Physical Activity Staging Distribution: Establishing a Heuristic Using Multiple Studies

C. Nigg, Ph.D.
University of Hawaii at Manoa

L. Hellsten, Ph.D.
University of Saskatchewan, Canada

G. Norman, Ph.D.
San Diego State University

L. Braun, Ph.D., R.N., C.S.
Rush-Presbyterian-St. Luke's Medical Center

R. Breger, M.P.H.
Oregon Health & Science University

P. Burbank, D.N.Sc., R.N.
University of Rhode Island

M. Coday, Ph.D.
University of Tennessee Health Science Center

D. Elliot, M.D.
Oregon Health & Science University

C. Garber, Ph.D.
Northeastern University

M. Greaney, Ph.D.
University of Rhode Island

S. Keteyian, Ph.D.
Henry Ford Health System

F. Lees, M.A.
University of Rhode Island

C. Matthews, M.S., Ph.D.
Vanderbilt University Medical Center

E. Moe, Ph.D.
Oregon Health & Science University

B. Resnick, Ph.D., C.R.N.P.
University of Maryland

D. Riebe, Ph.D. and J. Rossi, Ph.D.
University of Rhode Island

D. Toobert, Ph.D.
Oregon Research Institute

T. Wang, M.S.P.H.
Emory University

G. Welk, Ph.D.
Iowa State University

G. Williams, M.D.
University of Rochester

ABSTRACT

The purpose of this study was to identify the population prevalence across the stages of change (SoC) for regular physical activity and to establish the prevalence of people at risk. With support from the National Institutes of Health, the American Heart Association, and the Robert Wood Johnson Foundation, nine Behavior Change Consortium studies with a common physical activity SoC measure agreed to collaborate and share data. The distribution pattern identified in these predominantly reactively recruited studies was Precontemplation (PC) = 5% (± 10), Contemplation (C) = 10% (± 10), Preparation (P) = 40% (± 10), Action = 10% (± 10), and Maintenance = 35% (± 10). With reactively recruited studies, it can be anticipated that there will be a higher percentage of the sample that is ready to change and a greater percentage of currently active people compared to random representative samples. The at-risk stage distribution (i.e., those not at criteria or PC, C, and P) was approximately 10% PC, 20% C, and 70% P in specific samples and approximately 20% PC, 10% C, and 70% P in the clinical samples. Knowing SoC heuristics can inform public health practitioners and policymakers about the population's motivation for physical activity, help track changes over time, and assist in the allocation of resources.

INTRODUCTION

Despite substantial literature supporting the physiological and psychological health benefits of physical activity (1,2), approximately 60% of American adults are not active enough to obtain health benefits and 25% are completely sedentary (2). To combat sedentary lifestyles, interventions based on the cognitive and behavioral determinants of behavior change increasingly have been undertaken to promote physical activity and active lifestyle adoption and adherence (3–5).

The Transtheoretical Model (TTM) has been used to characterize the different stages of motivational readiness and has been applied to numerous health behaviors, including physical activity (6,7). A central concept in the TTM is the Stages of Change (SoC) (8). Through the use of the SoC, individuals can be classified into one of the following five stages along the

---

Terry Wang is now with the Centers of Disease Control and Prevention.

This work was supported by Grant 043377 from the Robert Wood Johnson Foundation to C. R. Nigg.

We thank the National Institutes of Health Behavior Change Consortium Physical Activity Workgroup for their collective work, valuable discussions, and contributions, and the contributing sites for sharing their data and making this successful collaboration possible.

Reprint Address: C. R. Nigg, Ph.D., Department of Public Health Sciences, John A. Burns School of Medicine, University of Hawaii at Manoa, 1960 East-West Road, Honolulu, HI 96822. E-mail: cnigg@hawaii.edu

readiness for physical activity continuum. Precontemplation (PC) describes individuals who are not regularly physically active and who have no intention of becoming regularly physically active. Contemplation (C) describes individuals who are not regularly physically active but are thinking about becoming regularly physically active in the next 6 months. Preparation (P) describes individuals who are not regularly physically active but are planning on becoming regularly physically active within the next 30 days. Action (A) describes individuals who have been regularly physically active for fewer than 6 months. Maintenance (M) describes regularly physically active individuals who have been active for 6 months or more.

Although not explicitly reported on in this research project, it is important to note that movement through these stages may not occur in a linear fashion; often individuals move through the stages repeatedly in a cyclical manner before M is reached. As people progress, stage-specific strategies (processes of change), self-efficacy, and decisional balance are employed to alter their experiences and environments in order to change their behavior (7,8).

Using the SoC, it is possible to examine a target population containing a heterogeneous mixture of individuals and categorize these individuals according to their degree of readiness to change (or to adopt) health-promoting behaviors. Through this categorization, the population distribution across the SoC can be determined and interventions can be tailored to contain messages appropriate for each individual's current level of readiness. In contrast, many health behavior change interventions of the past tended to assume individuals were already cognitively prepared to change their behaviors, which lead to messages inappropriate for the majority of the population who were not yet ready to take action (9). Successful tailored SoC interventions have been conducted for a variety of health behaviors including exercise and physical activity adoption (3,4,10,11).

Determining the distribution of individuals along the SoC continuum has been explored in some areas of health behavior change research. For example, investigators studying the application of SoC to smoking cessation (12–14) have found that samples of American smokers generally exhibit a distribution of 40% PC, 40% C, and 20% P. Reviewers of the TTM's applicability to the exercise domain have generally concluded that it has been supported across all populations studied (3,6,7,15–17). This conclusion implies that the pattern of changes in TTM variables across the stages of exercise change is similar and reproducible across populations. This conclusion is important because it suggests that the theoretical principles underlying the stage-matched interventions are the same regardless of the population of interest. Although most studies examining regular exercise across the SoC (18–21) present their distribution results, there appears to be little agreement in overall exercise SoC distribution or in the SoC distributions of separate populations. In a comparison of five large population-based studies in the United States and Australia, no compelling evidence to support a stable or reproducible distribution across the SoC for regular exercise was found (9). Furthermore, exercise is not synonymous with physical activity. Exercise is a subcategory of physical activity and it is generally defined as planned, structured, repetitive physical activity for the purpose of improving or maintaining of one or more facets of physical fitness. Essentially, physical activity is the act of moving about and includes physical activities done as part of daily living, occupation, leisure, exercise, and sports (22). Despite the significant differences between exercise and physical activity, there is limited research in SoC distribution for physical activity (23).

A number of factors that contribute to the disparate results observed for the SoC distributions just reported may also affect SoC distributions for physical activity. The use of different SoC measures and sample populations may confound efforts to compare relationships across different studies. In addition, sample recruitment methods may affect the SoC distribution pattern. Individuals who volunteer to participate in an exercise or physical activity study may be more physically active than individuals who are proactively recruited. Additional research is needed to more systematically test for the presence of stable, reproducible SoC distributions. If reproducible SoC distributions are found, then it may be possible to determine the subgroups that are most in need of physical activity intervention, increase the effectiveness of physical activity interventions by targeting the interventions appropriately, and improve the social marketing of physical activity interventions.

PURPOSE

The purpose of this study is to identify the population prevalence across the SoC for physical activity continuum and to establish the prevalence of people at risk for sedentariness (i.e., those not meeting the active criteria = PC, C, or P) using a common SoC measure and data from nine collaborating large-scale physical activity studies. The at-risk prevalence is also examined to see whether it varies for subsamples and whether the at-risk stage distributions differ due to recruitment methods (reactive [i.e., volunteers who contact the project in response to recruitment advertisements] vs. proactive [i.e., where research staff contact potential participants directly]) and/or sample characteristics.

METHOD

The Behavior Change Consortium (BCC) is a collection of 15 behavior change studies in the United States supported by the National Institutes of Health, American Heart Association, and the Robert Wood Johnson Foundation. The goal of the BCC is to advance research on mechanisms of behavior change and to foster cross-study collaboration among investigators. The Physical Activity Workgroup within the BCC specifically encouraged the use of common physical activity measures and outcomes in each of the studies to facilitate cross-study comparisons. Nine of the 15 studies targeted physical activity, and each of these studies included a common SoC measure of physical activity in their baseline data collection assessment. The details of the sample populations and interventions in these studies have been previously described (24).

Sample

The sampling methodology of the studies is presented in Table 1. Due to their diverse focus, the studies were analyzed together and also separated into clinical and specific subsamples. The four clinical subsamples included samples of individuals with health problems/concerns, whereas the remaining five studies examined specific populations including an occupational group and underserved or minority populations where health problems were not a defining characteristic. Sample sizes ranged from 99 to 1,281 participants, with three of the studies focusing on women only. The mean ages of study participants ranged from 40.70 (*SD* = 8.77) to 81.71 (*SD* = 6.35), and no less than 65% of the participants in all studies had at least a high school education.

Assessment of Physical Activity Stage of Change

To facilitate cross-site comparisons, a common physical activity staging instrument was used by all of the participating sites in the study (see Figure 1). The instrument adhered to the recommendations of Reed et al. (25), and Nigg (26). Regular physical activity was defined as activity performed for at least 30 min at a time (or more) per day on 4 or more days per week. For each study, the distribution of participants across all five stages was determined, and 95% confidence intervals were calculated around these percentages. The distribution of at-risk participants (i.e., those not at criteria or PC, C, and P) was also compared across sites. A one-way chi-square test was conducted to test the goodness of fit of the population estimates. Due to the multiple studies, a Bonferroni correction was applied to the alpha level to ensure that the overall alpha level remained .05.

RESULTS

Recruitment

The sampling procedure used in the majority of the studies was reactive sampling. Only one study (Toobert) utilized proactive sampling exclusively, and two studies used a combination of proactive and reactive sampling techniques (Clark, Coday/Garrison).

Stage of Change Distributions Across All Samples

The complete stage distribution for each of the nine studies is presented in Table 2. The pattern of stage distribution differed somewhat across studies, however, the resulting percentage distribution heuristic pattern that resulted was PC = 5 (± 10), C = 10 (± 10), P = 40 (± 10), A = 10 (± 10), and M = 35 (± 10) for physical activity regardless of type of study or type of recruitment.

At-Risk Distribution Results

To make more direct comparisons between the stage distributions of at-risk individuals and other health-related stage distribution such as the smoking cessation literature, the at-risk stage distribution was examined separately. The distribution of at-risk (PC, C, and P) participants across all nine samples is presented in Table 3. The distribution heuristic of at-risk participants appeared to be 15% PC, 15% C, and 70% P. However, of the nine studies, the statistical hypothesis (H_0: $\pi_1 = .15$, $\pi_2 = .15$, $\pi_3 = .70$) was tenable for only five of the studies at a .001 significance level (Elliot, Peterson, Resnicow, Sher, and Toobert; see Table 4).

At-risk distribution by subsamples. The at-risk stage distributions were then examined to determine whether the stage distributions varied according to type of sample: specific or clinical (see Table 4 and Figures 2 and 3). Specific samples, such as the Peterson study (Reducing Disease Risk in Low-Income, Postpartum Women), involved targeted but healthy individuals. In comparison, clinical samples, such as the Toobert study (Enhancing Support for Women at Risk for Heart Disease), focused on individuals with or at risk for a specific health condition. Across the five specific samples (Clark, Coday/Garrison, Elliot, Peterson, and Resnicow), the stage distribution of at-risk individuals appeared to be 10% PC, 20% C, and 70% P. Three of the five samples (Coday/Garrison, Elliot, Resnicow) supported the entire distribution, with two samples (Clark, Peterson) supporting higher percentages of individuals in PC and fewer individuals in P than the other studies. Furthermore, the statistical hypothesis (H_0: $\pi_1 = .10$, $\pi_2 = .20$, $\pi_3 = .70$) was tenable for three of the studies (Elliot, Peterson, Resnicow; see Table 4).

The at-risk stage distribution appeared to be somewhat different in the clinical studies compared to the specific samples, with a 20% PC, 10% C, and 70% P distribution pattern across the four clinical samples (Resnick, Sher, Toobert, Williams). Compared to the specific samples, the clinical samples tended to recruit more PC participants and less C participants. Support for this distribution varied and ranged from no support (Williams) to complete support (Sher). Furthermore, the statistical hypothesis (H_0: $\pi_1 = .20$, $\pi_2 = .10$, $\pi_3 = .70$) was tenable for two of the studies (Sher, Toobert; see Table 4).

At-risk distribution by recruitment. One study (Toobert) utilized proactive sampling exclusively, and two studies used a combination of proactive and reactive sampling techniques (Clark, Coday/Garrison). The Toobert study supported all of the stages in the overall physical activity SoC distribution and was similar to the Sher study but varied from the other two clinical samples (Resnick, Williams) in the at-risk distribution results. Compared to the other clinical samples (Resnick, Williams), the Toobert study recruited more PC participants, approximately the same C participants, and fewer PC participants.

At-risk distribution by gender. The at-risk distribution was also examined by gender. Three samples were made up entirely of women (Peterson, Resnick, Toobert) and two studies included women predominantly (Coday/Garrison, 88.1%; Resnicow, 76.1%), whereas two studies included men predominantly (Elliot, 3.3% women; Sher, 39.6% women). After removing the Toobert study for possible gender-recruitment biases and comparing the at-risk SoC distribution for the remaining samples,

TABLE 1
Methodology Description and Descriptive Statistics Across the Samples

Title, Principle Investigator, and Grant No.	*Sampling Procedure*	*Sampling Method*	*Sample Characteristics*					
			N	*M Age (SD)*	*Female (%)*	*> High School (%)*	*Ethnic (%)*	*Income Below 30K (%)*
The SENIOR Project, Clark (NIA 1RO1AG16588)	Recruitment for the study was initiated with a press conference. Multiple recruitment mechanisms included (a) advertisements at grocery stores, gas stations, restaurants, and churches; (b) recruitment presentations at senior housing communities, senior centers, and flu clinics; (c) advertisements in community and local bulletins; (d) direct mailings and phone recruitment; (e) promotional pamphlets; and (f) informal channels. All recruitment methods involved incentives for participating.	Proactive/ Reactive	1,281	75.36 (6.68)	69.4	77.9	77.4[a] 7.7[b]	76.3
HOPE, Coday/Garrison (NCI 1 R01 CA80725-01)	Recruited three urban medical clinics including Church Health Center to refer subjects and one faith-based Wellness Center (Hope and Healing; a ministry of Church Health Center) in Memphis, TN, to recruit walk-in participants.	Proactive/ Reactive	361	47.0 (9.9)	88.1	95.9	25.6[a] 72.4[c] 0.8[b] 1.1[d]	50.6
Promoting Healthy Lifestyles: Alternative Models' Effects, Elliot (NIAMS 1RO1 AR45901-02 & PHS 5 MO1 RR00334)	Firefighters from departments in Portland and Salem, OR, and from Battleground, Bush Prairie, and Camas, WA, were recruited to participate. The fire departments did not have existing health promotion programs. Eligible firefighters were fit-for-duty and worked full-time paid positions with 24 hr on, 48 hr off shifts. Study staff met with chiefs, key administrators, and union representatives. Stations were given information flyers and a videotape about participation. Stations were matched by demographics and underwent balanced randomization to one of three study groups.	Reactive	599	40.7 (8.77)	3.3	100.0	90.5[a] 2.2[c] 2.5[e] 4.7[d]	0.2
Reducing disease risk in low-income, postpartum women, Peterson (NICHD RO1 HD37368)	A randomized, controlled trial comparing the effectiveness of usual WIC care to the Enhanced EFNEP program. Participants included postpartum women from two urban areas who were WIC eligible or current participants. Participants randomized into one of two treatments using a stratified procedure to ensure equal distribution by BMI and Spanish or English.	Reactive	660	27.0 (5.7)	100.0	69.0	16[a] 8[c] 75[e] 1[d]	100.0

Testing the Exercise Plus Program Following Hip Fracture, Resnick (NIA R01 AG17082-01 & NIA R37 AG09901)	2 × 2 design testing the impact of the Exercise Training component of the Exercise Plus Program alone, Plus component alone, and full Exercise Plus Program versus routine care on the initiation and adherence to a home-based exercise program for older women post hip fracture. There were 240 women randomly assigned to one of four groups. Participants were recruited from five acute care facilities participating in the Baltimore Hip Studies.	Reactive	100	81.71 (6.35)	100.0	65.0	95.0[a] 5.0[c]	73.8
Church-based Health Promotion Project: Eat for Life II, Resnicow (NCI CA-69688 & NHLBI HL64959)	Atlanta area churches recruited and matched in triplicates, stratified by income and size, and then randomized to one of three conditions (comparison, multicomponent intervention, and multicomponent intervention plus motivational interviewing). African American participants, ages 18 to 72, were recruited from 16 participating churches through health fairs conducted by project liaisons after regular Sunday services.	Reactive	1,057	45.68 (13.29)	76.1	83.9	91.7[c] 0.9[d]	26.5
A Couples Intervention for Cardiac Risk Reduction, Sher (NHLBI 5 R01 HL62158-02)	Participants with history of cardiovascular event, acute symptoms, or cardiac risk-reducing medical or surgical procedure referred and recruited from 2 large hospitals. Participants must have a spouse willing to participate in the program.	Reactive	111	61.71 (8.96)	39.6	94.6	60.41[a] 24.2[c] 7.7[e] 7.7[d]	11.7
Enhancing Support for Women at Risk for Heart Disease, Toobert (NHLBI RO1 HL62156-01)	Physicians recruited to participate in program; participants recruited from participating physicians through letters and phone calls. Participants were representative of participating primary care offices and state population and were stratified on physician practice, smoking status, and type of diabetes medication.	Proactive	279	60.97 (7.95)	100	90.3	93.9[a] 2.9[e]	54.3
Self-determination, Smoking, Diet, and Health, Williams (NIMH 1 R01 MH59594-01)	Adult smokers (5+ cigarettes/day) stratified according to normal vs. elevated LDL-C. Elevated LDL-C participants randomly assigned to one of three conditions: (a) usual care for smoking and elevated LDL-C, (b) SDT intervention for smoking cessation and usual LDL-C care, (c) SDT for smoking cessation and elevated LDL-C.	Reactive	1,070	45.40 (11.52)	63.7	78.2	81.7[a] 13.5[c] 2.3[e] 2.3[d]	42.9

Note. For full project descriptions, please see *Health Education Research*, Volume 17(5), 2002. SENIOR = The Study of Exercise and Nutrition in Older Rhode Islanders; HOPE = Health Opportunities with Physical Exercise; WIC = Women, Infants, Children Program; EFNEP = Enhanced Expanded Food and Nutrition Education Program; BMI = body mass index; SDT = self-determination theory.
[a]White. [b]Portuguese. [c]African American/Black. [d]Other. [e]Hispanic.

Physical Activity Staging Questions

REGULAR PHYSICAL ACTIVITY: For physical activity to be regular it must be done for *30 minutes at a time* (or more) per day, and be done *at least* 4 days per week. For example, you could take a 30-minute brisk walk or ride a bicycle for 30 minutes. Physical activity includes such activities as walking briskly, biking, swimming, line dancing, and aerobics classes or any other activities where the exertion is similar to these activities. Your heart rate and/or breathing should increase, but there is no need to exhaust yourself. Please answer all questions with either Yes or No.

According to the definition above:

1. Do you currently engage in regular physical activity?
   ❍ YES ❍ NO
2. Do you intend to engage in regular physical activity in the next 6 months?
   ❍ YES ❍ NO
3. Do you intend to engage in regular physical activity in the next 30 days?
   ❍ YES ❍ NO
4. Have you been regularly physically active for the past six months?
   ❍ YES ❍ NO

SCORING

If item 1 = NO and item 2 = NO	Precontemplation
If item 1 = NO and item 2 = YES and item 3=NO	Contemplation
If item 1 = NO and item 3 = YES	Preparation
If item 1 = YES and item 4 = NO	Action
If item 1 = YES and item 4 = YES	Maintenance

FIGURE 1 Physical activity stage of change instrument.

results showed that men were more likely to be in P than women, whereas women were more likely to be in PC or C than men.

DISCUSSION

Few SoC for physical activity distribution patterns have been reported in the literature, and currently there is no standard, reproducable SoC for physical activity distribution pattern for overall or separate populations. Thus, the purposes of this study were to identify the population prevalence across the SoC for physical activity continuum and to establish the prevalence of people at risk for sedentariness (i.e., those not meeting the active criteria = PC, C, or P) using a common SoC measure and data from nine collaborating large-scale physical activity studies. This study identified an overall 5% PC, 10% C, 40% P, 10% A, and 35% M physical activity distribution pattern across the nine samples in this study. In contrast, one study of 5,000 participants identified an approximate 15% PC, 15% C, 10% P, 15% A, and 45% M distribution utilizing a modified SoC for physical activity measure (23). It is likely that these pattern differences resulted from the use of different physical activity SoC measures.

Across the five specific samples, the at-risk distribution (with the exception of the Clark and Coday/Garrison studies) was identified as 10% PC, 20% C, and 70% P. Although the Coday/Garrison study was only marginally different, the Clark study was vastly different from the remaining studies. The Clark study recruited more than twice the number of PC participants than any of the other four studies, which may have been caused by targeted recruitment for tailored interventions where recruitment of the preaction individuals was of extreme importance. Alternately, the large number of PC participants in the Clark study may have been due to the much older sample recruited or due to the partially proactive recruitment of participants.

Across the four clinical samples, the at-risk distribution pattern was identified as 20% PC, 10% C, and 70% P. Thus, an at-risk distribution difference between clinical and specific samples was identified. One possible explanation for this difference is that clinical studies targeting individuals with or at risk for a health condition usually recruit from an ill population that may not be ready for change, resulting in a higher proportion of participants in PC. Furthermore, across eight of the nine samples in this study, more than half of the participants not meeting the physical activity criteria are in the P stage, suggesting that for

TABLE 2
Physical Activity Stage of Change Distribution Results Across the Samples

Title and Principle Investigator	*PC*	*C*	*P*	*A*	*M*	*Total*
The SENIOR Project (Clark)						
N	386	72	182	43	575	1,258
%	30.7	5.7	14.5	3.4	45.7	100
CI	28.1–33.2	4.4–7.0	12.5–16.4	2.4–4.4	43.0–48.5	
HOPE (Coday/ Garrison)						
N	22	90	169	38	1	320
%	6.9	28.1	52.8	11.9	0.3	100
CI	4.1–9.6	23.2–33.1	47.3–58.3	8.3–15.4	0–0.9[a]	
PHLAME (Elliot)						
N	25	54	180	90	249	598
%	4.2	9.0	30.1	15.1	41.6	100
CI	2.6–5.8	6.7–11.3	26.4–33.8	12.2–17.9	37.7–45.6	
Reducing Disease Risk in Low-Income, Postpartum Women (Peterson)						
N	108	138	249	63	64	622
%	17.4	22.2	40.0	10.1	10.3	100
CI	14.4–20.3	18.9–25.5	36.2–43.9	7.8–12.5	7.9–12.7	
Testing the Exercise Plus Program Following Hip Fracture (Resnick)						
N	26	8	40	3	22	99
%	26.3	8.1	40.4	3.0	22.2	100
CI	17.6–34.9	2.7–13.4	30.7–50.0	0.0–6.4[a]	14.0–30.4	
Church-based Health Promotion Project: Eat for Life II (Resnicow)						
N	60	79	382	94	366	981
%	6.1	8.1	38.9	9.6	37.3	100
CI	4.6–7.6	6.4–9.8	35.9–42.0	7.7–11.4	34.3–40.3	
A Couples Intervention for Cardiac Risk Reduction (Sher)						
N	7	2	45	12	45	111
%	6.3	1.8	40.5	10.8	40.5	100
CI	1.8–10.8	0.0–4.3[a]	31.4–49.7	5.0–16.6	31.4–49.7	
Enhancing Support for Women at Risk for Heart Disease (Toobert)						
N	29	15	142	20	73	279
%	10.4	5.4	50.9	7.2	26.2	100
CI	6.8–14.0	2.7–8.0	45.0–56.8	4.1–10.2	21.0–31.3	
Self-determination, Smoking, Diet, & Health (Williams)						
N	189	135	333	76	290	1,023
%	18.5	13.2	32.6	7.4	28.3	100
CI	16.1–20.9	11.1–15.3	29.7–35.4	5.8–9.0	25.6–31.1	

Note. PC = Precontemplation; C = Contemplation; P = Preparation; A = Action; M = Maintenance; SENIOR = The Study of Exercise and Nutrition in Older Rhode Islanders; CI = confidence interval; HOPE = Health Opportunities with Physical Exercise; PHLAME = Promoting Healthy Lifestyles: Alternative Models' Effects.

[a]Denotes CIs with negative lower limits; all such limits set to 0.

TABLE 3
At-Risk (Preaction: PC, C, and P) Distribution Results Across the Specific and Clinical Samples

Specific Samples Title and Principle Investigator	*PC*	*C*	*P*	*Total*
The SENIOR Project (Clark)				
N	386	72	182	640
%	60.3	11.3	28.4	100
CI	56.5–64.1	8.8–13.7	24.9–31.9	
HOPE (Coday/Garrison)				
N	22	90	169	281
%	7.8	32.0	60.1	100
CI	4.7–11.0	26.6–37.5	54.4–65.9	
PHLAME (Elliot)				
N	25	54	180	259
%	9.7	20.8	69.5	100
CI	6.1–13.2	15.9–25.8	63.9–75.1	
Reducing Disease Risk in Low-Income, Postpartum Women (Peterson)				
N	108	138	249	495
%	21.8	27.9	50.3	100
CI	18.2–25.5	23.9–31.8	45.9–54.7	
Church-based Health Promotion Project: Eat for Life II (Resnicow)				
N	60	79	382	521
%	11.5	15.2	73.3	100
CI	8.8–14.3	12.1–18.2	69.5–77.1	
Testing the Exercise Plus Program Following Hip Fracture (Resnick)				
N	26	8	40	74
%	35.1	10.8	54.1	100
CI	24.3–46.0	3.7–17.9	42.7–65.4	
A Couples Intervention for Cardiac Risk Reduction (Sher)				
N	7	2	45	54
%	13.0	3.7	83.3	100
CI	4.0–21.9	0–8.7*	73.4–93.3	
Enhancing Support for Women at Risk for Heart Disease (Toobert)				
N	29	15	142	186
%	15.6	8.1	76.3	100
CI	10.3–20.1	4.2–12.0	70.2–82.5	
Self-determination, Smoking, Diet, & Health (Williams)				
N	189	135	333	657
%	28.8	20.5	50.7	100
CI	25.3–32.2	17.5–23.6	46.7–54.5	

Note. PC = Precontemplation; C = Contemplation; P = Preparation; SENIOR = The Study of Exercise and Nutrition in Older Rhode Islanders; CI = confidence interval; HOPE = Health Opportunities with Physical Exercise; PHLAME = Promoting Healthy Lifestyles: Alternative Models' Effects.

[a]Denotes CIs with negative lower limits; all such limits set to 0.

TABLE 4
Studies Supporting the Proposed At-Risk (Preaction: PC, C, and P) Specific and Clinical Sample Population Estimates

	At-Risk		*Sample Specific*	
Study	*df*	χ^2 *Value*	*df*	χ^2 *Value*
Title and principle investigator				
Specific samples		15–15–70		10–20–70
The SENIOR Project (Clark)	2	1039.98**	2	1802.50**
HOPE (Coday/Garrison)	2	67.85**	2	25.55**
PHLAME (Elliot)	2	10.85*	2	0.27
Reducing Disease Risk in Low-Income, Postpartum Women (Peterson)	2	7.71	2	7.15
Church-based Health Promotion Project: Eat for Life II (Resnicow)	2	5.05	2	8.11
Clinical samples				20–10–70
Testing the Exercise Plus Program Following Hip Fracture (Resnick)	2	23.55**	2	11.21**
A Couples Intervention for Cardiac Risk Reduction (Sher)	2	6.11	2	4.85
Enhancing Support for Women at Risk for Heart Disease (Toobert)	2	7.07	2	3.57
Self-determination, Smoking, Diet, & Health (Williams)	2	131.51**	2	133.36**

Note. PC = Precontemplation; C = Contemplation; P = Preparation; SENIOR = The Study of Exercise and Nutrition in Older Rhode Islanders; HOPE = Health Opportunities with Physical Exercise; PHLAME = Promoting Healthy Lifestyles: Alternative Models' Effects.
*p = .01. **p = .001.

predominantly reactive sampling, the majority of individuals can be expected to be ready to change.

Across all studies, the percentage of participants meeting the physical activity criteria ranged from 12.2% to 56.7%. According to the 2000 Behavioral Risk Factor Surveillance System (BRFSS; 27), only 26.2% of adult Americans meet the physical activity recommendation to perform 30 min or more of physical activity for at least five times per week.

In comparison, the samples in this study were measured using slightly different criteria: For physical activity to be regular it must be performed for *30 min at a time* (or more) per day and be performed *at least* 4 days per week. Given this definition, only one sample reported fewer than 15% of the participants meeting the activity criteria (Coday/Garrison), two samples reported between 20 and 25% (Peterson, Resnick), two samples reported percentages in the 30 to 35% range (Toobert, Williams), and four studies reported that approximately 50% of their participants met the physically active criteria (Clark, Elliot, Resnicow, Sher). Thus, it appears that relative to the BRFSS criterion, the physical activity criteria adopted by the BCC resulted in an overestimation of the percentage of active individuals. The majority of the samples in this study reported more participants

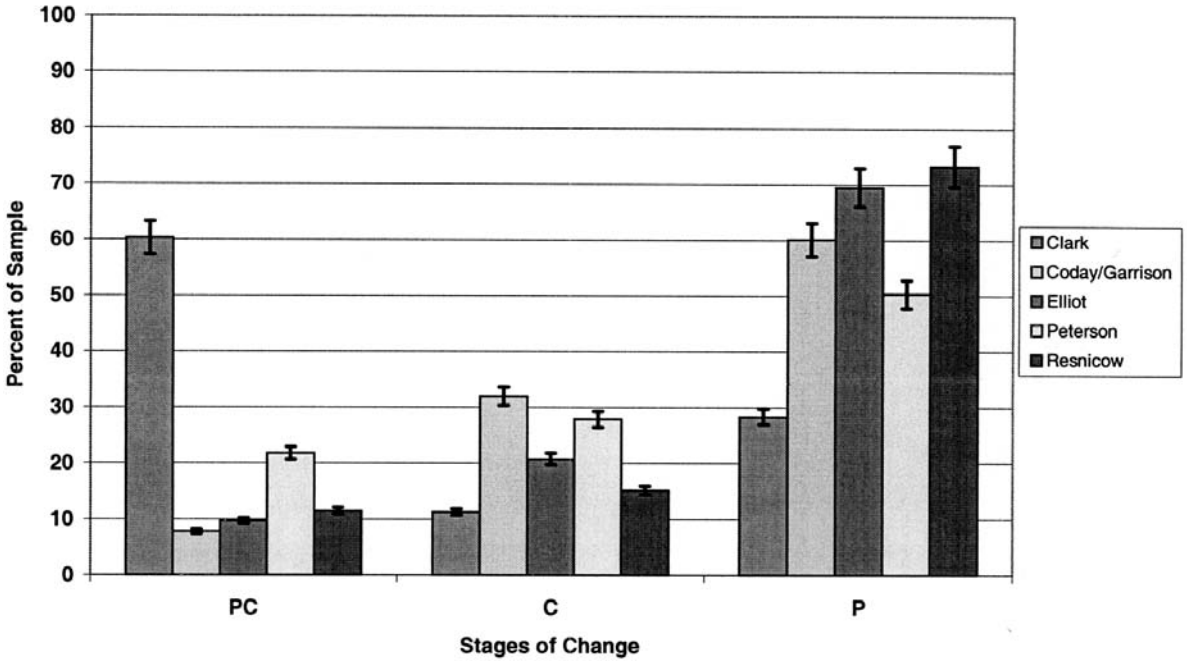

FIGURE 2 At-risk distribution results across the specific samples.

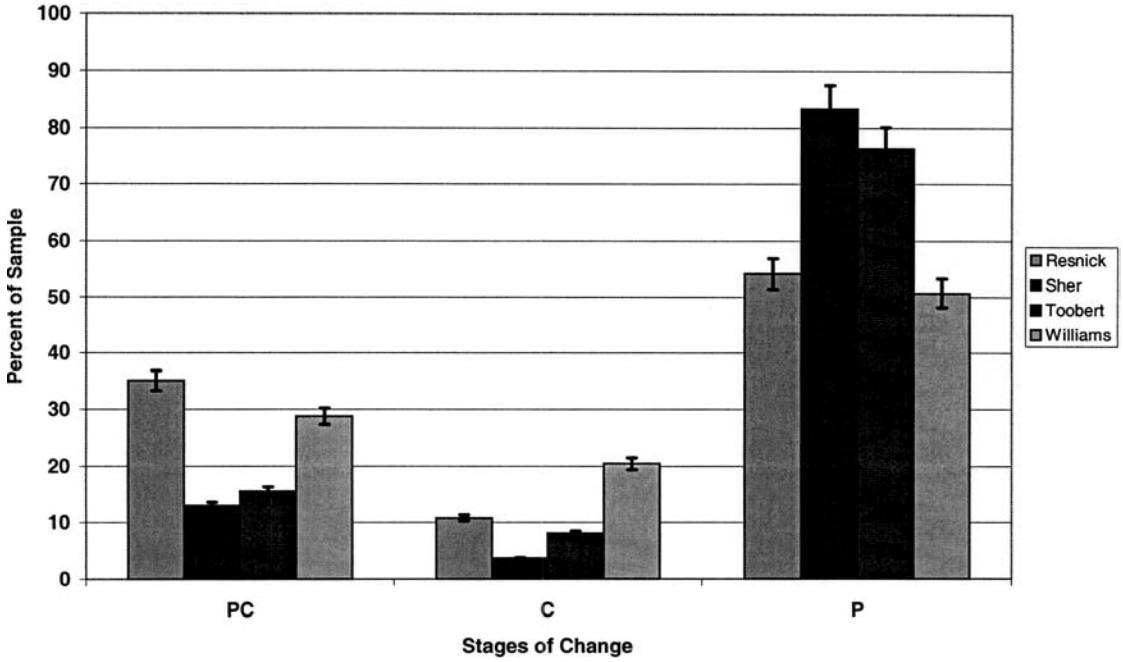

FIGURE 3 At-risk distribution results across the clinical samples.

meeting the physical activity criteria than the 2000 BRFSS results. As the majority of studies were multiple health behavior studies that did not limit the recruitment to at-risk individuals, we hypothesize that a greater proportion of active individuals are attracted to such studies than is present in a general population. People who are healthy are more likely to join health behavior trials.

The at-risk distribution results for the two types of recruitment methods (proactive/reactive) could not be examined in detail because only a single study (Toobert) utilized proactive recruitment exclusively. The finding that the Toobert study varied slightly from the other clinical samples in the at-risk distribution results may be explained by the idea that individuals who volunteer to participate in a physical activity study may be more physically active (and thus more likely to be P than PC) than individuals who are proactively recruited (who are more likely to be PC than P).

The at-risk distribution was also examined by gender. The findings that more P men were recruited than women and more PC and C women were recruited than men may be partially explained by a Gender × Sample Type interaction. Of the four clinical samples, two of the studies examined only women and one study examined predominantly women. Thus, the majority of the female samples were also clinical samples, and the clinical sample results show a higher percentage of PC recruitment than the targeted sample results.

Some limitations need to be considered when interpreting these results. The studies did not have an a priori plan for data sharing and, as such, represent different sampling and recruitment techniques, different measures of physical activities, and different project aims limiting the data integration. However, the variety of the studies included allows for some confidence in the generalizations of conclusions, especially to populations of volunteers for physical activity intervention studies. Further, although we do not believe this to be a serious limitation, this article used baseline cross-sectional data not allowing causal inferences.

CONCLUSIONS AND IMPLICATIONS

This study demonstrates the benefits of multisite collaboration. Physical activity data from nine large-scale, highly visible health trials was integrated and used to establish physical activity SoC distribution heuristics for overall and at-risk samples. The extant literature on physical activity SoC distributions is limited and based on a modified SoC measure. In contrast, all collaborating studies involved in this study employed the identical recommended metric for assessing SoC for physical activity that resulted in reproducible distribution heuristics.

In conclusion, for predominantly reactively recruited studies it can be expected that there will be a higher percentage of the sample that is ready to change and a greater percentage of active people compared to random representative samples. Furthermore, clinical samples can be anticipated to have individuals that are less likely to be ready to change physical activity behaviors. Both of these findings have implications for the practitioner in terms of creatively and proactively recruiting the subgroups that are most in need of physical activity interventions, developing appropriately targeted physical activity interventions, and improving the social marketing of physical activity interventions. In addition, an at-risk physical activity stage heuristic is important for allocating intervention resources at clinical, school, worksite, community, or population levels. Knowing the at-risk heuristic and tracking how it changes over time will better inform public health practitioners and policymak-

ers about the population's motivation for changing physical activity.

Future research should continue to work to confirm a stage heuristic for physical activity especially focusing on proactively recruited random samples to allow for true population estimates.

REFERENCES

(1) Pate RR, Pratt M, Blair SN, et al.: Physical activity and public health. A recommendation from the Centers for Disease Control and Prevention and the American College of Sports Medicine. *Journal of the American Medical Association*. 1995, *273:*402–407.

(2) U.S. Department of Health and Human Services: *Healthy People 2010 Fact Sheet*. Rockville, MD: Office of Disease Prevention and Health Promotion. Retrieved February 7, 2000, from http://www.health.gov/healthypeople

(3) Cardinal BJ: The stages of exercise scale and stages of exercise behavior in female adults. *Journal of Sport Medicine and Physical Fitness*. 1995, *35:*87–92.

(4) Marcus BH, Banspach SW, Lefebvre RC, et al.: Using the stage of change model to increase the adoption of physical activity among community participants. *American Journal of Health Promotion*. 1992, *6:*424–429.

(5) McAuley E, Courneya KS, Rudolph DL, Lox CL: Enhancing exercise adherence in middle-aged males and females. *Preventive Medicine*. 1994, *23:*498–506.

(6) Marcus BH, Simkin LR: The stages of exercise behaviour. *Journal of Sports Medicine and Physical Fitness*. 1994, *33:*83–88.

(7) Prochaska JO, Marcus BH: The transtheoretical model: Applications to exercise. In Dishman RK (ed), *Advances in Exercise Adherence*. Champaign, IL: Human Kinetics, 1994, 161–180.

(8) Prochaska JO, DiClemente CC, Norcross JC: In search of how people change: Applications to addictive behaviors. *American Psychologist*. 1992, 47:1102–1114.

(9) Laforge RG, Velicer WF, Richmond RI, Owen N: Stage distributions for five health behaviors in the United States and Australia. *Preventive Medicine*. 1999, 28:61–74.

(10) Jones ND, DellaCorte MR, Nigg CR, et al.: Senior*cise*: A print exercise intervention in older adults. *Educational Gerontology.* 2001, *27:*717–728.

(11) Marcus BH, Emmons KM, Simkin-Silverman LR, et al.: Evaluation of motivationally tailored vs. standard self-help physical activity interventions at the workplace. *American Journal of Health Promotion*. 1998, *12:*246–253.

(12) Fava JL, Velicer WF, Prochaska JO: Applying the Transtheoretical Model to a representative sample of smokers. *Addictive Behaviors*. 1995, *20:*189–203.

(13) Heimendinger J, Feng Z, Emmons K, et al.: The Working Well Trial: Baseline dietary and smoking behaviors of employees and related worksite characteristics. The Working Well Research Group. *Preventive Medicine*. 1995, *24:*180–193.

(14) Velicer WF, Fava JL, Prochaska JO, et al.: Distribution of smokers by stage in three representative samples. *Preventive Medicine*. 1995, 24:401–411.

(15) Buxton K, Wyse J, Mercer T: How applicable is the stages of change model to exercise behavior? A review. *Health Education Journal*. 1996, *55:*239–257.

(16) Marshall SJ, Biddle SJH: The Transtheoretical Model of Behavior Change: A meta-analysis of applications to physical activity and exercise. *Annals of Behavioral Medicine*. 2001, *23:*229–246.

(17) Nigg CR, Riebe D: The Transtheoretical Model: Research review of exercise behavior and older adults. In Burbank P, Riebe D (eds), *Promoting Exercise and Behavior Change in Older Adults: Interventions With the Transtheoretical Model*. New York: Springer, 2002, 147–180.

(18) Cardinal BJ: Construct validity of stages of change for exercise behavior. *American Journal of Health Promotion*. 1997, *12:*68–74.

(19) Rodgers WM, Courneya KS, Boydoza AL: Examination of the transtheoretical model and exercise in three populations. *American Journal of Health Behavior.* 2001, *25:*33–41, 2001.

(20) Nigg CR, Burbank PM, Padula C, et al.: Stages of change across ten health risk behaviors for older adults. *Gerontologist*. 1999, *39:*473–482.

(21) Schumann A, Nigg CR, Rossi JS, et al.: Construct validity of the stages of change of exercise adoption for different intensities of physical activity in four samples of differing age groups. *American Journal of Health Promotion*. 2002, *16:*280–287.

(22) Caspersen CJ: Physical activity epidemiology: Concepts, methods, and applications to exercise science. *Exercise and Sport Science Reviews*. 1989, *17:*423–473.

(23) Boyle RG, O'Connor PJ, Pronk NP, Tan A: Stages of change for physical activity, diet, and smoking among HMO members with chronic conditions. *American Journal of Health Promotion*. 1998, *12:*170–175.

(24) Nigg CR, Allegrante J, Ory M (eds): Behavior Change Consortium. *Health Education Research*. 2002, *17:*493–679.

(25) Reed GR, Velicer WF, Prochaska JO, Rossi JS, Marcus BH: What makes a good staging algorithm: Examples from regular exercise. *American Journal of Health Promotion*. 1997, *12:*57–66.

(26) Nigg CR: Physical activity assessment issues in population based interventions: A stage approach. In Welk GJ (ed), *Physical Activity Assessments for Health-Related Research*. Champaign, IL: Human Kinetics, 2002, 227–239.

(27) National Center for Chronic Disease Prevention and Health Promotion: *Behavioral Risk Factor Surveillance System*. Retrieved August 5, 2003, from http://apps.nccd.cdc.gov/brfss/