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OBJECTIVE:

To review the research literature on physical activity (PA) intervention trials, with an emphasis on underserved populations.

DATA SOURCE:

Research studies, review articles, and books.

CONCLUSION:

PA intervention studies have generally shown statistically significant but modest outcomes. Comprehensive intervention designs combining individual-level and physical environmental changes have posted the largest effect sizes, and emerging models are incorporating sociocultural and organizational environmental changes with promising results. Research including or targeting underserved populations poses unique challenges at each stage of the intervention process: design, recruitment, implementation, and evaluation. Synthesis of evidence-based approaches to address these challenges is presented.

IMPLICATIONS FOR NURSING**PRACTICE:**

Promoting PA in underserved communities is essential in improving population-level cancer outcomes. Additional resources are becoming available to nursing researchers and practitioners to aid in the conduct of PA intervention in understudied groups.

KEYWORDS:

Physical activity, exercise, ethnic minority, sedentary, cancer prevention, African American, Latino, Hispanic, obesity

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PHYSICAL ACTIVITY AS PRIMARY PREVENTION TO ADDRESS CANCER DISPARITIES

ANTRONETTE K. YANCEY AND A. JANET TOMIYAMA

GROWING evidence suggests that overweight/obesity and physical inactivity are important targets for cancer prevention and control. The International Agency for Research on Cancer estimates that “25% of cancer cases worldwide are caused by overweight or obesity and a sedentary lifestyle.”¹ The purpose of this article is to provide a brief review of existing research on physical activity (PA) intervention trials. Special emphasis will be placed on PA interventions in underserved populations, in which cancer burden is concentrated, and a discussion of factors associated with such interventions. This review will focus on adult populations. Comprehensive recent reviews of obesity prevention and control interventions in children and adolescents are available,²⁻⁶ and have also been synthesized by the Institute of Medicine.⁷

First, it is important to define the terms used throughout this article. *Obesity* is defined as having a body mass index (BMI; weight [in kilograms] divided by height [in meters] squared) of greater than 30. *Overweight* is defined as having a BMI between 25 and 29.9. *Physical activity* is bodily movement produced by the contraction of skeletal muscle and that substantially increases energy expenditure. *Moderate physical activity* is defined as activity that uses large muscle groups and is at least equivalent to brisk walking. In addition to walking, activities may include swimming, cycling, dancing, gardening and yard work, and various domestic and occupational activities. *Vigorous physical activity* is defined as rhythmic, repetitive physical activities that use large muscle groups at 70% or more of maximum heart rate, which roughly equals 220 beats per minute minus one’s age. Examples of vigorous physical activities include jogging or running, lap swimming, cycling, aerobic dancing, skating, rowing, jumping rope, cross-country skiing,

hiking or backpacking, racquet sports, and competitive group sports like soccer and basketball.⁸ *Sedentary behavior* does not have a standard definition, but typically describes a state of physical inactivity and low energy expenditure, classically characterized by excessive TV viewing.⁹ Studies have operationalized sedentary lifestyle in a number of ways, such as expending less than 10% of one's daily energy in moderate- to high-intensity activity (in which the metabolic rate increases at least four times from baseline¹⁰), or performing physical activities such as walking or biking less than 10 minutes per week.¹¹ *Underserved populations* are defined as those having minority status based on race/ethnicity, socioeconomic status (SES), gender, sexual orientation, or other socio-demographic characteristics.

OVERWEIGHT/OBESITY AND INSUFFICIENT PHYSICAL ACTIVITY INCREASE CANCER RISK

Studies from the United States have attributed one in five cancer deaths in women, and one in seven in men, to obesity.¹²⁻¹⁴ Regular PA has been associated with lower cancer incidence ranging from 10% to 50% across many types, including breast,¹⁵⁻²² colon,²²⁻³³ endometrial,³⁴⁻³⁷ and lung cancers.^{34,38-40} While it is difficult in most epidemiologic studies to disentangle the contributions of sedentariness and obesity to cancer risk, PA clearly exerts its protective influence both directly (for example, by decreasing gastrointestinal transit time, consuming calories needed for tumor growth, improving immune system functioning, and/or postponing pubertal development⁴¹) and indirectly (by decreasing fat stores, favorably altering fat distribution, and preventing weight gain). For further discussion of factors, see Courneya and Friedenreich⁴² elsewhere in this issue.

Despite this evidence of the cancer-protective influence of PA, more than 60% of Americans do not engage in adequate levels of PA.⁴³ Physical activity participation is even less common in low SES and ethnic minority populations, despite their higher morbidity and mortality rates for many cancers.⁴⁴⁻⁴⁶ In addition, a recent study identified physical inactivity as one of two health behaviors for which relative inequalities are increasing among those with less formal education compared with those with more.⁴⁷ SES-related obesity disparities are also increasing in women and among African Americans.⁴⁸

PHYSICAL ACTIVITY INTERVENTION DESIGN, IMPLEMENTATION, AND EVALUATION

Many PA intervention trials have been conducted, although few have targeted ethnically diverse or ethnic minority populations, nor have they generally succeeded in engaging representative samples of community residents or staff/members of the geographic areas and organizations from which they recruit.⁴⁹

Reviews of the PA intervention research literature^{4,50,51} have pointed to several recurrent challenges encountered in promoting PA. First, an active lifestyle is typically not maintained because it competes for time and financial resources with other sedentary but socially valued leisure activities (eg, personal care such as manicures and hair maintenance) and most obligatory PA (eg, for transportation, household chores) has been engineered out of our daily life.^{50,52-55} Second, intervention approaches to date have not successfully prompted generalization of PA to situations outside of the immediate intervention.⁵⁰ Finally, PA intervention studies have not been strongly rooted in applicable theory and designed to test relevant constructs. However, theoretical models have been fairly anemic in this area, explaining relatively little of the variance in PA adoption, or especially maintenance and discontinuation/resumption.

Level of Intervention

Most of the studies have been individually targeted. Community-based organizations have often been used, but usually as "staging grounds" or convenient locations for recruitment and intervention delivery in captive populations, rather than targets for change in the organizational, sociocultural, or physical environments.⁵⁶

Intervention Content

Although the exact design of interventions has varied dramatically from study to study, the interventions have included structured PA sessions and/or exercise "prescriptions" where participants are given specific recommendations for frequency, intensity, type, and time (FITT), or other goal-targeted activities such as using a pedometer to reach 10,000 steps/day. In addition, PA has often been packaged together with other health behaviors

to form what are called “lifestyle modification” interventions—in combination with nutrition programs, psychosocial interventions such as cognitive behavioral therapy, or interventions designed to increase adherence to chronic disease therapeutic medications.

Efficacy

A review by Holtzman et al⁵⁷ found that nearly half (45%) of individually targeted PA or fitness promotion interventions were successful in creating statistically significant increases in at least one outcome, generally lasting for at least 3 months post-intervention and producing modest effect sizes (between 0.2 and 0.5). On average, studies targeting moderate intensity PA had larger effect sizes than those targeting vigorous activity. Intervention exposure in this meta-analysis varied widely, from a single mailing to multiple sessions per week over many years. The 102 distinct outcomes studied also varied, from self-report measures to tests of maximal oxygen uptake.

In worksite settings, recent and methodologically sound PA promotion interventions have generally produced favorable outcomes when using individually tailored theory-based materials and/or environmental prompts, while those simply offering onsite fitness facilities or referrals to worksite fitness programs have showed little efficacy and engaged only already active or highly motivated staff.⁵⁰ Comprehensive approaches melding individual-level approaches (counseling, group health education) with physical environmental access (on-site fitness facilities, shower and changing rooms, accessible stairways) have been shown to be more effective in increasing levels of self-reported exercise than single-component interventions. Generalizability of these effects across more representative employee populations and for extended periods of time have yet to be established. Thus, emerging models have incorporated a group performance or skills practice component as a part of routine organizational practice (ie, a sociocultural environmental change), with early promise of increased effectiveness, sustainability, and return on investment for employers.^{56,58}

Most relevant to oncology nursing are interventions conducted in health care settings. Health care-based interventions usually consisted of clinicians offering advice regarding PA. Some in-

terventions involve multiple contacts with teams composed of physicians, nurses, health educators, and other mid-level providers.⁵⁹ Reviews of this literature (see Marcus et al⁵⁰ for a general review) have found mixed results regarding efficacy. Some found overall statistically significant (though modest) results, especially in the short term.^{59,60} However, results from other reviews^{61,62} were mixed and inconclusive when comparing interventions to usual-care controls. Qualities of successful interventions included multiple contacts with the health care team, behavioral approaches, supervised PA, equipment provision, and frequent patient follow-up.⁵⁹

Several research-related challenges are common across studies. First, more research is needed to determine the true efficacy and effectiveness of these interventions. As mentioned above, several PA interventions are packaged together with other types of health behavior interventions (ie, the design is not appropriate and/or the sample size is insufficient to permit discernment of independent intervention component effects). A related question, therefore, is which of the intervention components are most robust, and whether these active components remain viable in stand-alone interventions. Once *efficacy* is established, research must then be conducted to determine the “real world” feasibility, or *effectiveness*, of such interventions. An important component of effectiveness is the cost-effectiveness necessary for reimbursement by insurance providers. Reimbursement structures have yet to be systematically investigated as realistic targets of policy change.

PHYSICAL ACTIVITY INTERVENTION IN UNDERSERVED POPULATIONS

Importance for Improving Population-Level Cancer Outcomes

Research on PA interventions in underserved populations is critical to population health for at least three reasons. First, as noted above, such research is critical for the generalizability of study results, given the increasingly diverse U.S. population⁶³ (whites are no longer a majority in California and this will be true of the rest of the country by 2060).⁶⁴ For example, African American women are an underrepresented group with disproportionately high rates of obesity and

physical inactivity compared both with men and women of other ethnicities.⁶⁵

Second, relevant theoretical models must be developed or adapted.⁶⁶ In particular, accounting for the “behavioral economics” of PA: our evolutionary “hard-wiring” to avoid energy expenditure in adulthood⁶⁷⁻⁶⁹; stress/mood responses to discrimination and other forms of socioeconomic marginalization⁷⁰; and culturally influenced affective/emotional attraction or distaste for certain surroundings and activities.^{58,71,72}

Third, having homogeneous (usually white/European-American) samples is not ideal in prevention trials. Relatively advantaged populations may already be functioning at a high level, with little room for improvement. This ceiling effect may lead to underestimation of the influence of the intervention.

Fourth, research focusing on underserved populations can uncover subgroup-specific patterns of intervention response. For example, while stair prompts are widely cited as an evidence-based environmental approach to increasing PA levels, they were ineffective in African Americans in the only published stair study presenting subgroup analyses by ethnicity.⁷³

Last, there are strong cultural influences on PA and weight-related lifestyles. Ritenbaugh⁷⁴ first described obesity as a “culture-bound” syndrome, arguing that the development of obesity can be understood only within specific cultures and their core meanings and behavioral norms. Different cultures have different ideas and norms surrounding PA and eating, as well as obesity. For example, girls and women in African American culture may not wish to perspire because of arduous hair styling maintenance.^{50,58,71,75}

Despite the importance of PA intervention research in underserved populations, little data is available. Most large-scale studies have not had sufficient sample sizes of any underrepresented group to conduct subgroup analyses by ethnicity, much less by ethnicity and gender or SES.^{58,76} For example, a review of PA intervention studies published between 1984 and 2000 found only 18 studies with at least 35% African American women comprising the sample.⁷⁷ Furthermore, these studies were low in scientific rigor and had high attrition rates.^{77,78} What data that are available suggest that PA interventions are modestly successful, but long-term hard outcomes are equivocal, similar to findings for whites.⁵⁵ For example, the Fighting Cancer with Fitness (FCF) study,⁷⁸

with greater than 70% retention rate at 1-year follow-up, found significant increases in fitness (as measured by the sub-maximal treadmill test) and PA (self-reported), and decreases in BMI at 2 months post-intervention compared with control participants, but only the PA and fitness improvements remained at the 6- and 12-month follow-up assessments.

Thus, conducting PA interventions in underserved populations presents many challenges. The following sections detail these challenges, focusing on issues encountered in recruitment, implementation, and evaluation.

Recruitment

One of the greatest challenges for PA interventions targeting underserved populations is recruitment. Members of underserved populations are often reluctant to participate in any sort of scientific trial for several reasons, discussed below (see comprehensive review by Yancey et al⁷⁹). Because of the scarcity of evidence regarding recruitment specifically for PA intervention trials, some of the information below pertains to intervention research in general, but should be applicable to any type of intervention.

Negative perceptions of the scientific community. Symbolized by the Tuskegee Study (a government study in which treatment for syphilis was intentionally withheld from African American men from poor, rural Alabama), there is a high degree of mistrust of the scientific community in underserved populations, especially within the African American community. The process of informed consent, which is designed to protect participants’ rights, is instead sometimes seen as “signing away” one’s rights.⁸⁰ Mistrust of researchers is also manifested by participants reporting fears of being mistreated or exploited, fears of researchers portraying communities negatively, fears that community health problems will not be addressed, and fears that the researchers are only interested in furthering their own careers. To confront these issues of mistrust, researchers have recommended increased communication with potential participants and being explicit about aligning researchers’ goals with the community’s goals.⁷⁹

Community involvement. Community involvement from the study’s inception has been found to be a critical factor in recruitment.^{79,81} Obtaining the support of the community can be

facilitated by having investigators who come from the target community (“cultural insiders”). Support from community leaders and activating existing social networks within a community are essential tools for recruitment. Such support can also counteract the mistrust of researchers discussed above. Recruitment through churches and other community-based organizations are common strategies. Recruiting and conducting interventions within community clinics have also been shown to be successful.⁸²

Sampling approach. Probability samples (samples that are representative of the population from which they are drawn) are considered the gold standard in scientific research. However, probabilistic sampling often does not net adequate numbers of participants from underserved populations. To allay this, researchers have augmented their probability sampling with community-based recruitment.⁸³ While focused, community-based recruitment can be more arduous, time-consuming, and expensive (for example, Marquez et al⁸³ spent \$222 per participant compared with \$37 per participant in population-based sampling), such efforts are crucial for ensuring adequate representation of members of underserved populations. At least one understudied group should be over-sampled in the context of population sampling to ensure adequate power for subgroup analyses by ethnicity or SES and, if possible, other key socio-demographic attributes (see below).

Study design. Studies that use random assignment and control groups are the most scientifically rigorous, and also the most difficult in terms of recruitment. Placebos and other no-treatment control groups, randomization, and double-blind procedures are implicated. Potential participants may decline to participate unless they receive some sort of treatment, and being assigned to a control group or not knowing their assignment (in the case of double-blind studies) may decrease their motivation to enroll or invest. These barriers can be overcome by using wait-list control groups (or attention control condition in which the alternative or “control intervention” is also viewed as valuable and needed^{78,84}), communicating about the utility of randomization and control groups, and reducing participant burden.⁸⁵ The trade-off, however, between scientific rigor and successful recruitment must be balanced.⁸⁶⁻⁸⁸

Psychosocial and socioeconomic barriers. Potential participants from underserved popula-

tions may face both psychosocial and socioeconomic barriers to participating. Examples of the former include higher rates of mental disorders (such as depression), hostility, and distress, and lower levels of social support, self-efficacy, and quality of life^{60,79,89}; examples of the latter include limited financial resources, limited time, lack of transportation, limited access to child care, and lack of education.⁶⁰ Some of these barriers can be overcome by strategies to reduce participant burden (see below) and provide logistic support (eg, child care or transportation vouchers).

Incentives. Providing payments and other incentives (such as free gym memberships⁷⁸) can increase recruitment, participation, and retention (see below), and ameliorate socioeconomic barriers to participation.

Socio-demographic factors. Related to the socioeconomic barriers discussed above are certain socio-demographic factors. For example, if participants’ region of residence is far from the study site, recruitment may not be as successful. Immigration status is another important issue.⁸² Participants who do not have legal documentation may decline to participate for fear of prosecution and deportation. Potential participants who are recent immigrants or relatively less acculturated may also be less likely to participate because of language or cultural differences. Other socio-demographic factors associated with physical inactivity that should be considered include older age, female gender, and lesbian sexual orientation.⁵⁸

Cultural targeting. Some studies have found success in matching recruiters with the race/ethnicity of participants⁹⁰ or utilizing a community member as a recruiter⁹¹ Others have found recruiter experience and/or training recruiters to be more important than ethnic matching.⁹¹ A potential participant’s ethnic identity is likely an important mediating factor in whether race/ethnicity-matched recruitment will be effective.⁹² Cultural targeting is also relevant to intervention implementation, discussed below.

Implementation

Implementation refers to how well an intervention is actually carried out, or delivered. Many of the same issues pertaining to recruitment are relevant to implementation. It should be noted that there is a paucity of data on the actual implementation of PA interventions, and the sections below will

borrow from related literatures and intervention research in general.

Retention. Retention of participants from underserved populations refers both to the completion of intervention protocols and presentation for all assessments. This is perhaps the greatest obstacle to successful implementation of interventions. High rates of attrition are often found among racial/ethnic minority participants. Many of the same psychosocial, socioeconomic, and socio-demographic barriers involved in recruitment (for example, mental distress, lack of transportation, lack of time, lack of child care, and lack of residence stability) are also problems for retention. Reducing these barriers (for example, providing transportation or conducting intervention sessions near the participants, having flexible scheduling, or providing child care) will improve retention. Timely incentive payments have also been shown to increase retention.^{78,93} Researchers can further improve retention rates by having the same staff (preferably from the community) over time, and having these staff be accessible (such as through a toll-free phone number) and familiar with the participants and their families. Intensive follow-up contact with participants and strong social support have also been recommended.⁷⁹

Cultural targeting. Interventions that are culturally incongruous are unlikely to be successfully implemented.⁷⁹ At a very basic level, this entails translation of study materials into languages other than English when appropriate. At the levels of complexity necessary in most intervention research, cultural targeting means that content conveyed and people and settings depicted are culturally salient and compatible.⁹⁴ For instance, golfing as an example of PA may be irrelevant or unrealistic financially for some participants. A key aspect of successful cultural targeting is selection of appropriate messengers and models for the intervention. Beyond racial/ethnic congruence of at least some of the intervenors, particularly those in decision-making positions,^{95,96} intervention staff must be sensitive to the potential psychosocial, socioeconomic, and socio-demographic challenges facing participants. Much more research is needed, however, to gauge the efficacy of cultural adaptations and the specificity of targeting needed.⁵⁰

Adherence. Even if participants do not fail to present for assessments or drop out of the study, the issue of participant investment, or active engagement in intervention delivery activities and adherence to the intervention protocol, remains

important. Complicated, time-consuming, and difficult intervention protocols can interfere with adherence.^{60,79} Notably, many studies do not adequately measure or report adherence, interfering with researchers' abilities to assess and address this problem.

Evaluation

The conclusions we draw from intervention findings are only as good as the quality of their evaluations. Several evaluation issues are particularly relevant for underserved populations.

Measure selection. Outcome measures should be carefully selected to be relevant to study participants (ie, validated in socio-demographically similar samples). Sociocultural factors should be considered. For example, phlebotomy may not be acceptable as a measure in some cultures or groups, and other methods (such as salivary sampling) may be more palatable.⁹⁷

Evaluation staff. As in recruitment and implementation staff selection, participants must feel comfortable with evaluators. Feelings of discomfort in evaluation sessions might interfere with honesty in self-report measures, and may negatively affect study retention and intervention adherence. For example, in the Fighting Cancer with Fitness study⁷⁸ mentioned above, problems arose when young white female college student intern evaluators were tasked with measuring the waist and hip circumferences of obese older African American women. Participants felt that the students' facial expressions and comments conveyed disdain for their body sizes and shapes.

Logistical concerns. Evaluation sessions should be arranged to favor participant convenience over research staff convenience. However, some clinical/physiologic measurements, such as blood insulin levels, must be conducted in hospital, clinic, or university settings. In such cases, logistical support should be provided, as earlier noted.

CONCLUSION

The field of oncology nursing will benefit from understanding the importance of PA, both for primary prevention as well as for survival and quality of life (see Ingram and Viscovsky,⁹⁸ Knob et al,⁹⁹ and Young-McCaughan and Arzola,¹⁰⁰ elsewhere in this issue). While further research is clearly

needed on PA interventions in clinical settings, the available research has provided some starting points for successful intervention. These include providing the patient with multiple contacts with providers and frequent follow-up interactions.⁵⁹

Addressing underserved populations is an important concern for oncology at all levels of prevention. For example, while Latinos tend to have lower than average cancer prevalence rates, they present at a later stage and have poorer survival.¹⁰¹ Recent efforts spearheaded by the National Cancer Institute (NCI) have attempted to address these issues within primary care settings. For example, the NCI-funded Latin American Cancer Research Coalition (LACRC) created cooperative relationships between academic researchers, community clinics, and community partners and organizations in Washington, DC.^{82,95} The National Black Leadership Initiative on Cancer and National Hispanic Leadership Initiative on Cancer are similar national efforts, with various degrees of local involvement and implementation. The Centers for Disease Control and Prevention (CDC) have also funded eight Cancer Prevention and Control Research Network sites across the U.S. to foster such community-based participatory research approaches. Several focus on PA.¹⁰²

The following recommendations may be helpful in increasing the quantity, quality, representativeness and, hence, potential impact of PA promotion research on cancer outcomes:

- Identify and widely disseminate information about diversity-targeted PA research resources that erode territorial disease-specific “silos” (eg, the African American Collaborative Obesity Research Network,¹⁰³ the 25 newly funded National Center for Minority Health and Health

Disparities planning projects,¹⁰⁴ CDC-funded Racial and Ethnic Approaches to Community Health projects,¹⁰⁵⁻¹¹⁴ or the CDC-funded WISEWOMAN projects¹¹⁵⁻¹³³).

- Expand pipeline programs to cultivate “cultural insider” researchers, those able to integrate cultural contextual factors into research question development, hypothesis generation, intervention design and implementation, measure selection and evaluation to optimize cultural salience and, ultimately, intervention efficacy and effectiveness. Examples include the special NCI grant mechanisms requiring researchers at majority institutions commanding substantial extramural research funding to partner with faculty at minority-serving institutions (eg, historically black colleges and universities), and the California-based Minority Training Program in Cancer Control Research.^{134,135}
- Set research priorities and involve professional associations (ASCO, ASPO, Black Nurses groups, etc.) in advocacy for resources to support them. Examples include validation of instruments in culturally diverse samples, and setting standards and providing incentives (eg, research supplements) to create consistency in construct and measure selection, because resources are perennially constrained, a more systematic approach may provide more “bang for the buck.”

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