STATE OF THE ART
REVIEWS

Edward McAuley, PhD, and
Katherine S. Morris, MS

# Advances in Physical Activity and Mental Health: Quality of Life

Abstract: *Biomedical advances and the practice of preventive health behaviors have resulted in an unprecedented growth in the older population of the United States, a trend projected to continue during the next several decades. However, the addition of years to life is no guarantee that those years will be quality years. There is growing evidence to suggest that physical activity is a behavioral modality that is consistently associated with quality of life outcomes. However, there are numerous conceptual, theoretical, and definitional ambiguities associated with this literature. In this review, we examine the literature on physical activity and quality of life in older adults. Specifically, attention is given to the conceptualization of quality of life in the medical and psychological disciplines and how these differential viewpoints influence the outcomes measured and the nature of the relationships reported. We also address the question of whether a dose-response relationship exists between these constructs, as well as the extent to which physical activity is associated with important aspects of cognitive, physical, and psychosocial function. Finally, we propose a multidimensional model for examining the potential mediating and moderating factors in the physical activity and quality-of-life relationship and discuss the practical implications that such a model has for practitioners.*

Keywords: physical activity; well-being; quality of life

The importance of a physically active lifestyle for physical and psychological health is well established.[1] Despite the many known benefits of physical activity, population statistics send a dismal message, with only 45% of adults in the United States meeting public health recommendations (PHRs) (ie, the accumulation of ≥30 minutes of moderate activity ≥5 days of the week[2]). In addition, a mere 37% of the older adult population reports regular activity, which is a concern considering that this is the most rapidly growing segment of the US population, with approximately 35 million adults 65 years and older, and this number is projected to double in the next several decades.[3] As we age, susceptibility to chronic conditions, functional limitations and disability, and comorbidity increase, often resulting in compromised physical, emotional, and psychological well-being and reduced quality of life (QOL). The increasing number of older Americans has caused public policy to be directed at ways to maintain the independence, societal worth, and physical and mental well-being of this group. In essence, we have moved from simply trying to add quantity to life toward

> The examination of physical activity and cardiorespiratory fitness effects on brain structure and function in animals and humans is an increasingly "hot" area of inquiry, and there is accumulating evidence for the efficacious role played by physical activity and fitness in the maintenance of cognitive health.

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adding quality to those years of life. There is increasing evidence to suggest that physical activity interventions may represent an effective behavioral strategy not only for attenuating functional decline and reducing risk of disability,[4-6] but also for enhancing psychological well-being and QOL in older adults.[7,8]

In this review, we examine the literature linking physical activity and QOL outcomes. As will be seen, the term *quality of life*, while ubiquitously used, has been subject to varying operational definitions. Indeed, a recent bibliographic study by Garratt et al[9] identified 3912 studies in which 1275 patient-assessed measures of QOL were developed or evaluated. Therefore, we begin the review with a brief discussion of how QOL has been conceptualized and defined. We next attempt to answer the question of whether physical activity can actually influence QOL and how active one has to be to accrue such benefits (ie, is there a dose-response relationship?). To do so, we rely on several recent and comprehensive reviews.[10-14] Next, we make the argument that considering physical activity to have a direct effect on such a global construct is misleading and that such relationships are better viewed from the perspective of which factors mediate this relationship. To do so, we briefly review the effects that physical activity has on cognitive, physical, and self-related psychosocial function. In closing, we provide some suggestions as to how practitioners might effectively influence those more proximal outcomes of physical activity that might lead to enhanced QOL.

## What is QOL?

Bowling et al[15] describe QOL as a "multilevel, amorphous" construct that "reflects macro-societal and micro-individual differences." For many years, QOL was assessed as a function of morbidity and mortality indexes. Therefore, life-expectancy predictions and absence of disease were considered markers of QOL. These indexes were further augmented in the medical literature by the assessment of functional status to determine how illness and prescribed treatment of disease influenced overall health status or health-related QOL (HRQL).[16] The assessment of functional status as an indicator of QOL has operated under the premise that having compromised physical function (ie, being unable to perform certain activities of daily living) is associated with degradations in QOL.[17] Such a limited perspective ignores the adaptability of humans, as individuals with considerable physical limitations also report high levels of life satisfaction.[17]

Rejeski and Mihalko[10] identify a lack of precision in defining QOL as a major hurdle in making consensus statements relative to the relationship between physical activity and QOL. In defining QOL, it is important to realize that a true conceptualization of this construct must take into consideration the subjective nature of the evaluation of QOL and the comparative process of one's current life with some personally identified criteria.[18] It is apparent that many conceptualizations and definitions of QOL fail to do so.

Like Bowling et al,[15] many researchers take the position that QOL is a multidimensional or umbrella construct under which such dimensions as physical, social, psychological, and spiritual well-being reside. An earlier conceptualization of QOL in relation to the effects of physical activity was presented by Stewart and King.[19] Their model represented QOL as 2 broad categories, function and well-being, which included other more specific QOL outcomes. The model by Stewart and King has its roots in the framework provided by the Medical Outcomes Study,[20] which formed the fundamental basis for HRQL. The Medical Outcomes Study 36-Item Short-Form Health Survey (SF-36)[21] and its derivatives represent the most common multidimensional measure of HRQL in the biomedical and behavioral medicine literature. However, this measure was never developed as a measure of QOL but rather as a measure of health status. Although it is likely that physical and mental health status are significantly associated with QOL, they are conceptually and theoretically independent.[8]

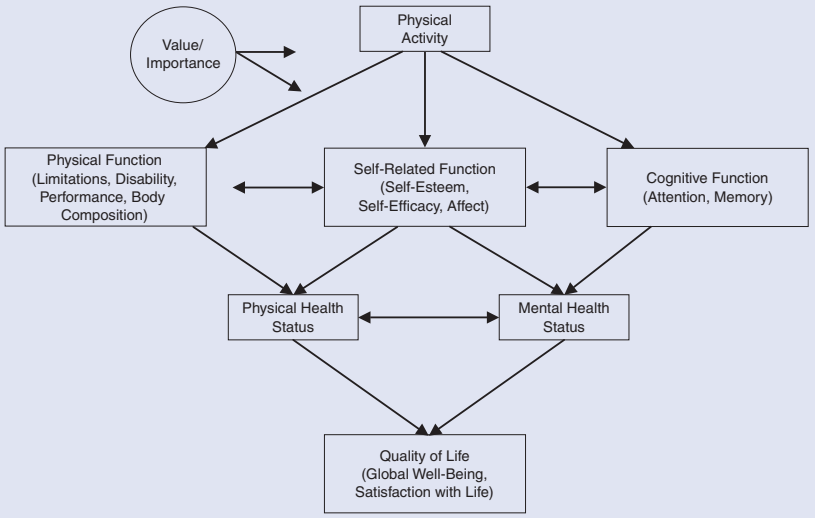
Other scholars suggest that any operational definition and assessment of QOL should consider comparative judgments of one's overall life status or satisfaction. Indeed, Diener[22,23] notes that QOL or subjective well-being reflects a "cognitive judgment of satisfaction with one's life." Adopting this perspective, Rejeski and Mihalko[10] argue that QOL, in relation to physical activity and aging, needs to be considered at the level of the psychological construct. This approach permits comparative judgments, places importance on cognitive assessments, and has implications for theory testing and development.[10] As such, QOL should be defined and measured at more global levels (eg, as satisfaction with life), thereby relegating such constructs as anxiety, depression, esteem, pain, and physical function to the level of proximal QOL outcomes or psychosocial outcomes that mediate the effects of physical activity on satisfaction with life. Therefore, it would seem that measures designed to allow the respondent to decide which components of one's life are important in making judgments relative to QOL reflect best the self-referenced subjective nature of global QOL.[10,14]

## Does Physical Activity Influence QOL?

The relationship between physical activity and QOL has witnessed a considerable increase in descriptive, prospective, and clinical trials, and there exist several contemporary reviews of this literature.[10-14] In their narrative review, Rejeski and Mihalko[10] update an earlier review,[16] organize their review relative to studies examining the multidimensional or umbrella definitions and measures of QOL, and offer their perspective on possible moderator and mediator variables that might explain the physical activity and QOL relationship in older adults. Rejeski and Mihalko conclude that the physical activity and QOL relationship is positive and is consistent across subgroups, activity settings, and activity mode, despite an array of measures being used to assess multidimensional QOL. Netz et al[11] confirm these conclusions relative to psychological

**Figure 1**

A Conceptual Model of the Physical Activity and Quality of Life Relationship




Note: Value or importance is considered a moderator of physical activity and quality of life outcomes.

well-being in a quantitative manner using meta-analysis. They note that regardless of how one measures the construct (including QOL and HRQL assessments) there is a significant positive association with physical activity across all studies. Although the association is small, Netz and colleagues note that physical activity interventions demonstrated significantly improved well-being from pretest to posttest, whereas control conditions did not change.

Of course, it is important from an implementation perspective to determine which factors may moderate or mediate the relationship between physical activity and QOL. Consistent associations have been reported between physical activity and self-related constructs such as self-efficacy and positive feeling states[24-26] and self-esteem,[27,28] and Rejeski and Mihalko[10] propose that such constructs may be important mediators between physical activity and QOL (satisfaction with life) in older adults. Others suggest that this mediation may be more complex, with physical activity effects on QOL working through self-efficacy and health status.[8] Indeed, some support for such a position can be inferred from the meta-analysis by Netz et al,[11] with some of the largest treatment vs control differences being for the effects of physical activity on self-efficacy.

Comparisons of treatment and control conditions on improvements in life satisfaction reveal no significant differences, which may be best explained by the relative value that older adults place on functional abilities and on physical activity[10] (ie, improvements in physical function and efficacy resulting from physical activity participation do not influence life satisfaction directly). Instead, variables such as perceived importance of physical function may moderate any effects of physical activity on QOL. This becomes a particularly important consideration when reviewing the greater QOL literature, in which often no consideration is given to the value or importance placed on outcomes identified as related to QOL. McAuley and Elavsky[14] argue that many of these QOL outcomes are proximal outcomes of physical activity, which may act as mediating activity effects on global QOL and may be moderated by personal value systems. We discuss these issues further in our presentation of a conceptual model (Figure 1) of the physical activity and QOL relationship.

## Is There a Dose-Response Relationship for Physical Activity Effects on QOL?

Knowing the extent to which a particular dosage of physical activity brings about a meaningful change in some health outcome permits clinicians and practitioners to accurately prescribe physical activity regimens and allows governing bodies and policy makers to formulate effective recommendations for activity participation. Spirduso and Cronin[13] adopt the classification model of QOL by Stewart and King,[19] with function (physical, cognitive, fitness, disease symptoms, and self-maintenance activities) and well-being (bodily, emotional, esteem, and global) as the umbrella terms under which multiple constructs representing QOL are captured. Based on their review, Spirduso and Cronin conclude that there is little support for a dose-response relationship. However, this conclusion can be explained in 2 ways. First, given the disparate nature of QOL assessment in these studies, it is unsurprising that no clear pattern of dose-response has emerged. For example, there is some clinical evidence at the cross-sectional and descriptive level to suggest a dose-response relationship between quantifiable physical activity outcomes such as strength, muscular power, and fitness and QOL outcomes such as chair rising, stair climbing, and walking. Whereas these are functional outcomes of health importance, there is little indication that such outcomes are representative of comparative judgments of how satisfied one is with one's life. Second, the absence of any assessment of the value or level of importance that respondents placed on the QOL outcomes identified in the review by Spirduso and Cronin make it difficult to determine whether any effects of physical activity would be meaningful for QOL improvements.[14]

An alternative approach to examining the physical activity and QOL relationship was taken by Schechtman and Ory[12] from the Frailty and Injuries: Cooperative Studies of Intervention Techniques group by conducting a

preplanned meta-analysis of the QOL outcomes from 4 randomized controlled physical activity interventions. However, QOL in this case was operationalized by the subscales of the SF-36.[21] Initial analyses revealed that the different types of physical activity interventions improved only the emotional well-being component of the SF-36, with a trend toward improvement in social functioning but no changes evidenced in the general health scale. Because the interventions had no significant effect on the bodily pain scales, Schechtman and Ory[12] view this latter finding in a more positive light. That is, older frail adults (60% with arthritis) did not experience any more pain as a result of physical activity, whereas an increase in pain would have been interpreted as an adverse consequence of exercise and a decrement in QOL.

Recent reports using large representative samples further explore the physical activity and QOL relationship from a dose-response perspective and adopt current PHRs for physical activity (eg, 30 minutes of moderate activity ≥5 d/wk or 20 minutes of vigorous activity ≥3 d/wk) as a basis for defining dose of activity. Moreover, they focus on HRQL measures for assessing QOL outcomes. This classification is typically compared with those who participate in no physical activity at all and with those who are active but do not meet PHRs (ie, insufficiently active). For example, Brown and colleagues[29,30] and Abell et al[31] report a dose-response relationship using data from the 2001 Behavioral Risk Factor Surveillance System (BRFSS). In these data, QOL (or HRQL, to be accurate) was defined as the number of unhealthy mental or physical health days in the previous 30 days. In their initial report, Brown et al[29] note that those who met PHR guidelines were significantly less likely to report 14 or more unhealthy days in the last 30 days, a finding that was consistent across age, sex, and ethnic groups. Abell et al[31] made similar comparisons among 212 000 individuals in the BRFSS who reported arthritis or joint symptoms. Again, there seemed to be a substantial gradient increase in HRQL (ie, fewer mental and physical unhealthy days) among those who met moderate or vigorous PHRs.

These findings have recently been replicated in Japanese[32] and French[33] samples. Health-related HRQL was assessed using the SF-36 in the Japanese sample (n = 4018), and activity levels were categorized as inactive, light, moderate, and vigorous. Once again, a linear relationship was reported, with individuals reporting greater levels of physical activity having higher scores across all SF-36 scales, and these relationships were consistent among men and women. Similarly, Vuillemin et al[33] used the SF-36 as the primary QOL outcome among 5654 French men and women. Physical activity level was categorized as inactive, irregularly active, moderately active, or vigorously active. The latter 2 categories were classified as meeting PHRs. Although women reported lower HRQL than men, both sexes showed a positive and linear relationship between being more active and having higher HRQL. Comparisons of those meeting PHRs and those who did not showed significantly higher levels of HRQL among those meeting PHRs.

The data from this recent series of studies are the most consistent support for a dose-response relationship in the literature. On the positive side, these studies use large representative samples, report similar relationships for multiple nationalities, and use PHRs to operationalize physical activity. They share similar weaknesses. First, they are all cross-sectional; therefore, causal statements and public policy recommendations are not possible. Second, the measures of physical activity used are of a self-report nature, although in such large samples this may be the only realistic method of collecting such data. Third, the focus is on health status measures rather than on comparative judgments of global QOL. However, as already mentioned, HRQL is not unimportant, and physical, mental, and social functioning may play crucial roles in informing overall levels of QOL.

## Physical Activity Effects on Function and Well-being

There is considerable evidence to suggest that physical activity influences several important aspects of physical and mental function, including cognitive function (eg, attention and memory processes), physical function (eg, functional performance and functional limitations and disability), and self-related psychosocial function (eg, self-efficacy and self-esteem). Because these represent important aspects of overall well-being that may be implicated in QOL determination (Figure 1), we briefly review these areas and direct the reader to the comprehensive and contemporary reviews cited for further information.

### Cognitive Function

An aspect of function that has been well established as demonstrating age-related declines is cognitive function, typically characterized by decrements in various processes, including attention and perceptual processes and aspects of memory. These declines in cognition have been identified as a major risk factor for nursing home entry[3] and for age-associated diseases such as Alzheimer dementia.[34] Consequently, development of strategies to maintain or enhance cognitive function in later life is an important public health goal. A behavioral modality that has been implicated in maintaining and enhancing multiple aspects of physical and psychological functioning across the life span is physical activity.

The evidence documenting beneficial effects of physical activity and fitness on cognitive function in human and animal models has grown considerably, as evidenced by 2 recent reviews.[35,36] Early investigations of the relationship between physical activity, fitness, and cognition, which date back at least 4 decades, generally report that higher fit individuals were able to perform more quickly and accurately on different perceptual, cognitive, and motor tasks than low-fit individuals.[37] Unfortunately, firm conclusions about the causal nature of these findings were hampered by

the cross-sectional nature of the experimental designs. Randomized clinical trials report equivocal findings relative to the effect of fitness training on the cognition of older adults.[38,39] A recent meta-analytic review of randomized controlled trials by Colcombe and Kramer[36] suggests that fitness training effects are more pronounced in aspects of cognitive function that are particularly susceptible to the ravages of aging, specifically executive control processes.[40] Such processes are typified by tasks that involve planning, scheduling, interference control, and working memory. Therefore, the results of the meta-analysis suggest that even processes that are susceptible to age-related changes seem to be amenable to physical activity intervention.

Not only do executive control functions decline with aging, but so do the brain regions that support these functions.[41] Such declines also seem to be associated with cardiorespiratory fitness levels.[42] Using high-resolution magnetic resonance imaging to assess the brain structure of older high-fit and low-fit adults, Colcombe et al[42] demonstrated that declines in tissue density were observed in both samples. However, the trajectory of this decline in cortical tissue density was moderated by fitness levels, with fitter adults showing less gray and white matter tissue loss. Results of more recent work in this area suggest that aerobically based training programs can result in improved neural functioning, as evidenced by functional magnetic resonance imaging data that indicated greater activation in cortical areas associated with effective attentional control.[43]

The examination of physical activity and cardiorespiratory fitness effects on brain structure and function in animals and humans is an increasingly "hot" area of inquiry, and there is accumulating evidence for the efficacious role played by physical activity and fitness in the maintenance of cognitive health. However, little evidence exists to suggest a physical activity effect on QOL being potentially mediated by improvements in cognitive function. Clearly, the maintenance of cognitive function would seem to play an important role with the satisfaction and quality of our lives as we age; therefore, further study of this relationship is warranted.

## Physical Function

The aging process is often accompanied by declines in functional abilities and health status, risk factors for subsequent disability, and loss of independence. Loss of independence is likely to attenuate overall QOL. It is well established that functional limitations in older adults are important risk factors for subsequent disability and institutionalization.[44] Functional limitations are typically manifest as self-reported frequency in restrictions or difficulty in walking, lifting, or carrying, and rates of limitation in function seem to be exacerbated by sedentary behavior.[45] Keysor[6] concludes that physical activity can have a protective effect on functional limitations in the disablement process. For example, engaging in even a small amount of activity (eg, walking 1.6 km/wk) has been shown to result in a significant slowing of the functional limitation trajectory during a 6-year period.[4] Keysor and Jette[46] report that there is evidence, if somewhat inconsistent, that being involved in physical activity programs also results in improvements in important physical function performance behaviors such as walking speed, rising and transferring from a chair, and climbing stairs. Therefore, physical function performance involves a quantitative assessment of the behavioral act (eg, walking speed), whereas functional limitations are perceived restrictions in the frequency of being able to carry out these activities.

Stewart[47] argues that such improvements reflect improvements in functional performance and should precede functional limitations as a distinct step in the disablement process.[48] Therefore, physical activity influences functional limitations indirectly through functional performance. In their examination of functional limitations and functional performance, Guralnik and Ferrucci[49] underscore the importance of assessing functional limitations as a marker of risk for disability. As defined in the model by Nagi,[50] functional limitations are characteristics of the individual that are modifiable, whereas disability denotes a less transient domain. Indeed, Jyhla et al[51] noted that self-reported restrictions in walking (ie, functional limitations) and objectively measured maximal walking speed (ie, physical function performance) were independently associated with health status in a sample of older women. A recent study[8] of a large sample of older women confirms the independence of the functional performance and functional limitations and indicates that the influence of physical activity on functional limitations operates through self-efficacy and functional performance. Therefore, it would seem that the physical activity and QOL relationship must also be considered from the perspective of the possible mediating role of physical function performance and limitations.

## Self-related Psychosocial Function

Increased susceptibility to chronic conditions and to functional declines with advancing age often precipitates compromised emotional and psychological health, resulting in reduced QOL. Physical activity has been consistently and positively associated with several self-related psychosocial constructs, including self-esteem,[25,52] self-efficacy,[53-55] and emotion.[11] Consistent with our conceptualization of QOL as a global sense of well-being, any effects of physical activity on QOL are expected to be indirect, operating in part through self-related psychosocial constructs.

Self-efficacy is the active ingredient in the social cognitive theory by Bandura[56] and has been widely applied in the physical activity and psychological outcomes literature. Previous research has demonstrated that physical activity influences and is influenced by self-efficacy.[26,28] Self-esteem is another psychological variable that is commonly assessed in models of QOL. Similar to self-efficacy, higher levels of self-esteem have been associated with satisfaction with life,[57,58] and self-esteem has been shown to act as a determinant and as an outcome of physical activity.[25,59,60]

Finally, emotional or affective indicators of well-being have also been consistently reported to be enhanced by physical activity participation.[11,61-63] Most important, a preponderance of positive over negative affect is viewed as being an important component of overall subjective well-being[22] and has been shown to be an important correlate of long-term improvements in QOL brought about by physical activity in older adults.[28]

In the next section, we make a case for the importance of considering these 3 aspects of physical function as potential mediators of the effects of physical activity participation on QOL through their effects on health status. In addition, we argue the case for considering value or importance of physical activity and QOL outcomes as moderators of this relationship.

## Physical Activity and QOL: What Can the Practitioner Do?

The importance of physical activity as a behavioral modality for enhancing physical and psychological health cannot be underestimated. Being content and satisfied with one's life, especially as we age, would seem to be fundamentally influenced by our health status. Although there is considerable literature examining the physical activity and QOL relationship, it is perhaps premature to make consensus statements on which practical applications might be founded. However, we believe that some cautious recommendations for practitioners might be considered.

To guide these recommendations, we provide a "road map" of the pathways through which physical activity might influence QOL (Figure 1). As such, we suggest that this relationship is not direct but rather indirect, involving more proximal factors such as physical, cognitive, and self-related psychosocial function that are likely to mediate the influence of physical activities on overall mental and physical health status. These more proximal variables are also more amenable to change, making them efficacious targets for intervention. In turn, health status is seen to be the more immediate informant of global QOL. Most important, depending on the design of any single intervention, not all pathways are likely to emerge as significant.

We believe that there are several opportunities for practitioners to influence QOL outcomes. Clearly, practitioners may best serve their patients through referrals to physical activity resources and programs within the community. This recommendation stems from the multitude of benefits associated with the adoption of a physically active lifestyle. Improvements in functional health, psychological well-being, cognitive processing, and risk factors for chronic conditions are changes that are meaningful to the patient and to the physician. Indeed, it seems appropriate to rank physical activity behavior as one of the most effective and comprehensive risk factor interventions, as it addresses elements of palliative and preventive care. Unlike the traditional pharmacological intervention, which is largely physician driven, a physical activity intervention necessitates input from the patient to determine the appropriate "prescription." Incorporating elements of the individual and his or her beliefs into the health promotion strategy is expected to increase the likelihood that the patient will adopt, adhere to, and maintain the prescribed health behavior (physical activity).

We show in Figure 1 that the value or importance that older individuals place on physical activity, function, and well-being has a potentially substantial role to play in QOL outcomes. For example, consider 2 older patients. Patient 1 is an individual who places a great deal of value on his eyesight so that he may continue to enjoy books and newspapers. Patient 2 has been an active individual all of her life; however, she is now experiencing osteoarthritis in her hands and knees. Patient 2 is expected to report greater improvements in her satisfaction with life as a result of engaging in physical activity than Patient 1, as changes resulting from a physically active lifestyle are more valued by her.

Indeed, practitioners may be most effective in their efforts to target this component of the model through the provision of practitioner-led education. Although the benefits of physical activity are evident to most of the population, tailoring the mode of exercise along with the expected benefits is likely to result in greater internalization on the part of the patient. Therefore, suggesting water-based therapy to a patient with pain in the knee joints is expected to be better received than perhaps a walking program, a modality that may result in pain simply through daily activities. In addition, identifying which aspects of functioning are most important to the patient (ie, maintaining functional independence) will help the practitioner tailor activity recommendations and prescriptions to maximize preferred outcomes, thereby enhancing satisfaction with life. Moreover, such recommendations, if appropriately tailored, have implications not only for adoption, but also for maintenance of a physically active lifestyle.

We are cognizant of the increasing limitations that face practitioners in terms of resources and time spent with patients. Therefore, establishing contacts within the local community may complement these waiting room interventions and may serve as an invaluable delivery system. Implementing initiatives such as informational brochures detailing available programs in the local community or establishment of a partnership with rehabilitation and activity outlets to which patients may be directly referred are 2 further avenues to explore. Clearly, feasibility in terms of the delivery and the adherence to an intervention to promote physical activity among patients needs to be carefully considered. However, practitioners are in a unique position to positively influence individual health behavior and ultimately to influence an individual's QOL. Through the promotion of prevention, active recovery, or even attenuation of decline, practitioners are arming their patients for a happier and healthier lifestyle.

## Concluding Remarks: Physical Activity and QOL in a Public Health Context

The demography of our society will dictate that QOL will continue to be a major

public health promotion objective. The relationship between QOL and physical activity seems to be positive and consistent in older adults, but there is a need to more carefully refine our conceptualization and measurement of the QOL construct. In addition, there is a great need for determining what the moderators and mediators of this relationship might be. Identifying factors that play a role in this relationship and that are modifiable (eg, self-efficacy and function) is also important, as such factors can be targeted in future studies and interventions. There is a continued need to differentiate between intermediate and global outcomes of QOL and to ascertain that intermediate outcomes are of value and relevance to participants. Unless this is done, it becomes difficult to determine whether such outcomes truly represent QOL. Seeking and incorporating participant input into the design and implementation of a program is a strategy to more aptly target intermediate outcomes deemed relevant to the participant. Finally, we believe that practitioners have a crucial role to play in maximizing the QOL effects of physical activity.

It is clear that QOL is an important aspect of living a meaningful and fulfilling life and that physical activity interventions hold promise for influencing more proximal outcomes that may affect QOL through health status. However, verification of these relationships is necessary through large-scale randomized controlled trials and prospective studies. AJLM

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