5. Highlights from wave I of the National Survey of Personal Health Practices and Consequences: United States, 1979. Vital and Health Statistics, series 15, No. 1. DHHS publication No. (PHS) 81-1162. National Center for Health Statistics, Hyattsville, MD, June 1981.
6. Canada Fitness Survey: Fitness and lifestyle in Canada. Canada Fitness Survey, Ottawa, May 1983.
7. Bradstock, M. K., et al.: Behavioral Risk Factor Surveillance, 1981-1983. CDC Surveillance Summaries. MMWR 33 (No. 1SS): 1SS-4SS (1984).
8. The Miller Lite report on American attitudes toward sports. Miller Brewing Co., Milwaukee, 1983.
9. Kannel, W. B.: Habitual level of physical activity and risk of coronary heart disease: the Framingham study. Can Med Assoc J 96: 811-812 (1967).
10. Berkman, L. F., and Breslow, L.: Health and ways of living: the Alameda County study. Oxford University Press, New York, 1983.
11. Montoye, H. J.: Physical activity and health: an epidemiologic study of an entire community. Prentice-Hall, Inc., Englewood Cliffs, NJ, 1975.
12. Taylor, H. L., et al.: A questionnaire for the assessment of leisure time physical activities. J Chronic Dis 31: 741-755 (1978).
13. Haskell, W. L., Montoye, H. J., and Orenstein, D. R.: Physical activity and exercise to achieve health-related components of physical fitness. Public Health Rep 100: 202-212, March-April 1985.
14. Chubb, M., and Chubb, H. R.: One third of our time? An introduction to recreation behavior and services. John Wiley and Sons, Inc., New York, 1981, p. 95.
15. Canada Fitness Survey: Canadian youth and physical activity. Canada Fitness Survey, 506-294 Albert St., Ottawa, KIP 6E6, October 1983.
16. Powell, K. E., and Paffenbarger, R. S.: Summary of the workshop on epidemiologic and public health aspects of physical activity and exercise. Public Health Rep 100: 118-126, March-April 1985.
17. The Gallup Poll: Six of 10 adults exercise daily. Los Angeles Times Syndicate, Los Angeles, May 1984.
18. Contemporary Research Centre, Ltd.: Behaviour and attitude toward physical activity among Canadians. Results of a national survey conducted for PARTICIPaction. PARTICIPaction, 80 Richmond St. West, Suite 805, Toronto, Canada M5H2A4, Toronto, May 1982. Mimeographed.
19. Canada Fitness Survey: Exercise and sports: age is not a barrier. Canada Fitness Survey Highlights No. 14, October 1983.
20. The use of time, edited by A. Szalai. Mouton, The Hague, 1972.
21. A dictionary of epidemiology, edited by J. M. Last. Oxford University Press, New York, 1983.
22. Department of Health and Human Services: Promoting health/preventing disease: objectives for the nation. U.S. Government Printing Office, Washington, DC, fall 1980, (*a*) p. 81.
23. Paffenbarger, R. S., Hyde, R. T., Wing, A. L., and Steinmetz, C. H.: A natural history of athleticism and cardiovascular health. JAMA 252: 491-495, July 27, 1984.
24. Laporte, R. E., Montoye, H. J., and Caspersen, C. J.: Assessment of physical activity in epidemiologic research: problems and prospects. Public Health Rep 100: 131-146, March-April 1985.
25. Montoye, H. J.: Estimation of habitual physical activity by questionnaire and interview. Am J Clin Nutr 24: 1113-1118 (1971).
26. Bouchard, C., et al.: A method to assess energy expenditure in children and adults. Am J Clin Nutr 37: 461-467 (1983).
27. Sallis, J. F., et al.: Physical activity assessment methodology in the Five-City Project. Am J Epidemiol 121: 91-106 (1985).
28. Furrie, A. D., and Stephens, T.: Energy expenditure patterns in the Canadian population. *In* Health risk estimation, risk reduction and health promotion, edited by F. Landry. Proceedings of the 18th annual meeting of the Society for Prospective Medicine, 1982. The Canadian Public Health Association, Ottawa, pp. 103-114, 1983.

The Determinants of Physical Activity and Exercise

ROD K. DISHMAN, PhD
JAMES F. SALLIS, PhD
DIANE R. ORENSTEIN, PhD

Dr. Dishman is an Associate Professor, Department of Physical Education, University of Georgia, Athens, GA 30602. He was formerly the Associate Director, Adult Fitness and Cardiopulmonary Rehabilitation Exercise Programs, University of California at Davis. Dr. Sallis is Assistant Adjunct Professor, Division of General Pediatrics, University of California at San Diego, La Jolla. Dr. Orenstein is a Research Psychologist in the Behavioral Epidemiology and Evaluation Branch, Division of Health Education, Center for Health Promotion and Education, Centers for Disease Control, Atlanta, GA 30333.

Tearsheet requests to Dr. Dishman.

Synopsis

Evaluation and delivery of physical activity and exercise programs appear impeded by the substantial numbers of Americans who are unwilling or unable to participate regularly in physical activity. As a step toward identifying effective interventions, we reviewed available research on determinants relating to the adoption and maintenance of physical activity. We categorized determinants as personal, environmental, or characteristic of the exercise. We have considered supervised participation separately from spontaneous activity in the general population.

A wide variety of determinants, populations, and settings have been studied within diverse research traditions and disciplines. This diversity and the

varied interpretation of the data hinder our clearly summarizing the existing knowledge. Although we provide some directions for future study and program evaluation, there is a need for research that tests hypotheses derived from theoretical models and that has clear implications for intervention programs. We still need to explore whether general theories of health behavior or approaches relating to specific exercises or activities can be used to predict adoption and maintenance of physical activity.

NATIONAL GOALS call for participation in *regular* and *vigorous* physical activity by 90 percent of youth and 60 percent of adults by 1990 (*1*). At this time, however, best estimates indicate that 41 percent to 51 percent of adults are sedentary (*2,3*) while only one-third of all adults participate in exercise on a weekly basis. Just 15 percent are believed to expend an energy equivalent (1,500 kcal per week) of known epidemiologic significance (*3,4*). Of those already regularly engaged in either group or solitary exercise, about 50 percent will discontinue activity at some time in the coming year (*5–7*). Moreover, less than 10 percent of sedentary adults are likely to begin a program of regular exercise within a year (James F. Sallis, unpublished observations, November 18, 1982, and reference *3*).

Estimates (reference *8* and Steven N. Blair, Institute for Aerobics Research, Dallas, TX, unpublished observations, May 26, 1984) do show recent increases in participation in activity that develops cardiopulmonary and musculoskeletal fitness. However, these increases seem to occur in certain population segments only—notably young adults, the well educated, and members of high socioeconomic groups (*3,4*).

These findings are similar to recent Canadian estimates (*9*); however, the U.S. increases are not as high as the Canadian increases. According to available figures, our nationwide participation in all types of physical activity has increased only slightly (from 4 percent to 14 percent) during the past decade (*3,9,10*). Although we cannot precisely identify the current nationwide rate (*8*), it seems unlikely that the 1990 goals for the nation for participation in physical activity and exercise can be met without intervention.

One barrier to developing effective methods to encourage physical activity among all segments of the population is lack of knowledge of the determinants of regular physical activity. It appears that the public health potential of physical activity and exercise cannot be defined or fulfilled until the behavioral determinants of participation are identified and subsequently managed; yet these determinants remain poorly understood.

Goals of This Review

The first goal of this paper is to review the scientific literature on known determinants of regular exercise and physical activity. We categorized these determinants by focusing on (*a*) characteristics of the person and his or her lifestyle habits, (*b*) characteristics of environments, and (*c*) characteristics of the activity itself. This approach helped to organize the review and to identify domains that may account for the wide range of determinants contributing to participation in physical activity. Identifying these areas may also help specify segments of the population we need to target and important variables for future interventions.

The second goal is to identify what appear to be the most important determinants in each of the three categories previously described. Because any single factor can be influential under certain conditions, we present each individually. It is important to note, however, that these factors probably interact in complex ways and that their relative importance can vary. Few factors have shown behavioral uniformity across settings, populations, and time periods.

Our final goal is to recommend specific study areas that could help us understand what motivates people to become physically active and help us develop ways to increase activity. Effective exercise interventions will probably require that both abstract (for example, beliefs) and concrete (for example, disability) determinants be addressed in complementary ways to (*a*) diminish or compensate for psychological and physical or environmental barriers to activity; (*b*) provide knowledge, skills, and reinforcements that augment the willingness and ability to be active; and (*c*) permit selection of appropriate forms and intensities of activity. Underlying our recommendations is the need to integrate the efforts of epidemiology, behavioral medicine, health psychology, and exercise science under a public health umbrella. In the past, the purpose, methods, and scope of the various study approaches have not assured an orderly progression of theoretical and practical knowledge. The disparities

Table 1. Studies that have investigated determinants of physical activity and exercise

Determinant	Positive association	No association	Negative association
	Supervised exercise programs		
Personal characteristics			
Past participation	((5–7)		
Past extra-program activity	(6)	(16)	
School athletics, 1 sport	(17)	(5,16)	
Blue-collar occupation			(6,12,59,62)
Smoking			(6,12,59,62)
Overweight			(15,19,20)
Higher risks for coronary heart disease	(15,21)		
Health exercise knowledge, attitudes		(7,13,27)	(6,7,12,22)
Enjoyment of activity	(35)		
Perceived health	(25,27)		
Mood disturbance			(13,29,30)
Age		(5,6,7)	
Perceived physical competence		(5,7)	
Self-motivation	(11,18,29)		
Costs/benefits	(35)		
Environmental characteristics			
Spouse support	(5–7,26,33)		
Perceived available time	(6,7,53)		
Access to facilities	(6,13,23,26)		
Disruptions in routine			(6,13,37)
Social reinforcement (staff, exercise partner)	(11,13,34,35)	(26,37)	
Activity characteristics			
Activity intensity		(62,63)	(43,61)
Perceived exertion			(13,14)
	Spontaneous physical activity		
Personal characteristics			
Youth sport (organized)	(3,45,46,47)		
School athletics, 1 sport		(10)	
School athletics, >1 sport	(10)		
Blue-collar occupation		(3,46)	(9)
Health exercise knowledge	(3,9)	(4,11,13,54,55)	
Health exercise attitudes	(4,46)	(49,56)	
Age		(9)	(3,49,52)
Self-motivation	(56)		
Environment			
Perceived available time	(3)	(4,9)	
Access to facilities	(25)	(4,9)	
Family influences	(46,48,49)		
Peer influences	(45,47)		
Costs		(3)	

in methods and standards (paradigms) need to be diminished or reconciled in order to generate more complete knowledge.

Organization of the review. This research review is organized into separate discussions of studies of "supervised" exercise programs and studies of "spontaneous" changes in levels of physical activity within a population base. This distinction accurately portrays the origin of most available data. It also provides compatible data for future comparisons of the impact of small group interventions and population trends. However, the behavioral significance of supervision per se, while seemingly important for some people, is yet to be determined.

Within both sections—supervised exercise programs and spontaneous physical activity—personal, environmental, and activity characteristics are considered. In addition, distinctions are made between historical and contemporary influences, and between determinants of adoption or initiation of exercise and maintenance of exercise habits. Each of these distinctions can help us understand both theoretical and practical views of existing evidence.

Tables 1 and 2 summarize the findings of our review. Because this is a new area of study, we have included both cross-sectional and correlational, as well as experimental, data when they appear to add to existing knowledge.

Caveats. Because most available research has been pragmatic, not theoretical, in origin, data have been generated by different methods, from different populations, with somewhat different outcomes in mind. Therefore, there is little standardization in defining and assessing determinants and physical activity. Also, the variables studied and time frames sampled are inconsistent across population segments and settings. Thus, it is difficult to make comparisons among studies.

Population surveys have the potential to be generalized to a larger population group. However, these surveys rely on subjective, possibly inaccurate, estimates of activity and a narrow set of possible determinants. These surveys often use cross-sectional, retrospective designs, yield seemingly incongruous results, and do not permit a weighting of relative influence between variables.

Studies of clinical settings and specific community samples have used more precise measures of activity and determinants, and they frequently examine variable interactions. However, their ability to be generalized to other populations, settings, and activities usually has not been tested and is, therefore, restricted. Although prospective studies are common, there are relatively few controlled experiments. Thus, there is some imbalance in methods and knowledge across populations, settings, and activity (see tables 1 and 2).

Each study has specific limitations because of inadequacies in either measurement of determinants or activity patterns, sample size, and representativeness, or because of inadequate control or quantification of possible confounding variables. All these factors further limit the ability of the studies to be generalized to other population groups. Also, most studies have been descriptive, relying on correlational data rather than experimental data. Hence, in most instances our use of the term "determinant" indicates a reliable association or predictive relationship, not causation. Because of this diversity, we are more confident when multiple studies converge toward one result.

Although it is likely that different determinants may exist for specific circumstances (for example, cardiac rehabilitation versus worksite fitness) or for different behaviors (for example, adopting versus maintaining regular participation), it is noteworthy that several factors (such as work status, smoking, self-motivation, and social reinforcement) have shown a fairly generalized relationship with activity (*6,7,9,11–14*).

Table 2. Summary of variables that may determine the probability of exercise

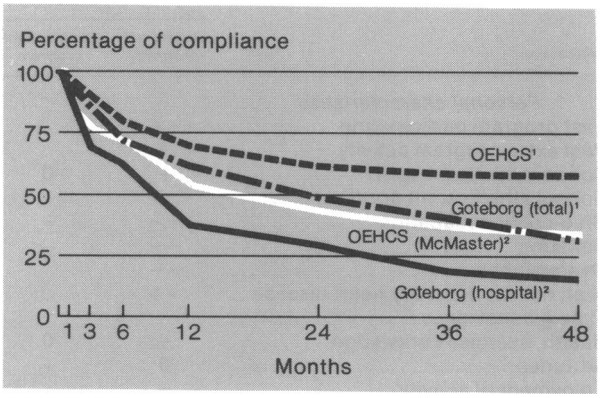
Determinant	Changes in probability: Supervised program	Changes in probability: Spontaneous program
Personal characteristics		
Past program participation	++	
Past extra-program activity	+	
School athletics, 1 sport	+	0
School athletics, >1 sport		+
Blue-collar occupation	−−	−
Smoking	−−	
Overweight	−−	
High risk for coronary heart disease	++	
Type A behavior	−	
Health, exercise knowledge	−	0
Attitudes	0	+
Enjoyment of activity	+	
Perceived health	++	
Mood disturbance	−−	−−
Education	+	++
Age	00	−
Expect personal health benefit	+	
Self-efficacy for exercise		+
Intention to adhere	0	0
Perceived physical competence	00	
Self-motivation	++	0
Evaluating costs and benefits	+	
Behavioral skills	++	
Environmental characteristics		
Spouse support	++	+
Perceived available time	++	+
Access to facilities	++	0
Disruptions in routine	−−	
Social reinforcement (staff, exercise partner)	+	
Family influences		++
Peer influence		++
Physical influences		+
Cost		0
Medical screening	−	
Climate	−	
Incentives	+	
Activity characteristics		
Activity intensity	00	−
Perceived discomfort	−−	−

KEY: ++ = repeatedly documented *increased* probability; + = weak or mixed documentation of *increased* probability; 00 = repeatedly documented that there is *no change* in probability; 0 = weak or mixed documentation of *no change* in probability; − = weak or mixed documentation of *decreased* probability; −− = repeatedly documented *decreased* probability. Blank spaces indicate no data.

Supervised Exercise Programs

Influence of personal characteristics. Personal characteristics are defined here as past or present knowledge, attitudes, behaviors, personality characteristics, biomedical traits, and demographic factors that may influence exercise habits.

Compliance rates in two long-term clinical trials of exercise and rehabilitation following myocardial infarction, Ontario Exercise Heart Collaborative Study (OEHCS) and Goteborg, Sweden



[1]Control.
[2]Training.

SOURCE: Oldridge, N.B.: Compliance and exercise in primary and secondary prevention of coronary heart disease: a review. Prev Med 11: 62, January 1982. Copyright © 1982 by Academic Press, Inc. Used with permission.

In supervised programs where activity can be directly observed, past participation in the program is the most reliable correlate of current participation (*5–7,13*), and this may account for 30 percent to 50 percent of the variance in participation in activity across the first few months (Herman M. Frankel, Kaiser-Permanente, Center for Health Research, Portland, OR, unpublished observations, January 27, 1984). This variance holds for men and women alike in adult fitness programs and is consistent with observations in treatment programs for patients with coronary heart disease and obesity. As shown in the figure, the rate of participation typically drops within the initial 3 to 6 months, then plateaus and continues a gradually decreasing but linear pattern across the next 12 to 24 months. Individuals who are still active after 6 months are likely to remain active a year later (*6,15*).

The impact of previous activity not performed in a supervised situation is less clear. In programs for healthy women (C. Bayles, graduate student, School of Public Health, University of Pittsburgh, unpublished observations, May 23, 1984) and male cardiac rehabilitation patients (*6*), routine walking and active leisure predict participation in supervised programs, but the intensity, duration, and frequency of reported preprogram activity among male cardiac patients has not been predictive of attendance in a supervised program (*16*).

Although one cross-sectional study shows that active male participants in adult fitness programs are likely to have had a background in sports (*17*), no prospective study has shown a relationship between adherence to cardiac rehabilitation exercise programs and participation in interscholastic or intercollegiate athletics (*5,13,16*). This illustrates the need for cautious interpretation of studies using retrospective designs. One study found that an enjoyable elementary physical education program predicts adherence to a supervised running program in adult men (Ping Ho, Stanford University School of Medicine, unpublished observations, June 7, 1984).

Current personal characteristics are strong determinants of participation in clinical exercise programs. Blue-collar workers and smokers are likely dropouts from cardiac rehabilitation exercise programs (*6*) and corporate exercise programs (*12, 13*). Overweight persons are less likely to continue a fitness program (*15,18*); even in gentle walking programs, up to 70 percent of obese people stop within a year (Herman M. Frankel, unpublished observations, January 27, 1984) (*19*). Obese persons are also less likely to respond to alternative activity programs (*20*).

While neither circulatory disability nor a high degree of aerobic fitness reliably predicts adherence to supervised programs (*5,6,13*), some studies have found positive relationships (*6,7,15* and Ping Ho, unpublished observations, June 7, 1984). However, other studies show that men at risk for coronary heart disease are not likely to enter an exercise program without referral or are not likely to maintain the activity (*6,12*). Paradoxically, self-report of the Type A, coronary-prone behavior pattern was positively related to fitness gains in one study (*21*), but people who show Type A behavior have been early dropouts from cardiac rehabilitation (*6*) and infrequent participants in corporate exercise programs (*22*). These findings collectively suggest that those who could benefit most are most resistant to increased activity in program settings.

Knowledge of and belief in the health benefits of physical activity may motivate initial involvement (*23*), but feelings of enjoyment and well-being seem to be stronger motives for continued participation in corporate programs (*24*). Patients who perceive their health as poor are unlikely to enter or adhere to an exercise program, and, if they do, they are likely to perform little exercise (*25*). Those who believe exercise has little value for health and fitness and also believe health outcomes are out of their control have been found to exercise less frequently and to drop out sooner in fitness-related programs than cohorts holding opposite views (*7*). However, because most entrants into supervised programs share similarly positive attitudes and beliefs about exercise, their self-perceptions of exer-

cise ability, feelings of health responsibility, and attitude toward exercise do not predict who will adhere to the program (*13,26*). In fact, there are conflicting findings about the importance of health beliefs concerning exercise (*5,13,27* and Ping Ho, unpublished observations, June 7, 1984). Health beliefs can influence the intention to be active, but intentions have also failed to predict subsequent participation (*13,28*). The roles of belief in personal ability to exercise and control health outcomes, belief in the value of exercise, anticipation of benefits from it, and self-expectations to be active remain to be demonstrated.

Although the importance of personality has not been systematically studied, several studies show that a self-motivation trait is related to program adherence (*11,18*) and can help predict behavior when combined with biological traits such as body weight and composition (*18,29*). Also, self-perceived mood disturbance is related to early drop-out from adult fitness (*29*) and cardiac rehabilitation programs (*30*), and a depressive personality (*31*) and somatization (*32*) have also been associated with inactivity. The trait of extroversion has been both positively (*30*) and negatively (*12*) related to adherence, and ego-strength has shown both a positive (*30*) and a neutral (*18*) influence.

Although these findings are too sparse to interpret clearly, they collectively support the principle that individual behavioral differences must be accommodated in the planning of supervised programs. Concern for physical tolerance alone appears inadequate. From the standpoint of health risk, those who may benefit the most from an exercise regimen seem most resistive to adopting or maintaining one. Thus, interventions aimed at personal change may be more effective if they help people feel good about themselves than if they focus exclusively on knowledge of the health benefits of physical activity and exercise.

Influence of environmental factors. Environmental factors can help or hinder physical activity. The influences of the social environment on physical activity habits include the attitudes of family, peers, and health professionals. Aspects of the physical environment that may influence exercise include weather, distance from facilities, and time pressures. Also, there can be a difference in the actual environment and the way people perceive the environment, and this needs to be assessed as well.

Support by a spouse is a consistent influence on adherence to clinical exercise programs, and the spouse's attitude can be more important than the participant's (*6,7,26,33*). This finding illustrates the power of the social environment to shape exercise patterns. Personalized social reinforcement from program staff or an activity partner has also been found to be a potent determinant of adherence to clinical programs in several studies (*34–36*) but not in all studies (*26,37*).

'. . . nationwide participation in all types of physical activity has increased only slightly . . . during the past decade. Although we cannot precisely identify the current nationwide rate, it seems unlikely that the 1990 goals for the nation for participation in physical activity and exercise can be met without intervention.'

The physical environment also influences adherence to clinical programs. The most common reason given for dropping out of programs is lack of time (*6,7,14*). However, dropping out may reflect a lack of interest, intention, or commitment, since regular exercisers are as likely as (*3*), or more likely than (*9*), the sedentary to view time as a barrier to activity. Both perceived convenience of the exercise setting and actual geographic proximity to home or place of employment are consistent predictors of entry and continued participation in clinical programs (*6,13,23,26*).

Even among the active who are well-intentioned and who value benefits of their participation in exercise, unexpected disruption in the routine of the activity or its setting can interrupt or conclude a previously continuous exercise program (*6,13*). Life occurrences such as relocation, medical events, and periodic travel can impede the continuity of activity and create new barriers.

It is believed that the impact of stressful events is diminished as the activity habit becomes more established (*7*). Interventions appear to help people anticipate and plan for stressful events, recognize these events as temporary impediments, and develop appropriate self-regulatory skills (*37,38*).

In summary, there are several important environmental influences on activity that exert their influence outside the program setting. Thus, effective planning for adherence cannot rely solely on management of the exercise environment. Although proximity and convenience of the program are important, perceived lack of time and disruptions in

'From the standpoint of health risk, those who may benefit the most from an exercise regimen seem most resistive to adopting or maintaining one.'

daily routines also interfere with participation. These factors may require behavioral planning on the part of the exerciser. Behavioral and cognitive-behavioral strategies may be useful adjuncts to existing exercise programs, but their specific impact on increasing vigorous activity has not yet been demonstrated. The influence of historical environmental factors, such as social support during childhood, has not been studied, but adherence can be fostered by individualized support by program staff or exercise partners. Neither type of individualized support, however, seems as influential as support by a spouse, suggesting again that program adherence cannot be understood by viewing the supervised setting alone.

Relatively few experimental studies of changes in physical activity have been attempted. Those conducted have applied general principles and techniques of behavior modification to alter exercise behavior rather than to manipulate known correlates of exercise behavior. This has been partly a pragmatic decision, because several known exercise determinants (for example, smoking, work status, and overweight) are themselves difficult to change. However, these determinants have not been controlled, and therefore they may confound the outcomes.

The techniques and principles of behavior modification can be viewed either as reinforcement and stimulus control strategies or as cognitive-behavioral and self-regulation skills. Behavioral approaches, including written agreements (*39*), behavior contracts and lotteries (*40,41*), stimulus control (*42*), and contingency incentives (*36*), have been used successfully in case-control studies. Cognitive approaches, including self-monitoring (*39*), sensory distraction (*34*), goal setting (*34,37,42*), and decisionmaking (*35*), have appeared equally effective when used alone or when combined in intervention packages (*34,43*).

Behavioral techniques are collectively associated with a 10- to 25-percent increase in frequency of physical activity, but we do not know their impact on changes in intensity and duration of activity.

With few exceptions (*43*), studies have not focused on health advantages. Likewise, most interventions have lasted only 3 to 10 weeks, and only a few show maintenance of activity in followup assessments. Also, placebo control comparisons have been infrequent. Therefore, we cannot make generalizations about specific components of the interventions that are effective for specific populations. Strategies that effect a change have in common a dimension of social reinforcement (*36*). And they appear more successful when carried out in groups rather than in outside supervised settings (*13,44*).

Influence of the activity itself. Because the mode and intensity of activity examined have not systematically differed across populations or settings, the influences of activity characteristics on supervised and spontaneous activity participation will be discussed together in the following section.

Spontaneous Physical Activity

Influence of personal characteristics. In one representative population survey, about two-thirds of adults with a history of participation in two or more sports in their youth were physically active, and they were two to three times more likely to engage in vigorous activities than people who had not participated in sports in their youth (*10*). Former participants in only one sport had the same likelihood of regular exercise as those with no history of participation in sports. However, by middle age, former male college athletes may be less active than men who did not participate in sports (*45*). These findings reinforce the need to distinguish between sport, recreation, and fitness-related exercise when describing activity patterns.

There appears to be a relatively strong relationship between sport play in youth and involvement in organized sports as an adult (*3,45,46*), especially among women (*47*). However, there is less continuity in recreational sport activity between adolescence and adulthood (*45,46*) than there is in competitive sport activity. It appears that while exercise or sport experience in youth can be a strong agent in influencing exercise behavior in adults, its influence is frequently overridden by other personal and environmental influences. While attitudes about exercise are related to sport participation in youth (*48,49*) and adulthood, they are unrelated to adherence to leisure activity or fitness programs in adults (*13,26,50* and W. P. Morgan, Sports Psychology Laboratory, University of Wisconsin, Madison, unpublished observations, April

14, 1983). It is not known if factors related to the decision to discontinue sports participation in youth influence adult activity patterns. Also, there is little information on activity patterns that do not relate to sports in youth and future adult exercise habits.

Some current personal characteristics are consistent in studies of supervised activities and in general population studies. These findings indicate that well-educated persons are more likely to exercise (*3,4,9,17,51* and Ping Ho, unpublished observations, June 7, 1984). There is also strong evidence that activity decreases with advancing age (*3,4,8,9,51,52*).

Blue-collar workers are less likely to engage in either leisure or supervised exercise (*6,12*). Surprisingly, in one community sample (*51*), a person's body mass was not related to measures of activity. Working women and single parents are more likely to exercise than other groups (*53*), but this relationship may be confounded with age.

There is little relationship between improving knowledge about or attitudes toward exercise and increased adherence (*7,13,54*). While both active and inactive people view exercise as a positive health behavior (*3,9,26,49*), those who strongly value exercise, who believe they have control over health outcomes, and who expect personal health benefits from exercise are likely to engage in much exercise (*7,13*). Knowledge of health and exercise was associated with improved maintenance of lifestyle activities (routine leisure activities such as walking) for men and women in one community sample (James F. Sallis, unpublished observations, November 18, 1982), but not with participation in vigorous activity (exercise for fitness) (*3,9*). Thus, no evidence supports the idea that increased knowledge about exercise leads to enhanced participation. In fact, less than 5 percent of the population believe that more information on fitness benefits would be likely to increase their participation (*3*).

In one survey, more than 80 percent of both active and inactive respondents felt that they should exercise more than they do (*4*). Estimates from several countries (*9,55*) indicate that more than half the public is aware of fitness promotion programs, but less than 20 percent of the active respondents in one survey felt that they were influenced by such programs (*55*). Thus, while the active are more knowledgeable about exercise, it is unclear whether such knowledge is an antecedent or a consequence of involvement. Active people also believe in the benefits of activity, but only one study has indicated that exercise-related attitudes predict activity (James F. Sallis, unpublished observations, November 18, 1982). There are also mixed results on the association between attitudes toward other health behaviors and probability of regular exercise (*4,56,57*). In one survey (*9*), regular activity was rated seventh most important among health-related behaviors. However, the active were twice as likely (55 percent versus 26 percent) to view it as very important.

'. . . no evidence supports the idea that increased knowledge about exercise leads to enhanced participation. In fact, less than 5 percent of the population believe that more information on fitness benefits would be likely to increase their participation.'

Perceived self-efficacy, or confidence in one's ability to exercise (James F. Sallis, unpublished observations, November 18, 1982), and self-estimates of the likelihood of adherence (Ping Ho, unpublished observations, June 7, 1984) have predicted future activity, while perception of one's overall physical competence has not (*5,13,50*). These findings collectively suggest that if psychological factors are to be successfully used to predict future activity, they should be directed toward specific types or intensities of physical activity or single exercise behaviors and time frames (for example, adopting versus maintaining involvement) rather than toward a broad and diffuse concept of exercise.

On the other hand, additional psychological data indicate that broad behavioral traits may indeed be linked with overall adherence to an exercise routine. If so, standardization of variables across future studies would be enhanced. For example, those who are self-motivated or have a generalized tendency to follow through with behavioral decisions (*18*) are more likely to continue exercise programs in clinical, corporate, and community settings (*7,11,29,56*). This characteristic does not, however, reliably predict daily participation or whether the person will drop out of supervised settings (*11,29,35*), suggesting that persons with high and low self-motivation are equally likely to select activity environments that do not rely on professional or social support. Self-motivated persons also appear less sensitive to activity barriers, such as inconvenience or competing lifestyle behaviors (*7,11*).

'Feelings related to well-being and enjoyment seem more important in maintaining activity than concerns about health. Also, the ability to make specific plans to avoid relapse may be important.'

In both clinical and community programs, the act of rationally evaluating the anticipated benefits and costs of being active has consistently facilitated increased participation or a return to activity among people who had been active but subsequently became inactive (*35*). This increase in or return to activity has been demonstrated only for short periods (4 to 10 weeks) among the already motivated. Thus, this evaluation appears to prompt an existing behavioral skill (*20*), or it may strengthen an earlier decision to exercise.

It is believed that many who intend to be active but remain sedentary (*28*) lack the self-regulatory skills necessary to engage in the complex sets of behaviors referred to as exercise habits. Short-term studies suggest that interventions that teach goal setting, planning, self-monitoring, and self-reward skills can increase participation among people who do intend to exercise (*34*). Long-term exercise goals related to health and fitness are more predictive of continued involvement than are short-range expectations (*3,34*), although flexible daily goals can increase maintenance of involvement. Feelings related to well-being and enjoyment seem more important to maintaining activity than concerns about health (*7,9,24*). Also, the ability to make specific plans to avoid relapse may be important (*37,38*).

Although dropouts from supervised exercise programs are more likely than adherents of these programs to view time conflicts and inconvenience of the setting as barriers to participation, perceived barriers to exercise were similar for active and inactive respondents in one nationwide survey (*4*). The principal barriers were lack of time (43 percent), lack of willpower (16 percent), "just don't feel like it" (12 percent), medical problems (9 percent), and lack of energy (8 percent). This similarity suggests that perceived barriers may often represent logical post hoc explanations rather than true determinants of inactivity. That nearly twice as many sedentary (13 percent) as active people (7 percent) observed that they "just don't feel like it" is consistent with the view that perceived barriers may frequently reflect inadequate motivation to be active rather than reasons for inactivity (*9*). This can be a critical distinction, because no data support the notion that removing stated barriers leads to increased activity.

In summary, the people most likely to engage regularly in spontaneous exercise are well-educated, are self-motivated, and have the behavioral skills to plan an exercise program and prepare for relapses. But we need to know more about the development of self-motivation and exercise behavior skills. Active people tend to expect and believe that they receive personal health benefits from exercise, but positive feelings from activity seem more important than beliefs. Perceived barriers to exercise do not preclude participation. Knowledge of the health benefits of exercise predicts lifestyle activity but not fitness-related exercise; a history of involvement in sports during youth may predict physical activity in young adulthood, but not in middle age. In general, continuity of activity through the life cycle is poorly understood. It is not known how or why people decide to become active and to what degree they will be active, why a person's activity often declines with age, or what might be changed to prevent or diminish this decline.

Influence of environmental factors. During childhood, family influence on exercise behavior is probably based on modeling of interests and skills, reinforcing behavior, and providing activity prompts and settings. Activity modeling and support by the mother are particularly strong predictors of later exercise participation by daughters (*47,48*). However, early peer and family influences on later behavior have not been well studied, though it is reasonable to expect some indirect effects. Although the family seems to influence and be influenced by the physical activity habits of its members (*3,4*), most of the studies in this area are retrospective surveys. Among parents who participate in sport, nearly 60 percent spend one-half of their involvement participating with the family (*3*). Among those who choose exercise as leisure activity, 37 percent have spouses who share their preference for exercise over sedentary leisure pursuits (*4*).

Children's participation in physical activity outside structured programs is perhaps influenced more by peers than by family (*9,45*). Peer influences are sex-linked through adolescence but can become independent of gender in adulthood. Peer influences appear to strengthen with age, moving from neighborhood influences in childhood to people in the place of employment in adulthood. Peers can exert

the social influence to exercise more or less, and they provide models for exercise-related attitudes and behaviors (*47*). It is not clearly known, however, to what degree peers influence behavior change or are chosen to match existing interests and skills.

As Iverson and colleagues (*58*) point out, physicians represent potentially effective change agents for increasing physical activity, but evidence on their impact has been mixed. Estimates suggest that among regular exercisers, one-fourth have been advised to exercise by their physicians; however, in one survey only 3 percent reported that this was the reason for their activity (*10*). In more recent survey data (*9*), 23 percent of adults cited doctor's orders to be active as a very important reason for activity; however, this was the seventh-ranked reason, and the ranking did not differ between active and sedentary persons. This observation is interesting in light of findings that 75 percent of family members express confidence in their physicians (*4*) and that substantial proportions of both the inactive (43 percent) and the active (32 percent) state that a physician's recommendation would likely increase their involvement in sport (*3*).

Survey results indicate that enrollment fees are not perceived as barriers to participation in community, corporate, or clinical exercise programs (*9,58*). In one sample, just 10 percent of the public reported that less expensive facilities would likely increase their sports involvement. The already active were paradoxically twice as likely as the inactive (13 percent versus 6 percent) to hold this view (*3*). While adherence rates are similar in commercial programs and free corporate and research programs (*12,34,35,59*), the impact of cost on program entry has not been determined. However, 75 percent of family members feel that medical checkups, often recommended as a prerequisite to exercise participation, are a financial burden (*4*).

In a survey of habitual runners, only 10 percent reported that weather conditions had no impact on their activity patterns (*60*). Climate influences choices and seasonal feasibility of outdoor leisure activities (*9,46*), but it is unknown to what extent climate affects overall activity level. Very active adults are more likely to reside in the West and Midwest, while inactive adults are more likely to reside in the South and East (*3,8*). This distribution is confounded by age and socioeconomic factors, however. Although 27 percent of the public state that more favorable weather would probably increase their sport involvement, nearly twice as many active persons (33 percent) as inactive persons (18 percent) believe this to be the case.

'Although these findings are too sparse to interpret clearly, they collectively support the principle that individual behavioral differences must be accommodated in the planning of supervised programs. Concern for physical tolerance alone appears inadequate.'

Access to facilities is a necessary but insufficient facilitator of community exercise participation (*3,9*). Contrary to findings concerning clinical exercise programs, participants in unsupervised activity who live *closer* to the exercise setting have been shown to be more likely to drop out, stating that they perceive inconvenience as a factor leading to their return to inactivity (*38*). Also, the already active are twice as likely as the inactive to feel that greater availability of resources would increase their participation (*3,9*). The already active are also twice as likely to believe that a more flexible work schedule would increase their participation (*3,9*).

The available evidence on environmental factors suggests that the influence of the family on current activity habits is strong but that family variables have been insufficiently explored. Similarly, the effect of peers from childhood into adulthood appears to be important but is poorly defined. While the impact of physicians' recommendations of exercise participation is potentially great, little effect has been documented. Weather has a direct effect on participation, but the effects of cost and convenience are complex and uncertain. One interpretation of the effects of physical environments on activity habits is that such considerations as time, money, and convenience are irrelevant to those who have not made the decision to exercise, while active people are attuned to environmental barriers. The long-term effects of the social environment and the influences of past physical environments are largely unknown, but they are likely to be minor in relation to contemporary pressures.

Influence of the activity itself. Different activities require different skills for maintained participation. The commitment required to plan 30 minutes for a walk before supper is probably less than that needed to join a health club and make the necessary preparations to swim or run for 30 minutes several times per week. The behavioral differences between

lifestyle and programmed activities have been discussed previously (*49*), and they have different prevalence patterns (*51*).

Lifestyle activity patterns (that is, routine physical activity) do not differ greatly by age or gender, but men and younger adults are much more likely to engage in vigorous activities (that is, fitness-related activities) (*51*). While more men than women will adopt vigorous exercise in the period of a year, a comparatively large proportion of women will increase routine or lifestyle activities. Furthermore, lifestyle activities show a dropout rate roughly one-half of that typically seen for vigorous exercise (James F. Sallis, unpublished observations, November 18, 1982). And in high-intensity, high-frequency running programs, a substantial number of participants can be expected to drop out because of stress-induced injury (*61*). However, in a 4-year study of a clinical exercise program (*62*), the amount of exercise was unrelated to adherence.

Physical activity produces results that can encourage or discourage subsequent participation. For example, perceived discomfort during an exercise program, regardless of exertion, has been reported among women who drop out (*62*). Some highly committed exercisers may use activity as a coping strategy for mental stress (*13*), and positive feelings associated with activity may be associated with an excessive dependence in certain types of people (*63*). Numerous studies show that exercise is related to positive mood and psychological functioning (*64,65*), but the behavioral meaning of this relationship is not yet known.

A daily routine that helps reinforce participation and minimize impediments should include a convenient and consistent time and place that is flexible enough to accommodate a person's existing activity preferences and daily fluctuations in motivation and yet is planned to achieve tangible, long-term objectives within a reasonable time (for example, 6–10 weeks) (*9,13,34*).

The available evidence indicates that lifestyle activities have higher prevalence and adherence rates than fitness-related (particularly aerobic) exercises. But little is now known about the amount and mode of activity needed from a behavioral health perspective, as opposed to an exclusively fitness-oriented perspective. Likewise, we do not know the impact of how people choose their activities and what role this has in regular participation. However, it is clear that the current practice of designing activity plans exclusively on the basis of initial fitness and its biological dose-response rate neglects important perceptions of the effects of activity strain.

Summary

Regular participation in physical activity and exercise must be viewed as a dynamic process in which adoption and maintenance of involvement are key outcomes. Intention, personal capabilities, behavioral skills, commitment, and reinforcement emerge as determining factors that appear constant across populations, settings, and modes of activity. Knowledge of, attitudes toward, and beliefs about health and activity; perceived needs and abilities; and outcome expectations interact with biomedical and personality traits, feelings, lifestyle behaviors, and environments to influence a person's disposition to adopt or maintain involvement in physical activity. This disposition is shaped by a history of activity; normative modeling; reinforcement by health care agents, family, and peers; environmental prompts; and accessibility of facilities. Although the decision to be active or sedentary ultimately resides in the individual person, evidence indicates that this is not exclusively a reasoned decision. Critical behavioral determinants may not be known by the individual or may be outside the control of the person's abilities or skills. Environmental barriers can outweigh personal intention. Thus, physical activity and exercise are at once socially and self-regulated behaviors.

It is not possible to specify important interactions among known determinants at this time. However, it appears that some determinants are direct in their influence while others operate indirectly, through mediators. Some describe dynamic behavioral processes but many mark personal and environmental traits or behavioral products. It is necessary to recognize these distinctions because effective interventions must allow for stable influences while attempting to modify those that are dynamic.

Recommendations for Future Research

The following recommendations are based upon a public health perspective. While knowledge of determinants of physical activity habits is a fruitful area in which to test scientific theories and gather basic data, the major application to public health is that knowledge of determinants can guide interventions. The questions below are those that we deem important for future investigations to address. They can be clustered in three major groupings, according to need and outcome.

First, there remains a need to conceptualize and in a general way rank determinants according to priority. Our knowledge will continue to benefit

from replication, extension, and direct comparison of factors implicated by previous studies. Therefore, we need to:

1. Determine factors that lead to the decision or intention to begin a physical activity program.
2. Specify the cognitive and behavioral skills or physical abilities needed to initiate and maintain a physical activity program.
3. Identify and put in priority the critical interactions, within and among personal and environmental factors, that determine a person's willingness and ability to be active.
4. Determine the degree to which influences on participation may vary for different activity behaviors.
5. Determine the behavioral significance of perceived barriers to activity and, likewise, excuses for inactivity.
6. Examine the degree to which known health-risk factors precede or follow inactivity, and why.
7. Determine how perceived exertion during and after activity influences future activity.

Second, as our general knowledge grows, it will also be necessary to specify major activity determinants for certain populations and settings. Therefore, we need to:

8. Study how activity determinants differ according to a person's age, gender, ethnicity, socioeconomic level, and health or fitness status.
9. Investigate possible differences in determinants of lifestyle (routine leisure) and vigorous (exercise for fitness) activities.
10. Establish whether determinants of participation in supervised and unsupervised programs differ.
11. Determine if history of previous activity or sports, family or peer influences, socioeconomic status, education level, and age represent true influences on activity or if these represent a selection bias.
12. Determine who is most likely to follow and benefit from programs of vigorous exercise, from routine physical activity, and from activity modified for disabling conditions (*66*).
13. Investigate the extent to which physical activity and other health behaviors may reinforce or negate each other.

Third, advancing age and elapsed time after initial adoption of an activity are among the most reliable predictors of inactivity. Thus, it seems likely that past activity environments and experiences are strong influences on present and future participation. Yet, little is now known in these areas. Therefore, we need to:

14. Examine when and how preferences for types and intensities of activity are formed and how they influence future activity.
15. Establish what determinants at one age (for example, childhood) can be altered to increase the likelihood that the person will be active at another age (for example, adulthood).
16. Determine if certain types of individuals are predisposed to activity or inactivity and if this changes at definable stages across the lifespan.
17. Examine why activity seems to diminish with advancing age and what might be done to retard this decline.
18. Investigate how self-motivation and intrinsic reinforcements for regular participation develop, what the time course is for their impact, and whether it is realistic to change them to increase activity.
19. Determine if definable stages or patterns of participation exist in which different determinants operate or vary in their influence, making specific interventions uniquely effective at different times.

To address the preceding questions and to provide guidance to those planning intervention programs, the following recommendations for research and program design are offered.

1. Most population studies of determinants are retrospective and cross-sectional. Current knowledge suggests that a longitudinal population study should be conducted. A representative sample (including all sex, age, ethnic, socioeconomic, health, and regional groups) should be assessed at intervals of 3 to 4 years. A natural history of activity and factors associated with changing patterns will be useful, but measures should be chosen based on probable relevance to interventions targeted for people and environments.
2. Small descriptive and experimental studies, testing the application of behavioral science theories to determinants of activity habits, should be carried on concurrently. These studies should focus on selected groups (such as children, blue-collar workers, working mothers, Hispanics, blacks, Asians, those with high-risk health profiles, and the habitually active), or should test intervention hypotheses, assess the interaction of selected determinants, or validate survey reports of activity and its determinants.
3. Study questions, variables, and measurement methods should be standardized, or their disparities

quantified and reconciled, to allow researchers to examine whether the results of studies of behavioral patterns and determinants can be generalized across settings, activities, and population segments. Standardized questions concerning determinants should be added to population surveys.

4. Most studies have been guided by applied concerns rather than by theory. Although some attempts to conceptualize existing evidence (*7,13,14*) have helped form predictive hypotheses, there is a need to continue bridging applied questions with theory. This is important if physical activity, exercise, and fitness are to be examined in relation to other health behaviors and outcomes. Standardized theories and technologies will allow us to determine if common determinants exist or if models unique to physical activity are needed. Although previous tests of generalized behavior models (such as health locus of control, the health belief model, theory of reasoned action, and self-efficacy or competence motivation) have not been encouraging (*18,27, 52,53,67,68*), further efforts are warranted. This conclusion seems timely, since recent public health reviews of behavioral change have not discussed theories within which exercise and physical activity are target behaviors (*69–72*).

References

1. Department of Health and Human Services, Office of Disease Prevention and Health Promotion: Prevention '82. DHHS Publication No. (PHS) 82–50157. U.S. Government Printing Office, Washington, DC, 1982.
2. National Center for Health Statistics: Health, United States, 1977–1978. U.S. Government Printing Office, Washington, DC, 1980.
3. The Perrier study: fitness in America. Perrier-Great Waters of France, Inc., New York, 1979.
4. The General Mills American family report, 1978–1979: Family health in an era of stress. Yankelovich, Skelly and White, Inc., New York, 1979.
5. Morgan, W. P.: Involvement in vigorous physical activity with special reference to adherence. *In* National College of Physical Education Association Proceedings, edited by G. I. Gedvilas and M. E. Kneer. University of Illinois Press, Chicago, 1977.
6. Oldridge, N. B.: Compliance and exercise in primary and secondary prevention of coronary heart disease: a review. Prev Med 11: 56–70 (1982).
7. Dishman, R. K.: Compliance/adherence in health-related. exercise. Health Psychol 1: 237–267 (1982).
8. Stephens, T., Jacobs, D. R., and White, C. C.: The descriptive epidemiology of leisure-time physical activity. Public Health Rep 100: 147–158, March-April 1985.
9. Canada Fitness Survey. Fitness and lifestyle in Canada. Fitness Canada, Ottawa, 1983.
10. Clarke, H. H., editor: National adult physical fitness survey. President's Council on Physical Fitness and Sports Newsletter, Washington, DC, special edition, May 1973.
11. Dishman, R. K.: Motivation and exercise adherence. *In* Psychological foundations of sport, edited by J. Silva and R. Weinberg. Human Kinetics Publications, Champaign, IL, 1984, pp. 416–430.
12. Cox, M. H.: Fitness and lifestyle programs for business and industry: problems in recruitment and retention. J Cardiac Rehabil 4: 136–142 (1984).
13. Dishman, R. K.: Exercise adherence and habitual physical activity. *In* Coping with mental stress: the potential and limits of exercise intervention, edited by W. P. Morgan and S. N. Goldston. National Institute of Mental Health, Rockville, MD. In press.
14. Martin, J. E., and Dubbert, P. M: Exercise applications and promotion in behavioral medicine: current status and future directions. J Consult Clin Psychol 50: 1004–1017 (1982).
15. Dishman, R. K.: Biologic influences on exercise adherence. Res Q Exerc Sport 52: 143–159 (1981).
16. Dishman, R. K.: Prediction of adherence to habitual physical activity. *In* Exercise in health and disease, edited by F. J. Nagle and H. J. Montoye, Charles C Thomas, Springfield, IL, 1981.
17. Harris, D. V.: Physical activity history and attitudes of middle-aged men. Med Sci Sports 2: 203–208 (1970).
18. Dishman, R. K., and Ickes, W.: Self-motivation and adherence to therapeutic exercise. J Behav Med 4: 421–438 (1981).
19. Brownell, K., and Stunkard, A. J.: Physical activity in the development and control of obesity. *In* Obesity, edited by A. J. Stunkard. W. B. Saunders and Company, Inc., Philadelphia, PA, 1980.
20. Brownell, K., Stunkard, A. J., and Albaum, J.: Evaluation and modification of exercise patterns in the natural environment. Am J Psychol 137: 1540–1545 (1980).
21. Rejeski, W. J., Morley, D., and Miller, H. S.: The Jenkins Activity Survey: exploring its relationship with compliance to exercise prescription and MET gain within a cardiac rehabilitation setting. J Cardiac Rehabil 4: 90–94 (1984).
22. Shephard, R. J., and Cox, M.: Some characteristics of participants in an industrial fitness programme. Can J Appl Sport Sci 5: 69–76 (1980).
23. Teraslinna, P., et al.: Characteristics affecting willingness of executives to participate in an activity program aimed at coronary heart disease prevention. J Sports Med Phys Fitness 9: 224–229 (1969).
24. Morgan, P. P., Shephard, R. J., and Finucane, R.: Health beliefs and exercise habits in an employee fitness programme. Can J Appl Sport Sci 9: 87–93 (1984).
25. Shephard, R. J.: Physical activity and aging. Croom Helm, London, 1978.
26. Andrew, G. M., et al.: Reasons for dropout from exercise programs in post coronary patients. Med Sci Sports Exerc 13: 164–168 (1981).
27. Lindsay-Reid, E., and Osborn, R. W.: Readiness for exercise adoption. Soc Sci Med 14: 139–146 (1980).
28. MacKeen, P. C., Franklin, B. A., and Nicholas, W. C.: Body composition, physical work capacity and physical activity habits at 18-month follow-up of middle-aged women participating in an exercise intervention program. Int J Obes 7: 61–71 (1983).
29. Ward, A., and Morgan, W. P.: Adherence patterns of healthy men and women enrolled in an adult exercise program. J Cardiac Rehabil 4: 143–152 (1984).
30. Blumenthal, J. A., et al.: Physiological and psychological variables predict compliance to prescribed exercise therapy

in patients recovering from myocardial infarction. Psychol Med 6: 519–527 (1982).
31. Lobstein, D. D., Mosbacher, B. J., and Ismail, A. H.: Depression as a powerful discriminator between physically active and sedentary middle-aged men. J Psychosom Res 27: 69–76 (1983).
32. Collingwood, T. R., et al.: Caronical correlation analysis of clinical and psychological data in 4,351 men and women. J Cardiac Rehabil 3: 706–711 (1983).
33. Heinzelmann, F., and Bagley, R. W.: Response to physical activity programs and their effects on health behavior. Public Health Rep 86: 905–911 (1970).
34. Martin, J. E., et al.: The behavioral control of exercise in sedentary adults: studies 1 through 6. J Consult Clin Psychol. In press.
35. Wankel, L. M.: Decision-making and social-support strategies for increasing exercise involvement. J Cardiac Rehabil 4: 124–135 (1984).
36. Stalonas, P. M., Johnson, W. G., and Christ, M.: Behavior modification for obesity: the evaluation of exercise, contingency management, and program adherence. J Consult Clin Psychol 46: 463–469 (1978).
37. King, A. L., and Frederiksen, L. W.: Low-cost strategies for increasing exercise behavior: relapse preparation training and social support. Behav Mod. In press.
38. Marlatt, G. A., and Gordon, J. R.: Determinants of relapse: implications for the maintenance of behavior change. *In* Behavioral medicine: changing health lifestyles, edited by P. Davidson and S. Davidson. Brunner-Mazel, New York, 1980, pp. 410–452.
39. Oldridge, N. B., and Jones, N. L.: Improving patient compliance in cardiac rehabilitation: effects of written agreement and self-monitoring. J Cardiac Rehabil 3: 257–262 (1983).
40. Epstein, L. H., et al.: Attendance and fitness in aerobics exercise: the effects of contract and lottery procedures. Behav Mod 4: 465–479 (1980).
41. Wysocki, T., et al.: Behavioral management of exercise: contracting for aerobic points. J Appl Behav Anal 12: 55–64 (1979).
42. Keefe, F. J., and Blumenthal, J. A.: The life fitness program: a behavioral approach to making exercise a habit. J Behav Ther Exp Psychiatry 11: 31–34 (1980).
43. Epstein, L. H., Koeske, R., and Wing, R. R.: Adherence to exercise in obese children. J Cardiac Rehabil 4: 185–195 (1984).
44. Wilhelmson, L., et al.: A controlled trial of physical training after myocardial infarction. Prev Med 4: 491–508 (1975).
45. Loy, J. W., McPherson, B., and Kenyon, G.: Sport and social systems. W. B. Saunders and Company, Inc., Philadelphia, PA, 1978.
46. The Miller Lite report on American attitudes toward sports. Research & Forecasts, Inc., New York, 1983.
47. Greendorfer, S. L.: Shaping the female athlete: the impact of the family. *In* The sporting woman, edited by M. Boutslier and L. San Giovani. Human Kinetics Publishers, Champaign, IL, 1983, 135–155.
48. Butcher, J.: Socialization of adolescent girls into physical activity. Adolescence 18: 753–766 (1983).
49. Engstrom, L. M.: Physical activity of children and youth. Acta Paediatr Scand [Suppl] 283: 101–105 (1980).
50. Sonstroem, R. J.: Attitudes and beliefs in the prediction of exercise participation. *In* Sports medicine, sports science: bridging the gap, edited by R. L. Cantu and W. J. Gillespie. The Collamore Press, Lexington, MA, 1982, 3–16.
51. Sallis, J. F., et al.: Physical activity assessment methodology in the Five City Project. Am J Epidemiol. In press.
52. Montoye, H. J.: Physical activity and health: an epidemiological study of an entire community. Prentice-Hall, Inc., Englewood Cliffs, NJ, 1975.
53. Gettman, L. R., Pollock, M. L., and Ward, A.: Adherence to unsupervised exercise. Phys Sportsmed 11: 56–66 (1983).
54. Meyer, A., et al.: Skills training in a cardiovascular health education campaign. J Consult Clin Psychol 48: 129–142 (1980).
55. McIntosh, P.: "Sport for All" programs throughout the world. Report prepared for UNESCO (Contract No. 207604). UNESCO, New York, 1980.
56. Fitness Ontario: The relationship between physical activity and other health-related lifestyle behaviors. A research report from the Ministry of Culture and Recreation, Sports and Fitness Branch, Government of Ontario, Toronto, 1982.
57. Blair, S. N., Jacobs, D. R., and Powell, K. E.: Relationships between exercise or physical activity and other health behaviors. Public Health Rep 100: 172–180, March-April 1985.
58. Iverson, D. C., Fielding, J. E., Crow, R. S., and Christenson, G. M.: The promotion of physical activity in the U.S. population: the status of programs in medical, worksite, community, and school settings. Public Health Rep 100: 212–224, March-April 1985.
59. Fielding, J. E.: Effectiveness of employee health improvement programs. J Occup Med 24: 907–916 (1982).
60. Sacks, M. H., and Sachs, M. L., editors: Psychology of running. Human Kinetics Publishers, Champaign, IL, 1981.
61. Pollock, M. L., et al.: Effects of frequency and duration of training on attrition and incidence of injury. Med Sci Sports 9: 31–36 (1977).
62. Oldridge, N. B., et al.: Predictive indices for dropout: the Ontario Exercise Heart Collaborative Study Experience. Am J Cardiol 51: 70–74 (1983).
63. Inger, F., and Dahl, H. A.: Dropouts from an endurance training program. Scand J Sports Sci 1: 20–22 (1979).
64. Morgan, W. P.: Negative addiction in runners. Physician Sports Med 7: 57–70 (1979).
65. Taylor, C. B., Sallis, J. F., and Needle, R.: The relationship between physical activity and exercise and mental health. Public Health Rep 100: 195–202, March-April 1985.
66. Dishman, R. K.: Medical psychology in exercise and sport. Med Clin North Am. In press.
67. LaPorte, R. E., et al.: The spectrum of physical activity, cardiovascular disease and health: an epidemiologic perspective. Am J Epidemiol 120: 507–517 (1984).
68. Godin, G., and Shephard, R. J.: Physical fitness promotion programmes: effectiveness in modifying exercise behavior. Can J Appl Sport Sci 8: 104–113 (1983).
69. Owen, N., and Lee, C.: Why people do and do not exercise: recommendations for initiatives to promote regular, vigorous physical activity in Australia. Department of Recreation and Sport, South Australia, Sport and Recreation Minister's Council, Adelaide, 1984.
70. Benfari, R. C., Eaker, E., and Stoll, J. G.: Behavioral interventions and compliance to treatment regimes. Annu Rev Public Health 2: 421–471 (1981).
71. Green, L. W.: Modifying and developing health behavior. Annu Rev Public Health 5: 215–236 (1984).
72. Fielding, J. E.: Health promotion and disease prevention at the worksite. Annu Rev Public Health 5: 237–265 (1984).