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EVIDENCE REPORT AND EVIDENCE-BASED RECOMMENDATIONS

Exercise Programs for Older Adults: A Systematic Review and Meta-analysis

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Executive Summary

The Centers for Medicare and Medicaid Services, as part of its Healthy Aging initiative, requested an evidence-based systematic review of physical activity interventions to better assess the potential benefits of physical activity as it relates to older adults. For this report, CMS asked us to provide evidence in response to the following questions:

- What are the benefits of physical activity for seniors? What is the impact of physical activity on health status, health outcomes, functional status, quality of life, mental health and ability to maintain independence?
- How are seniors motivated to engage in physical activity?
- What is the role of family and social support?
- What is the role of the physician?
- What are barriers and how can they be reduced?
- What is known about adherence to programs?
- What are the best strategies for promoting physical activity - by public health, medical model, social services or a combination of these approaches?
- What are the key messages for seniors?
- Is there an infrastructure that promotes senior exercise—if not, what are recommendations for building the infrastructure?
- What is the range of public policy responses towards this intervention (e.g., Centers for Disease Control and Prevention (CDC), Administration on Aging (AoA) programs)? Are there any programs/benefits that could be expanded to include these additional interventions? (e.g., could senior center programs be

improved and expanded to include appropriate exercise programming?) What is the interaction between falls prevention and physical activity?

- Are different strategies needed for different cohorts (e.g., functional status levels)?
- Cost effectiveness or cost savings—does the intervention appear to reduce health care costs by reducing disease, physician office visits, hospitalizations, nursing home admissions, etc?

Methods

We conducted a systematic review and meta-analysis of controlled clinical trials of the effects of exercise on health and related outcomes for seniors. To be included, studies had to report outcomes on strength, cardiovascular fitness, physical function, or depression. Other outcomes were not reported sufficiently often to justify meta-analysis. Strength was usually measured by large muscle (knee, quadriceps) strength, while cardiovascular fitness was measured by VO_2 max. Function was measured by the Activities of Daily Living (ADL) scale, the Sickness Impact Profile (SIP), and the SF36. Depression was measured using the Beck Depression Inventory (BDI) or CES-D.

To identify existing research and potentially relevant evidence for this report we searched a variety of electronic databases including the Cochrane Library (containing both a database of systematic reviews and a controlled-trials register), Medline, HealthSTAR, Ageline, and EMBASE. We exchanged reference lists with a group at the University of Illinois which had received a grant from the Centers for Disease Control and Prevention (CDC) to prepare an evidence report on what types of physical activity have demonstrated robust health benefits among seniors and what types of strategies promote adherence in this population. In addition, RAND had many articles on hand

from a recent evidence report on the prevention of falls among older adults; exercise was one focus of that report. We also contacted experts in the field and asked for any studies that were in press or undergoing review. Finally, we combed the reference lists of all review articles. Article selection, quality assessment, and data abstraction were done in standard fashion by two trained physician reviewers working independently. Disagreements were resolved by consensus or third-party adjudication.

The research questions regarding efficacy were addressed with meta-analysis. We conducted separate meta-analyses for each of the outcomes. We included all controlled trials that assessed the effects of an intervention or interventions relative to either a group that received usual care or a control group. The majority of our outcomes were continuous and we extracted data to estimate effect sizes for these outcomes. For each pair of arms, an unbiased estimate of Hedges' g effect size and its standard deviation were calculated. A negative effect size indicates that the intervention is associated with a decrease in the outcome at follow-up as compared with the control or usual care group. Because follow-up times across studies can lead to clinical heterogeneity, we excluded from analysis any studies whose data were not collected within a specified follow-up interval chosen based on clinical knowledge.

We also conducted a stratified analysis on each outcome where it was possible. We categorized each exercise intervention as primarily endurance or primarily strength, and then pooled the effect sizes within the endurance and strength strata. (A trial with more than one intervention group could contribute to the analyses in both strata. If an intervention could not be classified as either primarily endurance or primarily strength, the trial was dropped from the stratified analysis.)

We assessed the possibility of publication bias by evaluating a funnel plot of effect sizes for asymmetry, which can result from the non-publication of small trials with negative results.

Results

Key Question #1

- What are the benefits of physical activity for seniors? What is the impact of physical activity on health status, health outcomes, functional status, quality of life, mental health, and ability to maintain independence?

We were able to conduct meta-analysis to determine effects on strength, cardio-vascular fitness, function, and depression. We identified 47 trials that reported strength outcomes, of which 32 could be included in a meta-analysis. The pooled effect size was 0.48, (95% CI: 0.29, 0.67); this is equivalent to an increase in strength of about 7 kilograms in knee extension. Considering only the interventions aimed primarily at strength, the pooled effect size was 0.66 (95% CI: 0.38, 0.94), or an increase in knee extension strength by almost 10 kilograms. Stratifying studies by the duration of the intervention, there were statistically significant pooled effect sizes for all three time strata**,** with effect sizes of 0.65 and 0.22 at 0-3 months and 3-6 months, respectively, increasing to an effect size of 0.95 at a follow-up of 6-12 months. From these data, we conclude that interventions aimed at improving strength in sedentary older adults result in statistically significant benefits as early as 1-3 months after beginning the intervention and persisting at least through 12 months.

For endurance and cardiovascular fitness, we identified 18 studies that could be included in a meta-analysis of VO_2 (max). With only two exceptions, these RCTs studied subjects at least 70 years of age. The pooled effect size of 17 studies that assessed

endurance exercise interventions was an increase of VO_2 (max) of 0.41, (95% CI; 0.23, 0.59). This effect size is equivalent to an increase in VO_2 (max) of about 10 ml/kg/m^2, meaning the average VO_2 (max) of participants after endurance training was about 30 ml/kg/m^2, or about 8.5 mets. Clinically, this means the participants could now engage without difficulty in activities such as walking upstairs, pitching softball, or general gardening that previously had been the limit of their exertion, and their new limit of exertion (8.5 mets) is equivalent to engaging in activities such as climbing hills (with a 21-42 pound load), running a 12 minute mile, or playing singles tennis.

The six studies that measured physical function using the SF36 had a pooled effect size of 0.15 (95% CI: -0.03, 0.34). For the Sickness Impact Profile, the pooled effect size of three studies was 0.08 (95% CI: -0.22, 0.38). For the outcome Activities of Daily Living (ADL), the pooled effect size of five studies was 0.40 (95% CI: -0.07, 0.87 p = 0.09). We were able to pool ten studies that reported depression outcomes. The pooled effect size was -0.21 (95% CI: -0.46, 0.04), an effect that was not statistically significant. However, the trends in effect for all these outcomes were in a beneficial direction.

Key Questions #2, #5, #6, #10

- How are seniors motivated to engage in physical activity?
- What are the best strategies for promoting physical activity – by public health, medical model, social services or a combination of these approaches?
- What is the role of the physician?
- What is the role of family and social support?

These four key questions are interrelated and will be dealt with together. The data on the efficacy of counseling by physicians or other clinicians to improve physical activity

in adults were recently reviewed for the US Preventive Services Task Force (USPSTF) by the University of Oregon. The review found that the evidence is inconclusive regarding whether counseling adults in primary care settings to increase physical activity is effective. In contrast to the mixed and modest results reported for clinician-based counseling, a review done for the Guide to Community Preventive Services was more supportive of various behavior, social, and environmental approaches to improving physical activity. Both randomized and observational studies were included in the review, which focused on all age ranges. Among the interventions assessed that were relevant to older adults, the study reported that several interventions had sufficient evidence that they are effective, including: point of decision prompts (i.e. signs placed by elevators to motivate people to use stairs); community-wide campaigns; social support interventions in community settings (i.e. setting up a "buddy" system or walking groups); individually adapted health behavior change programs, which are those tailored to the individual's readiness for change based on established health behavior change models; and the creation of or enhanced access to places for physical activity.

Key Question #3

- What are the barriers and how can they be reduced?

The previously mentioned Guide to Community Preventive Services noted substantial barriers to implementing these interventions. For example, stairways in buildings may be difficult to find or poorly lit making point of decision prompts less effective. Community-wide campaigns require careful planning and sufficient resources to implement, and individually adapted health behavior change programs also require careful planning and coordination, well-trained staff members and resources sufficient to

carry out the program. Furthermore, several recommended interventions involve policy and environmental approaches, not within the usual domain of health care.

Key Question #4

- What is known about adherence to programs?

In 1996, Dishman and Buckworth published a quantitative synthesis of 127 studies examining interventions for increasing physical activity among adults. To be included, each study had to report an amount of physical activity as an outcome or a measure of fitness that is a surrogate of amount of physical activity. The analysis suggests that large effects were associated with those interventions based on behavior modification principles delivered to healthy people in a community setting. Effects were particularly strong when the interventions were delivered to group (as opposed to individuals) and involved leisure physical activity of low intensity. They found an absence of effects for interventions using health risk appraisals or health education.

Key Question #5

- What are the best strategies for promoting physical activity – by public health, medical model, social services, or a combination of these approaches?

A combination approach that includes encouragement from public health education, exercise prescriptions from physicians, and widely publicized available programs in senior centers and other social service locations seems to have the best chance of success.

Key Question #7

- What are the key messages for seniors?

Messages should emphasize that exercise improves many aspects of health and function for seniors, including strength, cardiovascular conditioning and endurance, fall prevention, as well as mood. The choice to begin an exercise program is perhaps the most

difficult step, but that once it is begun, the benefits become apparent within a short time period.

Key Question #8

- Is there an infrastructure that promotes senior exercise? If not, what are the recommendations for building the infrastructure?

The current infrastructure for senior exercise has multiple components, but they are not well coordinated (either between or within types). Most common are the senior center programs, funded by a combination of Older American's Act federal funds, state funds, and local funds and facilities. Many Medicare HMO programs offer an exercise benefit, often through health clubs or franchised "Silver Sneakers" programs, in an attempt to recruit more health-conscious enrollees as well as to keep enrollees as healthy as possible. Formal exercise programs provide supervised exercise programs for short periods of time. Several states are attempting to overcome the poor coordination of services through statewide planning. If successful, these programs could be emulated by other states.

Key Question #9

- What is the range of public policy responses towards this intervention? Are there programs/benefits that could be expanded to include additional interventions?

The above existing programs should be encouraged to expand through greater outreach to a larger population. While few data exist on what proportion of the older population are using these programs, it is estimated as relatively small. Thus, there is much room for growth. More medically oriented programs for frailer populations should be encouraged as well, perhaps with an expanded Medicare benefit for longer-term rehabilitation-oriented exercise programs, possibly tied to specific diagnoses. The HMO

health club benefit (e.g. Silver Sneakers) could be considered as a general Medicare benefit to non-HMO Medicare enrollees.

Key Question #11

- What is the interaction between falls prevention and physical activity?

Our meta-analysis from a recent report on falls prevention showed that exercise interventions yielded a statistically significant decrease in a person's risk of falling at least once by 12% and the number of falls by 19%. While several types of exercise programs were included, there were insufficient data to identify the most effective exercises. Falls prevention programs using exercise typically included one or more of the following: cardiovascular endurance, muscular strength, flexibility, and balance. Differences in effectiveness between exercise types were not consistent and not statistically significant.

Key Question #12

- Are different strategies needed for different cohorts?

Exercise needs are different for different individuals, depending on medical conditions and baseline level of exercise and conditioning. Strategies for healthy community living individuals, who can probably be beneficially served by non-medical exercise professionals, will be very different from those for more frail or disabled individuals, who will likely need more medical supervision and tailoring. Additionally, some persons respond to social motivations more than individual motivations, so recruitment and adherence strategies should be tailored to individual psyches and readiness to change as much as possible.

Key Question #13

- Cost effectiveness vs. cost savings – does the intervention appear to reduce health care costs by reducing disease, physician office visits, hospitalization, nursing home admissions, etc.

There is very limited evidence in randomized clinical trials regarding the economic impact of physical activity programs for older adults. One study estimated it might cost more than $5,000 to move a person from sedentary to a recommended level of physical activity. (No direct health or utilization benefit was assessed in this study.) Another trial reported short-term exercise might have beneficial effects on health care use in some subgroups of older adults, although no significant health improvement was found.

Conclusions

The strongest evidence supporting a beneficial effect of exercise in older adults exists in fall reduction. Our evidence report on fall prevention indicates a physician-based intervention targeted at high risk individuals can be highly cost effective and possibly even cost savings.

There are sufficient data to conclude that exercise can modestly to moderately improve strength and cardiovascular performance among previously sedentary older people. The benefits in endurance are equivalent in a change in maximal exertion from pitching softball to playing singles tennis.

There is a trend in the appropriate direction supporting modest benefits of exercise on function and depression.

There have been no long term randomized controlled trials of exercise in older persons, therefore there is no evidence supporting or refuting any long term health effects

of exercise. The significant beneficial effects of exercise have lasted at least as long as the periods of study.

Extrapolating the results from these relatively short-term trials to a longer term could lead to conclusions qualitatively similar to the conclusion of longer term cohort studies with respect to strength, function, and mood. Thus, there is room to be optimistic about possible longer-term benefits.

The existing evidence is inconclusive regarding the efficacy of physician-based intervention to increase physical activity. The evidence is more encouraging regarding community-based interventions.