcomes. In fact, only six studies measured outcomes at a level other than the individual (45,79,81,83,96,104).

The clinical areas that were assessed are listed in Table 1.

Individual outcomes were assessed with measures including laboratory values for hemoglobin A1c (HbA1c) for diabetes (46) and CO2-validated smoking cessation (56), and clinical measurements of height, weight, body mass index, waist circumference, and blood pressure (97). Self-administered questionnaires included known measurement characteristics assessing breast and cervical cancer screening (47). A number of studies used instruments, including semistructured questionnaires, focus group protocols, and surveys developed for the study, whose measurement properties were not reported (45,87,91,95–100,104,107,117).

Provider or provider/patient, team, group, family, and organizational measures of outcome were relatively less frequent. One provider-level measure was reported; Plescia et al. (104) evaluated a (community) lay health worker intervention at the group level using interviews. In another study, a lay health worker group intervention, the focus was on improving patient–provider communication; however, that study, did not measure outcomes at the provider level (95). One study focused on the family and assessed home air quality to change household risks, using a lung function monitor, alongside a symptom, medication, and activity-level diary to reduce asthma at the individual level (99).

Three studies examined organizational-level outcomes. Beresford et al. (79) administered the Checklist of Health Promotion Environments at Worksites (CHEW) to assess health behaviors in the worksite (121). Berg et al. (80) administered the Center for Substance Abuse Prevention (CSAP) measure to students to assess the outcome of a substance abuse intervention across schools, alongside aggregate (individual) measures of 30-day drug and alcohol use. Nash et al. (83) collected colonoscopy-screening rates at the hospital level after an organizational redesign, a provider update, and a patient navigation intervention.

At the community or policy levels, Jenkins et al. (45) collected ecological measures of HbA1c, lipid profile, and kidney testing, and lower extremity amputations for a community-targeted intervention to reduce diabetes. Wynn et al. (96) measured the outcome of a community- and policy-level intervention with the introduction of a tobacco control bill in the state legislature.

**Meta-analysis.** ESs for all 12 studies included in the meta-analysis are found in Figure 2 (96). The results of the meta-analysis on a subset of these studies suggest that, overall, multilevel studies report medium-size effects on health behaviors among

<table>
<thead>
<tr>
<th>Studies (ref.)</th>
<th>Outcome</th>
<th>OR</th>
<th>Log odds</th>
<th>P value</th>
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<td><strong>Individual outcomes</strong></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Berg et al., 2009 (81)</td>
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<td>0.42</td>
<td></td>
</tr>
<tr>
<td>Chin et al., 2007 (49)</td>
<td>Hypertension control</td>
<td>1.12</td>
<td>0.11</td>
<td></td>
</tr>
<tr>
<td>Emmons et al., 2005* (89)</td>
<td>Fruit/veg per day</td>
<td>1.35</td>
<td>0.30</td>
<td></td>
</tr>
<tr>
<td>Emmons et al., 2005* (89)</td>
<td>Physical activity</td>
<td>1.00</td>
<td>0.00</td>
<td></td>
</tr>
<tr>
<td>Fuller et al., 2007 (82)</td>
<td>Needle exchange beliefs</td>
<td>3.13</td>
<td>1.14</td>
<td></td>
</tr>
<tr>
<td>Hiatt et al., 2008* (46)</td>
<td>Mammography</td>
<td>1.50</td>
<td>0.41</td>
<td></td>
</tr>
<tr>
<td>Margolis et al., 2001 (83)</td>
<td>Well-care visits</td>
<td>2.24</td>
<td>0.81</td>
<td></td>
</tr>
<tr>
<td>Nash et al., 2006* (84)</td>
<td>Colorectal screening</td>
<td>1.93</td>
<td>0.66</td>
<td></td>
</tr>
<tr>
<td>Parker et al., 2008 (85)</td>
<td>Lung function</td>
<td>3.05</td>
<td>1.11</td>
<td></td>
</tr>
<tr>
<td>Rosamond et al., 2009 (86)</td>
<td>Heart disease risk</td>
<td>1.00</td>
<td>0.00</td>
<td></td>
</tr>
<tr>
<td>Rosamond et al., 2009* (86)</td>
<td>Tobacco use</td>
<td>1.05</td>
<td>0.05</td>
<td></td>
</tr>
<tr>
<td>Rosamond et al., 2009* (86)</td>
<td>Physical activity</td>
<td>0.80</td>
<td>0.22</td>
<td></td>
</tr>
<tr>
<td>Schensul et al., 2009 (87)</td>
<td>Vaccination barriers</td>
<td>1.00</td>
<td>0.00</td>
<td></td>
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<tr>
<td>Schensul et al., 2009 (87)</td>
<td>Vaccination rates</td>
<td>1.88</td>
<td>0.63</td>
<td></td>
</tr>
<tr>
<td>Stoddard et al., 2004* (88)</td>
<td>Fruit/veg per day</td>
<td>1.14</td>
<td>0.13</td>
<td></td>
</tr>
<tr>
<td>Stoddard et al., 2004* (88)</td>
<td>Physical activity</td>
<td>1.19</td>
<td>0.18</td>
<td></td>
</tr>
<tr>
<td>Stoddard et al., 2004 (88)</td>
<td>Hypertension control</td>
<td>0.95</td>
<td>0.05</td>
<td></td>
</tr>
<tr>
<td>Random Mean ES</td>
<td></td>
<td>1.27</td>
<td>0.24</td>
<td>&lt;.001</td>
</tr>
<tr>
<td><strong>Provider/organization outcomes</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Beresford et al., 2010 (80)</td>
<td>Health programming</td>
<td>1.06</td>
<td>0.05</td>
<td></td>
</tr>
<tr>
<td>Fuller et al., 2007 (82)</td>
<td>Syringe exchange</td>
<td>1.94</td>
<td>0.66</td>
<td></td>
</tr>
<tr>
<td>Nash et al., 2006 (84)</td>
<td>Patient navigation</td>
<td>5.86</td>
<td>1.77</td>
<td></td>
</tr>
<tr>
<td>Random Mean ES</td>
<td></td>
<td>2.53</td>
<td>0.93</td>
<td>.11</td>
</tr>
</tbody>
</table>

*Interventions focused on cancer prevention or control behaviors

Figure 2. Effect sizes and P values for individual and provider/organizational outcomes. ES = effect size; OR = odds ratio.
quality of the studies using the Physiotherapy Evidence Database (PEDro) coding scheme (12 studies)*

**Table 2.** Findings on the quality of the studies using the Physiotherapy Evidence Database (PEDro) coding scheme (12 studies)*

<table>
<thead>
<tr>
<th>PEDro coding scheme†</th>
<th>Number of studies</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Eligibility criteria were specified</td>
<td>12</td>
</tr>
<tr>
<td>2. Subjects were randomly allocated to groups (in a crossover study, subjects were randomly allocated an order in which treatments were received)</td>
<td>11</td>
</tr>
<tr>
<td>3. The groups were similar at baseline regarding the most important prognostic indicators</td>
<td>2</td>
</tr>
<tr>
<td>4. Measures of at least one key outcome were obtained from &gt;85% of the subjects initially allocated to groups</td>
<td>11</td>
</tr>
<tr>
<td>5. All subjects for whom outcome measures were received were assigned to the treatment or control condition as allocated or, where this was not the case, data for at least one key outcome were analyzed by “intention to treat”</td>
<td>12</td>
</tr>
<tr>
<td>6. The study provides both point measures and measures of variability for at least one key outcome</td>
<td>12</td>
</tr>
<tr>
<td>7. The study had an adequate treatment fidelity protocol, including manualized intervention and monitoring of treatment implementation</td>
<td>2</td>
</tr>
<tr>
<td>9. Loss to follow-up information is provided</td>
<td>7</td>
</tr>
</tbody>
</table>

* The PEDro coding scheme is based on the Delphi list developed by Verhagen et al. (67) at the Department of Epidemiology, University of Maastricht.
† Number of studies.

Discussion

The findings from this review suggest that multilevel interventions have positive outcomes across a number of health behavior outcomes (45,46,79–88,90,91,96). The findings also suggest that multilevel interventions may improve the quality of health-care system processes. Overall, the number of publications are few, and the measures are often not well described, so these results must be interpreted with caution.

Although these findings include positive outcomes for diseases other than cancer, cancer studies comprise more than one-quarter of the publications, so the findings may have implications for risk modification and screening. Additional studies of multilevel interventions, for example in care coordination, are warranted to extend these understandings through the cancer continuum, particularly using patient-reported outcomes (including symptoms).

Despite few comparative studies, the direction, type, and strength of the findings on social change reported in this review are similar to those reported for bilevel (provider and patient) and community-level changes among racial and ethnic minorities (73,122–125). In addition, the sample sizes are large among the studies reporting them, strengthening the findings among a high-need set of subgroups. Furthermore, while cost-effectiveness studies of multilevel programs are few (88,126), applying multilevel interventions to high-risk groups like ethnic and racial minorities may reduce intervention costs relative to populations of low- or moderate-risk patients.

Intervening on multiple levels requires unique design and implementation considerations. CBPR, which guided about one-third of the studies, involves all partners equally in setting priorities and executing tasks, strengthening local capacity, and equitably

| Figure 3. Funnel plot of standard error by log odds ratio. |
sharing power and resources (69,74). This is challenging and may require a specialized set of skills to engage in relationships with communities, collaborators, coalitions, and lay leaders to develop, implement, and disseminate the research over time. In these complex studies, attention to systematically reporting and assessing implementation processes is key (95). Lay and community workers are important to implementing interventions with the community as a target, as reported in previous reviews (123). Their supervision, training, and evaluation are unique, particularly to academic researchers, and trust must be allowed to develop over time (76).

Federal and foundation support have been instrumental in supporting the growth of multilevel intervention studies among ethnic and racial minorities (perhaps evidenced by the dramatic increase in publications since 2009), through the National Institutes of Health Centers for Population Health and Health Disparities; Centers for Disease Control and Prevention’s National Breast and Cervical Cancer Early Detection Program (NBCCEDP), Well-Integrated Screening and Evaluation for Women Across the Nation (WISEWOMAN), and Racial and Ethnic Approaches to Community Health (REACH) programs, as well as the Robert Wood Johnson Foundation’s Finding Answers: Disparities Research for Change programs. These efforts must continue—and expand—to encourage investigators to develop multilevel intervention studies, particularly those that systematically compare the impact of the same treatment on racial/ethnic minority and majority populations.

Many of the studies with positive outcomes used an empirically tested and refined social ecology model (92,93,127). Only a small number of studies used theory and models to guide study questions and design, to aid interpretation of the findings and to both contextualize and generalize the results, however (128). Many studies used the principles of CBPR to guide the intervention, or concepts like empowerment or capacity building, without specific outcome measures. Other than the Chronic Care Model, few of the rich set of organizational models (and their measures) (129,130) were referenced in any of the articles that met the review criteria. Without measures of the organization, questions about the role of the institution as a moderator of outcomes are left unanswered (131). Theoretical models of medical provider behavior are few, and none was cited in these articles (132,133).

With the concepts of intervention levels and targets still being defined in the field at large, around complex phenomena with uncertain explanations, enhanced application of theory can direct attention to the questions of what interventions (or intervention components) to apply, under what conditions, with which target population, over what period of time and sequence, and with which desired outcomes. Both increased application of existing theory—as well as additional model development (35–38)—are critical to the growth of this area of inquiry.

Although equity (14,120) was implicit in the aims of all of the intervention studies, only 15 studies used a comparison group at all, and only one (47) compared non-white Hispanic groups directly with white controls, so neither equity nor disparities (14) could be evaluated. Furthermore, all of the reviewed studies [except Downs et al. (98)] seemed to focus on interventions for proximal health risks or diseases rather than more distal social conditions (such as environmental justice or poverty). Future (and challenging) research comparing heterogeneous minority and majority populations, focusing on both distal and proximal determinants, is warranted to address whether multilevel interventions increase equity in health outcomes across the US population.

The reviewed studies focused on interventions for racial and ethnic minorities; culturally leveraging multilevel interventions may enhance their effectiveness, as suggested by a recent review (123). Culture—that is, the spoken language, shared norms, beliefs and expectations, and behavioral customs of a group of people (134)—is central to individuals, their communities, and the means by which they access the health-care environment. Cultural leverage involves adapting appropriate cultural meaning and context into the intervention materials, messages, and delivery systems (135).

**Study limitations**

Due to the paucity of studies between and among racial and ethnic minorities, as well as the lack of comparisons to majority populations, as described previously, we did not conduct any subgroup analyses. These heterogeneous population subgroups may have differences in multilevel intervention need and uptake, however (3,6,132,136–141). Furthermore, few of the studies reviewed examined the outcome of interventions with groups other than African American and Hispanics, limiting their applicability.

When conducting a review of a developing field, caution is warranted. Selection criteria necessarily limit the studies included for review, and different deployments of search strategies can influence the set of articles located. For example, we found more studies than either Taplin et al. (48) or Stange et al. (142), due to differences in the study publication years selected, and their requirement that impact be measured at each intervention level.

The review also is dependent upon the quality of the studies that were systematically examined. Design, measurement, and analytic approaches were inconsistent, and less than half of the studies reported outcome measures (and sample sizes) sufficient for systematic quantitative comparison with other research. Potential moderators of the ES (eg, type and dosage of the intervention) were inconsistently reported. Few studies [eg, Hiatt et al. (47)] accounted for clustering, potentially leading to false-positive findings. Research designs often were of the weakest type, with few comparisons to groups or over time. (The pooled ES is robust, however, because of the observed between-study variability.) Where comparisons were made, the control conditions were not fully described; service-as-usual conditions may have differed for ethnic and racial subgroups relative to majority patients (143). Although these drawbacks hindered our ability to summarize results quantitatively, this systematic review may improve the design and reporting of multilevel interventions in the future.

Increased development of research designs and measures to answer the questions posed by multilevel interventions are warranted. Murray et al. (144) have suggested that designs can change as research emerges from these developing partnerships, from screening intervention components (using randomization and fractional factorial designs) through efficacy tests (group-randomized trials; time-series, multiple baseline, and regression discontinuity quasi-experiments). Propensity scoring (145) could strengthen quasi-experimental designs by reducing bias in effect estimates. In addition, mixed-method approaches could strengthen designs
to reflect the emergent qualities of partnership development, intervention planning, and implementation as well as health outcomes over time (142). Similarly, the development of standardized well-validated measures of key theoretical constructs are suggested (146).

Conclusions

Because cancer (and other complex diseases) has multiple determinants, targeting interventions toward several levels of influence could improve their precision, efficacy, and effectiveness (11). Based on this systematic review, multilevel interventions show promise for reducing the burden of cancer and other diseases in racial and ethnic minorities in the United States.

References


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**Affiliations of authors:** SAIC, Outcomes Research Branch, Applied Research Program, Division of Cancer Control and Population Sciences, National Cancer Institute, Bethesda, MD (SSG); Department of Oncological Sciences, Mount Sinai School of Medicine, New York, NY (HB); Division of General Internal Medicine, New York University School of Medicine and VA New York Harbor Healthcare System, New York, NY (PK); Outcomes Research Branch, Applied Research Program, Division of Cancer Control and Population Sciences, National Cancer Institute, Bethesda, MD (IPD).