

Lifestyle-Specific Outcome Measures

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Introduction

The leading causes of death in the industrialized countries are significantly influenced by lifestyle factors. In the US, the infectious diseases which accounted for the majority of deaths in the early 1900s have been replaced by: cardiovascular disease, cancers, unintentional injury, pulmonary disease, suicide, homicide, and diabetes. The shift toward the chronic diseases as the major causes of morbidity and mortality is being witnessed on a global scale. The *World Health Report 1998* published by the World Health Organization (WHO), stated that the majority of the 15 million adults aged 20-64 who die each year succumb prematurely to largely preventable causes.¹

While deaths due to cancer will stabilize somewhat in the industrialized countries, lung cancer and colorectal cancer will increase dramatically in developing countries, primarily due to smoking and dietary preferences respectively. Similarly, circulatory disease as a cause of death will continue to decline in the industrialized countries, but will increase in the developing nations as the global population continues to age. Noninsulin dependent diabetes is expected to increase dramatically from 143 million in 1997 to 300 million in 2025, primarily due to inactivity, obesity, and dietary preferences. It appears that the world's population will experience an increase in the so-called "Syndrome X" characterized by hypertension, glucose

intolerance, low levels of high density lipoprotein, and hyperinsulinemia. Insulin resistance may very well be an adaptation to a sedentary lifestyle complicated by obesity and poor dietary choices.

Lifestyle Choices

The priorities for improving the health status of Americans described in the 1979 US Surgeon General's Report, *Healthy People*, appear to be salient goals for the entire world's population as we enter the 21st century.² The Report identified smoking cessation, physical exercise, nutrition and weight control, stress management, and the appropriate use of alcohol and other drugs as the priority areas for health promotion and disease prevention activities. While acknowledging the tremendous advances in medicine and public health, which have resulted in reduced infant mortality and increased longevity, the Report emphasized the need for individual responsibility in making lifestyle changes associated with reduced risk of premature morbidity. Since publication of the *Report*, health promotion efforts have naturally focused on those behavioral factors associated with contemporary causes of morbidity and mortality.

Exercise, Diet, and Stress

This chapter examines current methods of assessing levels of physical activity, dietary intake, and psychosocial stress. This is not to suggest that other risk-taking behaviors such as smoking or misuse of

ethanol should not be measured. We simply chose to explore those priority areas that require and utilize multiple methods of psychometric assessment and are subsequently less likely to be measured with dichotomous response variables. Exercise, diet, and stress management have each been targeted as priority areas for preventive strategies by epidemiologists, clinicians, voluntary health agencies, and governmental health agencies. Virtually all health status and risk assessment instruments attempt in some way to estimate physical activity, dietary preferences, and responses to perceived stress. For the health promotion specialist who wishes to measure one or more of these areas in detail, the range of specialized assessment tools can be overwhelming. We attempt to briefly describe the major features, strengths and limitations, and methodological issues which accompany the use of physical activity, diet, and stress assessment instruments. Included in this chapter are timely references from the scientific literature including special review articles which detail implementation issues and offer exemplary tools.

Fitness, Activity, and Public Health

More than 60 percent of American adults are not regularly active and an additional 25 percent are sedentary.³ In spite of the ample evidence that regular physical exercise is inversely related to coronary heart disease, hypertension, obesity, diabetes, and certain cancers, less than 20 percent of adults engage in regular, vigorous physical activity.⁴ Current recommendations suggest that exercise bouts need not be highly intense nor extraordinarily prolonged in order to reap risk-reducing benefits. Guidelines call for 30 minutes or more of moderate intensity, aerobic (cardiorespiratory) activity on all or most days of the week.³ Prospective studies have shown the greatest benefit was achieved when sedentary subjects progressed to moderate levels of regular exercise such as brisk walking 16-23 kilometers/week or running 8-12 km/wk (10-15 miles and 5-8 miles respectively). Williams conducted a cross-sectional study of male runners and concluded that considerable health benefits could be realized at levels of activity that substantially exceeded governmental guidelines.⁵

While there may be some controversy regarding the specific intensity, frequency, and duration of activity that is most likely to mitigate disease risk, there is little argument that the majority of children

and adults must increase their cardiorespiratory endurance, strength, and flexibility.

Physical Fitness

An accurate determination of physical fitness requires the use of sophisticated laboratory equipment, trained technicians, and a motivated subject. Cardiorespiratory fitness is determined by measuring expired air and respiratory volume when the subject is exercised to exhaustion, usually on a treadmill. Muscular strength is estimated when selected muscle groups are subjected to a series of contractions until the maximum repetitions at a given resistance are attained. Range of motion measurements (goniometry) are used to estimate levels of flexibility around a specific joint. Unfortunately, there is no uniformly accepted means of estimating habitual physical activity.⁶

Physical Activity

Physical activity includes leisure and sports, activities of daily living, and occupational activities. The range of possible physical movements that result in energy expenditure on any given day is immense. Variability within and between individuals can be extraordinary. Energy expenditure varies by season, time of day, type of activity, and the level of skill possessed by the exerciser. The choice of a physical activity assessment tool must be balanced by the desire of the practitioner for an accurate estimate of a client's level of energy expenditure, and the time and effort required of the client to complete the assessment tool. Questionnaires must include logical activities that subjects being studied are likely to engage in on any given day while simultaneously assessing the level of intensity, duration, and frequency of each listed activity. Cultural and gender differences have been reported in the literature and the readability level of the entire instrument must be suitable for the population under study.

Validity and Reliability

As with all health assessment tools which rely on self-reported data, physical activity instruments may over- or underestimate energy expenditure depending on a subject's memory or accuracy in recording the intensity, frequency, or duration of a listed activity. Physical activity levels have been measured using diaries similar to procedures used in dietary research. Conversely, retrospective assessments which require recall of customary activity are also widely used. In order to estimate caloric expenditure, a subject's body

mass index (weight/height²) is calculated and the energy required to accomplish specific tasks chosen by the subject is totaled. Typically, energy expenditure for a given activity is measured in multiples of the resting metabolic rate (METS) in kilocalories/kilograms of body weight/hours of activity. A 30-minute jog would be analyzed by estimating the intensity of the exercise (distance covered in 30 minutes) by the weight of the jogger. Physical activity instruments vary in the number of activities (e.g., jogging, gardening, swimming, walking) that a subject may choose as indicative of their habitual activity. Each of the listed activities have a calculated MET value depending on intensity and duration. The calculated values may vary somewhat depending on the equations adopted by the instrument. The subject indicates all activities performed, the duration of each, and some estimate of perceived intensity or exertion (e.g., light, moderate, heavy).

There is no single standard or criterion by which all measures of physical activity can be compared. Studies correlating reported levels of activity with the same subjects' measured cardiorespiratory fitness have shown moderate associations. Yet self-reported physical activity remains the principal contributor to predictive models of fitness.⁷ The reliability of any given instrument can be enhanced if the tool is carefully matched to the subject/population under study, procedures for administration are carefully observed, and the identical tool is used for follow-up analysis. The combination of physical activity assessments, health status measures, risk appraisals, and, where possible, physical fitness tests, gives the health promotion specialist a more complete profile of an individual's overall risk of premature morbidity.

Summary

Health promotion specialists, medical practitioners, and researchers are encouraged to use physical activity assessments when interventions include exercise prescriptions. Use of activity questionnaires and exercise diaries provide pre-post evaluations of exercise programs while simultaneously sensitizing clients to the components of a physically active lifestyle, namely cardiorespiratory, strength, and flexibility training. The effects of physical activity on selected diseases continues to be explored using this technology in population studies such as the National Health Interview Survey (NHIS), the National Health

and Nutrition Examination Survey (NHANES), the Behavioral Risk Factor Surveillance System (BRFSS), and others. The reader is encouraged to examine a supplement to the journal, *Medicine & Science in Sports and Exercise*, Vol. 29 (6), June 1997, wherein versions of most of the popular physical activity questionnaires are presented and directions for their use are described.⁸

Dietary Preferences

In 1998 the American Heart Association added obesity to the list of primary cardiovascular disease risk factors. Together with tobacco use, hypertension, hyperlipidemia, and sedentary lifestyle, the primary risk factors are also predictive of premature morbidity and mortality due to other leading causes including selected cancers. With an increase in longevity, a reduction in caloric expenditure, and the widespread availability of high calorie foods, we are witnessing a concomitant increase in the chronic diseases associated with "overnutrition." In 1988 the *U.S. Surgeon General's Report on Nutrition and Health* linked diet with 5 of the 10 leading causes of death.⁹ The report concludes that the principal problem with the Western diet is an overconsumption of foods rich in fats at the expense of foods high in complex carbohydrates and fiber.

Measuring Dietary Practices

Use of population study data such as NHANES provides the necessary basis for decisions regarding food fortification, formulations of dietary education goals, and the assessment of progress toward national dietary health goals. Population studies frequently rely on several research methods including dietary recall, food frequency questionnaires (FFQ), blood and urine biochemical analyses, and physical measurements.⁹

Dietary Intake

Dietary intake data are most valuable when combined with clinical and biochemical assessments. But multi-modality measurements may exceed the available resources of both practitioners and clients. The estimation of an individual's dietary intake is subject to the same challenges previously described for physical activity. Most instruments analyze data derived from questionnaires or food diaries completed by the subject. The food choices are used to estimate nutrient intake, which is determined using standardized nutrient databases such as the US Department of Agriculture's National Nutrient Data Bank. As with estimations of

physical activity, there is no "gold standard" for collecting or analyzing dietary intake data. Measurement techniques usually involve variations on four methods: 24-hour recall, food logs (diary), food frequency questionnaires, and diet histories. In addition, some investigators and clinicians have used a number of techniques designed to improve the accuracy of subjects' responses including: surrogates (spouse, parent), food models, pictures of food, biochemical markers of selected food ingestion, and unscheduled or surprise interviews. Each of these measurement techniques have strengths and limitations cogently described by Lee and Nieman.¹⁰

Assessment Methods

The method most often used by epidemiologists is the FFQ because it is easily administered and scored, requires minimal effort on the part of subjects, and is commercially available in a wide variety of options and forms. The FFQ typically requests respondents to indicate their "usual" intake of a specific food item taken from a lengthy list of options. For example, a single egg might have the following response categories: never or less than one/month; one/week; one/day; 3+/day. Subjects choose response items that best describe their "usual" dietary intake while estimating portion sizes for some of the selections. Food diaries and 24-hour recalls use open-ended reports, which allow for potentially accurate descriptions of the actual food items and portions consumed. The recall depends on short-term memory, and the food diary requires that subjects dutifully record all food and drink consumed during the study period. Diet histories combine methods such as the FFQ and recalls, or 3-day food records, presented to subjects over a prolonged period. Recalls and food diaries have also been used to validate FFQ, especially with respect to portion sizes.

Studies have shown that food diaries recorded over an extended period of time may be required depending on the nutrient of interest. For some nutrients weeks or months may be required, but for gross estimates of energy intake and macronutrients, 3-10 days of record keeping may be sufficient.¹¹ In general, those who eat less than the average tend to overestimate their dietary intake while those who eat more than the average usually underestimate their food intake.¹¹ Self-reported energy intake has been compared to energy expenditure using water labeled with deuterium which

is harmless to subjects and provides researchers with a means of calculating actual energy expenditure. Over a period of several weeks, analysis of the urinary excretion of the doubly-labeled water permits an accurate measurement of energy balance. These studies have confirmed a consistent underreporting of caloric intake, especially among obese subjects.¹²

Summary

There are numerous commercially available dietary assessment tools which analyze dietary records, recalls, and food frequencies. Software programs rely on databases such as the National Nutrient Data Bank. Researchers often modify databases in order to expand the possible number and quality of food analysis options available to users of a particular program. Dietary analysis is subject to a number of potential sources of error including: the memory of subjects, estimates of portion sizes, rigor of recording daily intake, and the variability in databases used to analyze specific food items. Estimating the nutrient value of a large apple is straightforward; a heaping helping of a homemade stew can be problematic. There is heightened interest in the role that diet may play in the promotion of health and in the mitigation or exacerbation of disease. There is a need for increased proficiency among health professionals in providing clients with accurate dietary assessments and empirically based nutritional advice. The use of a combination of dietary analysis methodologies will increase the likelihood that health promotion specialists will be able to identify individuals at nutritional risk while providing guidelines for healthy eating. In a supplement to *The Journal of Nutrition*, Volume 124 (11S), November 1994, the strengths and limitations of various dietary assessment methods are reviewed and a number of instruments are provided for comparison.¹³

Stress

One of the most arduous challenges in the mental health field has been to define the term "stress." In fact, despite more than a half-century of stress theory and research, a consensus on the meaning of stress has yet to be formed. The difficulty in defining stress stems from the fact that the stress response transpires on many levels: 1) physiological, 2) emotional, 3) cognitive, and 4) behavioral (see Table 1). In addition, stress emanates from a wide array of stimuli or stressors, which may be either physiological (illness,

pain), psychological (depression, humiliation), sociological (discrimination, poverty), or environmental (noise, taxes) in origin.¹⁴ The meaning of stress is further complicated by the notion that a person's appraisal of the potential stressor, which is influenced by various internal characteristics such as individual health status, personality, and past experience, may mediate responses to stress.

Table 1. The Multilevel Stress Response

Level of Stress Response	Common Response Indicators
Physiological	increased heart rate, elevated blood pressure, muscle tension/bracing, increased perspiration, nausea, urinary hesitancy, cool extremities, increased respiration, decreased saliva production
Emotional	irritability, frustration, anger, hostility, anxiety/tension, nervousness, confusion, impatience, sadness, depression, fear
Cognitive	obsessive rumination, preoccupation with past or future, lack of focus/attention deficit, negative self-statements, negative appraisal of experiences, negative self-esteem, disorganization of thought, denial
Behavioral	alcohol and drug use, aggressive behaviors, increased smoking, cessation of physical activity, laughter, crying, compulsive behavior, undereating/overeating, increased consumption of caffeine and other sympathomimetics, social withdrawal

Consequently, theories have been developed that emphasize stressors, responses, and/or individual appraisal, as the nuclear component of stress. The theoretical stress approach that has received the most recent attention is the transactional or interactional approach that highlights the dynamic interplay between an individual's adaptive capacities and environmental stimuli.¹⁵ This view posits that stress is a process in which internal or external demands are appraised as exceeding available coping resources and threatening physical and psychological well-being.¹⁶ This conceptualization of stress may best enable researchers to measure and understand how individual appraisal-coping processes can result in physical and psychological changes that increase susceptibility to pathogenesis.

Stress and Disease

The time since Dr. Hans Selye's extensive study of the physiological stress response has witnessed a burgeoning of research investigating the mechanisms through which stress influences physical and mental health. This vast body of literature demonstrates that chronic exposure to stressors that tax individual coping resources may contribute to the onset of a disease, and or affect the course, severity, and prognosis of an existing pathogenic condition.¹⁷ In 1990, the US Department of Health and Human Services in *Healthy People 2000*, identified stress as a potential risk factor in the development of several illnesses such as cardiovascular disease, immune disorders, gastrointestinal conditions, anxiety, eating disorders, and depression. Stress was further implicated in the occurrence of other related causes of disability, morbidity, and mortality including unintentional injuries, suicide, homicide, and other forms of intentional injury. A reduction in the prevalence of stress-related morbidity and mortality is achievable through implementation of individual and community psychological and environmental interventions that strengthen internal coping resources and prevent the employment of maladaptive coping responses (e.g., alcohol and drug use, smoking, denial, etc.). Furthermore, the practice of sound health behaviors such as consuming a nutritious diet and engaging in regular physical activity may also reduce the risk of stress-related insult to physical and mental health status.¹⁸

Measuring Stress

Stress research has generated three distinct measurement and testing modalities: (1) psychophysiological methods, (2) interview and narrative rating methods, and (3) self-report methods. Following is a brief description of these modalities, and the strengths and limitations associated with each.

Psychophysiological Methods of Stress Measurement

Psychophysiological methods of stress measurement focus on the two major physiological stress response pathways, the autonomic nervous system, particularly the sympathetic-adrenal medullary system (SAM), and the hypothalamic-pituitary-adrenocortical axis (HPA). The primary measures of SAM and HPA activation include the cardiovascular (increased blood pressure and heart rate) and endocrine (circulation and release of catecholamines and corticosteroids) systems. However, other markers of the physiological stress response such as skin conductance and resistance, muscle tension, and reduced number and function of leukocytes are also readily utilized in stress research.¹⁹

Measurement of cardiovascular reactivity typically involves the use of specific instrumentation (electrocardiograph), as does measurement of skin conductance and resistance (galvanometer), and muscle tension (electromyograph). Assessment of circulating or excreted levels of major stress hormones requires assaying of blood, plasma, urine, and saliva samples, whereas enumerative and functional assessment of leukocytes involves assaying blood samples.^{20,21} Investigators tend to use psychophysiological methods when a more direct measure is desired and/or if the objective is to determine the mechanisms through which specific physiological responses affect functioning of somatic systems and increase the risk of pathogenesis.²²

Although psychophysiological methods may serve as a more objective method of measuring the stress response, use of these methods is accompanied by several practical complexities such as instrumentation and space requirements, high cost, ethical considerations (the use of invasive procedures), specificity and sensitivity issues (hormonal variation), and limited access to equipment. Therefore, for many health professionals, these issues prompt the use of non-invasive psychological stress measurement modalities.

Interview and Narrative Rating Methods of Stress Measurement

The interview and narrative rating measurement methods arose from a need to counteract measurement errors inherent in previous Stressful Life Event checklist measures. These methods are driven by the theoretical perspective that socio-environmental changes, which disrupt emotional homeostasis, elicit stress that endangers physical and mental well being. Interview methods use qualitative probes to accurately pinpoint the components of negative life events thought to trigger the stress response. Unlike checklist measures, interview measures facilitate the use of memory aids to improve negative-event recall and valid reporting of significant dates and events of the designated time period leading up to the onset of physical or mental illness.²³ Therefore, information about pertinent characteristics of life events, the socio-environmental situation that precedes and follows the occurrence of life events, and the personality, attitudes, and beliefs of the individual exposed is more readily obtained.²⁴ One of the most commonly used interview and narrative rating methods is the Life Events and Difficulties Schedule (LEDS)²⁵ The objective of the LEDS interviewing component is to obtain enough information about what occurred before and after each reported stressful event so that a thorough narrative of each event can be formulated. This information is then used to rate the degree of threat that each event and or the problems surrounding the event pose to health status. Although the LEDS and other interview methods reflect a more thorough approach to measuring the relationship between life events and health status, they are often accompanied by several practical limitations such as cost, extensive training of interviewers and raters, and length of interview procedures. Furthermore, these measures present methodological concerns, such as lack of supportive research, inconsistent calculations of reliability, and potential confounding event rating due to multiple rating schemes.²³ For a comprehensive review of conventional and alternative interview and narrative rating methods, see Wethington, Brown, and Kessler.²³ In addition, a version of the Structured Event Probe and Narrative Rating Method (SEPRATE), a promising alternative interview and rating system, is presented in Dohrenwend, Raphael, Schwartz, Steuve, and Skodol.²⁴

Self-Report Methods of Stress Measurement

Self-report measurement methods are the most commonly employed due to their easy use and the fact that many theorists emphasize affective states and appraisal-coping processes as the primary tenets of the stress concept.²⁶ Self-report methods, however, do present some shortcomings. For example, the investigator cannot always ensure that the respondent is interpreting the words in a manner that is in concordance with the studied stress construct.²⁷ Self-report tools tend to fall into one of three categories: stressor/stimulus scales, psychological response scales, and interactional/cognitive-affective scales. Stressor/stimulus measures address respondent exposure to a list of environmental stressors or stimuli. Psychological response measures focus on the mood and affective symptoms associated with the psychological stress response. Interactional measures emphasize the cognitive, perceptual, and personality characteristics that mediate the stress response.^{26,28} Following is a brief review of some premium measurement tools within each of the aforementioned categories.

Stress/Stimulus Measures

Life event scales have served as the primary measure of the stressor/stimulus conceptualization of stress. These measures are based on the theoretical perspective that posits social and environmental changes (e.g., divorce, job promotion), which require adaptation, elicit the stress response.²³ One of the pioneer and most popular life event scales is the Social Readjustment Rating Scale (SRRS).²⁹ The SRRS, developed by Thomas Holmes and Richard Rahe is based on the original life events scale, the Schedule of Recent Experience (SRE) scale. The SRRS consists of 43 life events that are accompanied by a life-change (LCU) score. Respondents select events they experienced within the last year and sum the LCUs to obtain a global score, which equates to a certain level of health risk. In addition to concerns about test-retest reliability, this measurement approach has garnered other major criticisms. These criticisms suggest that: (1) life event scales do not address chronic or recurring demands that people experience; (2) items on these scales fail to account for individual differences in appraisal; (3) items do not reflect changes experienced by populations of various ages; and, (4) significant life

events, such as death of a spouse, rarely happen and thus do not serve as a typical measure of life stress.³⁰

Consequently, these limitations have spawned popular daily hassles measures, such as the Hassles Scale,³¹ and The Daily Hassles and Uplifts Scale,³⁰ which measure the frequency and severity of pre-selected minor everyday stressors, and the frequency of positive daily experiences. Research has shown that daily hassle scores may be a stronger predictor of affective distress and psychological symptoms than life event scores.³¹ Furthermore, research has indicated that the impact of major life events on long-term health status might be mediated by an accumulation of unresolved daily hassles that result from major life events.³² See Turner and Wheaton³³ for a review of self-report life event measures and Eckenrode and Bolger³⁴ for a review of daily stress measures.

Psychological Response Measures

Although most psychological response questionnaires assess multiple affective states, several scales have been developed that measure a single affective state or syndrome (e.g., anxiety, depression). One of the best known multidimensional psychological assessment tools is the Minnesota Multiphasic Personality Inventory (MMPI).³⁵ Initially used as a clinical psychiatric tool, the MMPI has been used as an outcome measure in stress research due to the vast amount of research done on the scale over the last forty years. However, use of the MMPI has its drawbacks, most notably its excessive length (566 items). Another popular multidimensional scale is the Symptom Checklist-90-R (SCL-90-R),³⁶ which is designed to measure symptomatic psychological distress. The instrument reflects psychopathology on nine primary symptom dimensions and three global indexes of stress. Advantages to its use include its moderate length (90 items), computer-based scoring, high levels of test-retest and internal consistency reliability, and high convergent and discriminant validity.^{26,28} Other popular psychological assessment instruments include the Beck Depression Inventory (BDI), the Profile of Mood States (POMS), and the State-Trait Anxiety Inventory (STAI). The reader should be aware that many of these measures, while having high validity and internal consistency, possess low to moderate test-retest reliability because affective/mood states fluctuate and/or are transitory in nature.³⁷

Interactional Stress Measures

Due to the recent popularization of the interactional stress approach, measures which assess variables that influence individual appraisal and characteristics of the invoked response, have a relatively short history in comparison to stressor and response type measures.²⁶ One of the most promising interactional measures is the Derogatis Stress Profile (DSP).³⁸ The DSP consists of 70 items designed to interactively measure environmental, affective, and personality characteristics of the stress equation. The DSP has moderate to high test-retest reliability and high internal consistency and predictive validity.³⁹ Other interactional stress measures include the Jenkins Activity Survey (JAS), which assesses Type A behavioral patterns, and the Ways of Coping Checklist (WACC), which measures methods individuals use to cope with stressful demands.²⁶

Summary

The purpose of this discussion was to introduce the reader to the importance of stress in relation to various health outcomes. At the same time, the reader should now be aware of the difficulties associated with defining, conceptualizing, and measuring stress, the link between stress and disease, and the different theory-driven modalities of stress measurement. With the plethora of instruments available, the task of choosing the "right" measure can seem overwhelming. This brief narrative should facilitate the process of selecting an appropriate instrument to address a specific stress construct within a particular population of interest. For a comprehensive review and/or listing of available stress measurement methods, see Cohen, Kessler, and Gordon,¹⁹ Murphy, Conoley, and Impara,⁴⁰ Golberger and Breznitz,⁴¹ and Zalaquett and Wood.⁴²

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