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Does Age Modify the Cost-Effectiveness of Community-Based Physical Activity Interventions?

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Abstract

Background—Community-based efforts to promote physical activity (PA) in adults have been found to be cost-effective in general, but it is unknown if this is true in middle-age specifically. Age group-specific economic evaluations could help inform the design and delivery of better and more tailored PA promotion.

Methods—A Markov model was developed to estimate the cost-effectiveness (CE) of 7 exemplar community-level interventions to promote PA recommended by the *Guide to Community Preventive Services*, over a 20-year horizon. The CE of these interventions in 25- to 64-year-old adults was compared with their CE in middle-aged adults, aged 50 to 64 years. The robustness of the results was examined through sensitivity analyses.

Results—Cost/QALY (quality-adjusted life year) of the evaluated interventions in 25- to 64-year-olds ranged from $42,456/QALY to $145,868/QALY. Interventions were more cost-effective in middle-aged adults, with CE ratios 38% to 47% lower than in 25- to 64-year-old adults. Sensitivity analyses showed greater than a 90% probability that the true CE of 4 of the 7 interventions was below $125,000/QALY in adults aged 50 to 64 years.

Conclusion—The exemplar PA promotion interventions evaluated appeared to be especially cost-effective for middle-aged adults. Prioritizing such efforts to this age group is a good use of societal resources.

Keywords

exercise; health promotion; middle-age; economics

Lack of regular physical activity (PA) is a major preventable cause of chronic disease and premature mortality.[1] Based on systematic reviews of research, the *Guide to Community*

Preventive Services (or the *Community Guide*) strongly recommends 5 community-level strategies to promote PA.[2,3] These strategies include community-wide campaigns, individually-adapted behavior change programs, and enhanced access to recreational facilities and other places for PA.

While many factors influence whether recommended strategies are implemented in a community, the cost-effectiveness of a particular intervention within a given strategy is an important consideration. Information on cost-effectiveness of *Community Guide* interventions is limited,[4] including information on how cost-effectiveness varies by population subgroup. If funds for a programmatic approach (eg, the diabetes prevention program[5]) or community campaign were limited, one could consider tailoring interventions to age groups where they are most cost-effective. This would reduce the development and implementation costs of a particular approach, and could help target scarce resources toward the most appropriate PA promotion effort for the age group that stands to benefit most (eg, simple walking trails for middle-aged adults versus multiuse sporting complexes which must accommodate a broad range of physical activity opportunities across the age spectrum).

One population subgroup of interest is the "baby boomer" generation, which was born between 1945 and 1964, and is now entering late middle and old age in large numbers. In the largest group ever to become older adults, to what extent can prevention efforts reduce the burden on the health care system and improve quality of life?

Recently, a Markov simulation model, the Centers for Disease Control (CDC) Measurement of the Value of Exercise (MOVE) model, was developed to measure the cost-effectiveness of 7 exemplar PA interventions, representative of 4 of the 5 "strongly recommended" *Community Guide* strategies for community-based promotion of PA in adults (ie, community-wide campaigns, individually-adapted health behavior change, social support interventions in community settings, and creation of or enhanced access to places for PA combined with informational outreach activities).[5–12] That cost-effectiveness analysis estimated the societal costs, health gains, and cost-effectiveness of these interventions among adults aged 25 to 64 years, across a 40-year time-horizon.[12]

Using the MOVE model, this current study aimed to: (1) estimate cost-effectiveness of these same exemplars over a shorter, 20-year time horizon across 2 age cohorts, middle-aged adults (adults age 50 to 64) and all adults aged 25 to 64 years; and (2) to determine the sensitivity of the model's cost-effectiveness calculations to the parameter estimates under evaluation. By comparing cost-effectiveness of public health interventions to promote PA in adults aged 50 to 64 years to that of adults aged 25 to 64 years, we sought to provide insight on how cost-effectiveness might vary across these age cohorts.

Methods

In this study, the MOVE model,[12] which is visually represented in Figure 1, was used to estimate the cost-effectiveness of the aforementioned 7 exemplar interventions over a 20-year time horizon, under 2 different scenarios. In the first scenario, we applied the interventions to a closed cohort, the size of the US adult population, aged 25 to 64 years, in

2004. In the second scenario, we applied the interventions only to the older members of this cohort, aged 50 to 64 years. A 20-year time horizon was chosen for this study to more accurately reflect health issues over the expected life span of this older population subset. Below we summarize the model simulations, the data upon which the model relies, and the methods used to calculate cost-effectiveness. A more detailed description of the model is provided in the previous study,[12] and a methodological technical appendix is available upon request.

Center for Disease Control Measurement of the Value of Exercise Model

All simulations were based on a cohort the size of the US population aged 25 to 64 years of age in 2004. At the start of the simulation, we assumed that all cohort members were healthy, which we defined as the absence of 5 modeled diseases: type 2 diabetes, coronary heart disease, ischemic stroke, breast cancer, and colorectal cancer. This approach is conservative, because it considers only the preventive benefits of activity. In practice, community-level interventions reach adults with chronic diseases such as diabetes and heart disease. There are well-documented therapeutic effects of PA in many chronic diseases,[13] and ignoring such benefits reduces the estimated cost-effectiveness estimates. The cohort, the size of the adult US population in 2004, was stratified by age, sex, and level of physical activity, using US Census Bureau and 2003 BRFSS data.[14,15] At the start of the simulation, all cohort members were assumed healthy.

The model then simulated how physical activity levels changed over the course of 20 years, and simulated the effects of these changes on incidence of the 5 diseases, quality of life, and mortality. The MOVE model incorporated data on how interventions moved cohort members across physical activity levels, and also incorporated data that specified how PA levels changed over time, in the absence of intervention (the “natural history model”).

In the first scenario, all cohort members, aged 25 to 64 years, were simulated to receive the exemplar interventions for 1 year, immediately upon entry into the model. Each cohort member had an intervention-specific probability of improving their level of PA. The effect of no intervention was also simulated. In the second scenario, the exemplar interventions were only applied to those adults 50 to 64 years of age, while the change in PA levels at 1 year for adults aged 25 to 49 years was determined using the natural history model.

The CDC MOVE model in this study retained parameter estimates used in the original study.[12] After the first year (ie, for the next 19 years), in each scenario, cohort members had an annual probability of either remaining at the same physical activity level or moving to a lower activity level, as it was conservatively assumed that the impact of an intervention would decline after the intervention had ended. For all of the interventions, with the exception of the enhanced access intervention, a 50% decline in physical activity in year 2 was modeled. For the enhanced access study, a 33% decline was modeled in this second year, because the environmental enhancements persisted long after the intervention had ended.

Following this assumed substantial decline (33% to 50%) in physical activity postintervention in year 2, cohort members were transitioned into a natural-history model, which modeled the general decline in physical activity that occurs with age. Thus each year participants faced sex- and age-specific probabilities of moving to a lower level or remaining at the same physical activity level. Among the healthy, the risk of developing one of the 5 diseases depended on activity level, age, and sex. The risk of death depended on age, sex, and disease status.

Data Sources

Population Demographics and Physical Activity Levels—We obtained data on age and sex distributions of the US population from the US Census Bureau.[15] Based upon public health PA recommendations[2] in place at the time of the study, CDC classifies adults into 1 of 3 levels of PA (inactive, irregularly active, meets public health recommendations). This study used 4 levels of PA by dividing the “meets public health recommendations” group into “sufficiently active” and “highly active”. We obtained data on the distribution of physical activity levels by sex and age from the 2003 BRFSS (Behavioral Risk Factor Surveillance System).[14] While there are more recent BRFSS data on PA levels, the 2003 data are used for comparability with the previous study’s methods, and because despite modest improvements in some PA population indicators like walking,[16] there have been no major shifts in PA levels of the US population.

Disease Risk—To estimate the annual probability of developing each disease, we combined population-based disease-specific incidence data[17–22] with relative risks derived from epidemiologic studies, specific for PA level and disease.[23–25]

Mortality Risk—The annual probability of death was estimated for both healthy individuals, and for individuals in the simulation who developed one of the 5 diseases. The probability of death was estimated for each age (5-year age group) and sex subgroup. In addition to disease-specific prevalence data,[26–30] data from 2002 National Vital Statistics Reports were used to estimate the annual probability of death in people with coronary heart disease (CHD), ischemic stroke, or type 2 diabetes, while the SEER database was used to estimate annual probability of death from breast or colon cancers.[31–34]

To estimate the annual probability of death for healthy individuals, available mortality data[35] excluding disease-specific death rates for the 5 modeled diseases, were adjusted for age group and sex.

Quality of Life—Quality of life (QOL) data were obtained for all disease and activity states from new analyses of the 2001 National Health Interview Survey, using previously validated scales for Quality of Well Being (QWB) widely used for assessing health-related quality of life.[36–39] We performed multiple regressions to estimate QOL as a function of age, sex, disease, and PA level.

Intervention Effectiveness and Costs—Data on the effectiveness of the 7 exemplar interventions was ascertained from published reports.[5–11] To determine all associated costs, the published protocols of each study were thoroughly reviewed to identify the components of each intervention. Tallied costs included material and intervention delivery costs, out-of-pocket expenses, participant time costs, and where applicable, costs associated with developing and maintaining the infrastructural components of an intervention. When possible, cost data for intervention components was obtained through direct communication with authors of the published reports.

To derive direct medical cost estimates, we used a longitudinal medical claims database[40] and analyzed claims for the 5 disease states by ICD-9 codes. An annual medical inflation factor of 8% was applied,[41] and the costs were discounted back to the present at 3% per year.[42] It should be noted that this discounting strategy may tend to subtly favor PA promotion and disease prevention in older cohorts, because of the longer period of discounting of medical costs in younger cohorts. However, health benefits were also discounted to balance this discounting phenomenon. To improve their national representativeness, medical claims data were then adjusted using Medical Expenditure Panel Survey data.[43] From these costs, we calculated the effective annual cost for each of the diseases over 20 years.

Modeling the Effect of Interventions

We characterized the 4 PA levels (inactive, irregularly active, sufficiently active, and highly active) in terms of a range of MET-minutes per week using BRFSS data (MET-minutes estimate the energy expended on PA, based upon the intensity, duration, and frequency of PA, and are used as a measure of total PA per week).[14] The effect size of each intervention was converted into an increase in MET-minutes per week. To estimate the probability of moving to a higher PA level after intervention, we added intervention-specific MET-minutes per week to the current level, and noted the proportion of the cohort that moved from one level of PA to another as a result of an intervention. This proportion was then used as our transition probability. For example, if adding a certain number of MET-minutes per week to all persons in the inactive group caused 25% of them to move up to the irregularly active group, we estimated the probability of moving from inactive to irregularly active as 0.25 in the first year following the intervention. For the analysis focusing on the middle-aged cohort, we applied the increase in MET-minutes and intervention costs only to cohort members 50 to 64 years of age. The intervention effect size was assumed constant across age groups, but sex-specific.

We modeled a substantial decline (33% to 50%) in intervention effect following the 1-year intervention, based on limited data available on long-term maintenance of PA resulting from interventions.[44–46] Following this decline, further changes in activity levels over time were determined by the natural history model.[47–49] That is, for each year except the first, individuals were assigned sex- and age-specific probabilities of either moving to a lower PA level or remaining at the same level.

Estimating Cost-Effectiveness

In both groups of simulations, we estimated the cost-effectiveness of each intervention as cost divided by quality-adjusted life year (cost/QALY), using methods consistent with the guidelines established by the Panel on Cost-Effectiveness in Health and Medicine.[42] Over a 20-year time horizon, the MOVE model was used to project costs, gains in life-years (survival), and gains in QALYs associated with each intervention, as well as with no intervention (natural history). Consistent with the panel's recommendations, the societal perspective was adopted, and future costs and benefits were discounted to the present at an annual rate of 3%.[42] Under each scenario, the performance of each intervention compared with no intervention was assessed using a ratio of the additional expected cost of each program divided by additional expected QALYs gained relative to the no intervention alternative. In addition, the number of cases of disease prevented was also estimated.

To determine the robustness of the final results, we conducted probabilistic sensitivity analyses, with particular emphasis placed on intervention effect size and cost estimates.

Sensitivity Analyses

To assess the impact of uncertain intervention cost and effect size parameter estimates on uncertainty in cost-effectiveness, we performed a probabilistic sensitivity analysis. When running such an analysis, we obtained not just a single cost-effectiveness ratio for each intervention, but a distribution of ratios reflecting joint parameter uncertainty of its cost and effectiveness.

Using the distributions from this analysis, we assessed the probability that the cost-effectiveness of each intervention was below various thresholds that are commonly used to determine whether interventions provide good value for money.

Results

Average Cost-Effectiveness

Tables 1 and 2 summarize the average costs, effectiveness, and cost-effectiveness ratios associated with a one-time application of each PA promotion intervention, relative to no intervention. Results are cumulative over a 20-year time horizon, but average per person values are reported in both tables.

In the first scenario (Table 1), interventions were applied to the entire cohort of adults aged 25 to 64 years, and compared with no intervention. With no intervention, the average discounted quality-adjusted life expectancy (total QALY) was predicted as 11.18 years, and 20-year cumulative costs were estimated at about $61,100. Intervention participation increased average total QALY by 0.008 to 0.063 QALYs (Table 1), or equivalently, intervention participation improved average healthy life expectancy by 0.42 to 3.28 weeks. Cost-effectiveness ratios ranged between ~$42,000 and ~$146,000 per QALY gained. The Lombard social support intervention[9] was estimated as the most effective, with the largest gain in QALYs (0.063), compared with no intervention. The Reger community-wide campaign[10] was estimated as the most cost-effective (about $42,500/QALY).

In the second scenario (Table 2), interventions were applied only to persons aged 50 to 64 years, and compared with no intervention. Intervention participation improved average QALYs by 0.003 to 0.024, which is equivalent to 0.16 to 1.25 weeks. Cost/QALY in middle-aged adults (age 50 to 64 years) were 38% to 47% lower depending upon the intervention, and ranged from ~$34,000 and ~$127,000 per QALY gained. That is, for each intervention, the cost-effectiveness was better when it was applied only to adults age 50 to 64.

All interventions reduced disease incidence in the simulations. The reductions ranged from 3 to 20 cases per 100,000 for colon cancer and from 55 to 420 cases per 100,000 for CHD.

Sensitivity Analyses

Results from the probabilistic sensitivity analysis for the middle-aged cohort are shown in the acceptability curves in Figure 2. For example, there is about a 40% chance that the cost/QALY of the young intervention[11] is less than $50,000 per QALY (a traditionally used benchmark of cost-effectiveness), and virtually a 100% chance that it is below the more contemporary threshold of $200,000/QALY.[50] A review of several studies found that the median estimate of willingness to pay for gains in quality of life was $265,345 per QALY.[50] That is, despite model parameter and resultant cost/QALY ratio uncertainties, it is almost certain that this intervention is an acceptable use of societal resources.

Discussion

The results of the study suggest that 7 exemplar interventions have acceptable cost-effectiveness when applied to middle-aged adults (age 50 to 64 years). The MOVE model estimated cost-effectiveness ratios between ~$33,600/QALY and ~$127,400/QALY for the 7 interventions. Cost-effectiveness ratios in this range imply good value for money, or an acceptable use of societal resources and are typical of many well-accepted and widely-implemented health interventions.[51–54] The conclusion of acceptable cost-effectiveness was supported by the sensitivity analysis, especially for the 4 interventions with the lowest cost/QALY ratios in middle-aged adults. The cost-effectiveness estimates were for a 20-year time horizon, and so they differ from the estimates in the previous study, which used a 40-year time horizon.[12] Together, the 2 studies suggest that community-level interventions to promote PA have acceptable cost-effectiveness over both a 20-year period and a 40-year period.

The exemplar interventions were more cost-effective when applied only to middle-aged adults than when applied to the larger population of adults aged 25 to 64 years. Depending upon the intervention, the cost-effectiveness ratios were 38% to 47% lower in middle-aged adults. As the Markov model does not provide standard errors for the cost-effectiveness estimates, we did not use statistical tests to determine if the cost-effectiveness ratios were significantly lower in middle-aged adults. Rather, to establish the robustness of our results, we conducted sensitivity analyses (Figure 2) that essentially showed that the lower the cost/QALY point estimates from the Markov model, the higher the probabilities that the true cost-effectiveness ratios were in the acceptable range. That is, over a 20-year time horizon, the results of this study indicate that although all interventions were cost-effective in both scenarios, there was a higher probability that they were cost-effective in the middle-aged subgroup.

What might account for better cost-effectiveness ratios in middle-aged adults? The cost-effectiveness estimates from the Markov model are most sensitive to intervention cost and to intervention effect size, but the model used the same cost and effect size for all age groups. However, with population-wide interventions, the absolute risk of a disease affects the cost-effectiveness of an intervention which prevents the disease; the higher the disease risk, the better the cost-effectiveness. Middle-aged adults have a higher risk of the 5 diseases in the MOVE model, so for this reason it is not surprising that the cost-effectiveness is better in middle-aged adults.

Several community interventions have successfully targeted specific age groups. AARP conducted a community-wide campaign, which targeted older adults.[55] The Wheeling Walks community-wide campaign targeted middle-aged adults, as well as older adults—an age group for which walking is the main form of activity.[10] The Active for Life program successfully translated individually-adapted behavior change interventions just for older adults.[56] The Environmental Protection Agency offers an award program for community design which promotes physical activity in older adults.[57] Of course, with some interventions, it is more difficult to target a specific age group. If a community created a new park, there would be many societal benefits for all citizens to enjoy. However, facilities within a park might target a specific age group. For example, while playgrounds generally would attract children, easy walking trails would likely attract more middle-aged and older adults.

The previous report on the MOVE model discussed several of its limitations,[12] such as the model having made several assumptions because the data necessary to include a proposed component in the model were not always available. Additional issues arise when the model is used to compare cost-effectiveness between 2 different scenarios. First, the model does not take into account a person’s PA history, because of insufficient information on how lifetime PA affects disease risk. A person who is sedentary until 50 years of age and then becomes regularly active is assigned the same health benefit due to activity as a person who is sedentary until 25 years of age and is regularly active thereafter. This feature of the model may make interventions in younger adults appear less cost-effective than they actually are. Second, the MOVE model does not currently take into account therapeutic benefits of activity in persons with chronic disease, which would tend to increase the benefits of PA in older populations with more chronic disease. Third, as noted above, the study presumes that the 7 interventions can be implemented in a manner so as to reach only certain age groups, which may lead to more conservative estimates of cost-effectiveness. Fourth, due to incomplete data on age-specific response rates to PA promotion, these rates are considered to be constant across age and initial PA level-specific groups. More research is required to determine how middle-aged adults respond to PA promotion efforts, and how durable these responses are. We attempt to account for the present uncertainty about these age-specific PA behaviors in sensitivity analyses, which demonstrate cost-effectiveness across a broad range of response rates. Fifth, due to limited data on ethnicity-specific disease outcomes, PA, and intervention effects, it is not possible to extend the model to assess the cost-effectiveness of interventions in subpopulations by ethnicity. It remains a priority for future PA promotion research to evaluate and address specific societal determinants of health to achieve the greatest benefits in vulnerable populations. Finally, the model focuses only on health benefits and does not include potential corollary benefits of increasing physical activity among older adults such as enhanced social interaction, cognitive function, greater mobility, and independence, not to mention the positive ripple effects extending to communities with some targeted enhanced-access opportunities. Thus, we believe that this analysis underestimates the overall benefits and cost-effectiveness of interventions to increase physical activity in older adults.

As health care expenditures continue to increase faster than inflation, policymakers are increasingly interested in prevention and in promoting overall health of communities. We believe the MOVE model is of importance to stakeholders in community health. The simulations suggest community-level, population-based approaches to promoting PA are cost-effective. The simulations quantify how much cost-effectiveness is improved by focusing interventions on middle-aged adults at higher risk for disease. It is important and justifiable to promote PA in all age groups. As the science of PA promotion advances, and newer and more effective interventions emerge along with new strategies to combine the best PA promotion strategies, cost-effectiveness of PA promotion will undoubtedly continue to evolve. However, given the current PA recommendations and finite resources, if the objective is to cost-effectively reduce relatively short-term disease risks, it may be appropriate to emphasize promotion of PA in older age groups. In particular, the middle-aged "baby boomer" generation will soon become the older adults group (aged 65 years and older) in great numbers. Preventive interventions in this age group could substantially delay health care costs due to age-related diseases.

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The principal investigator of this study, Larissa Roux, had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

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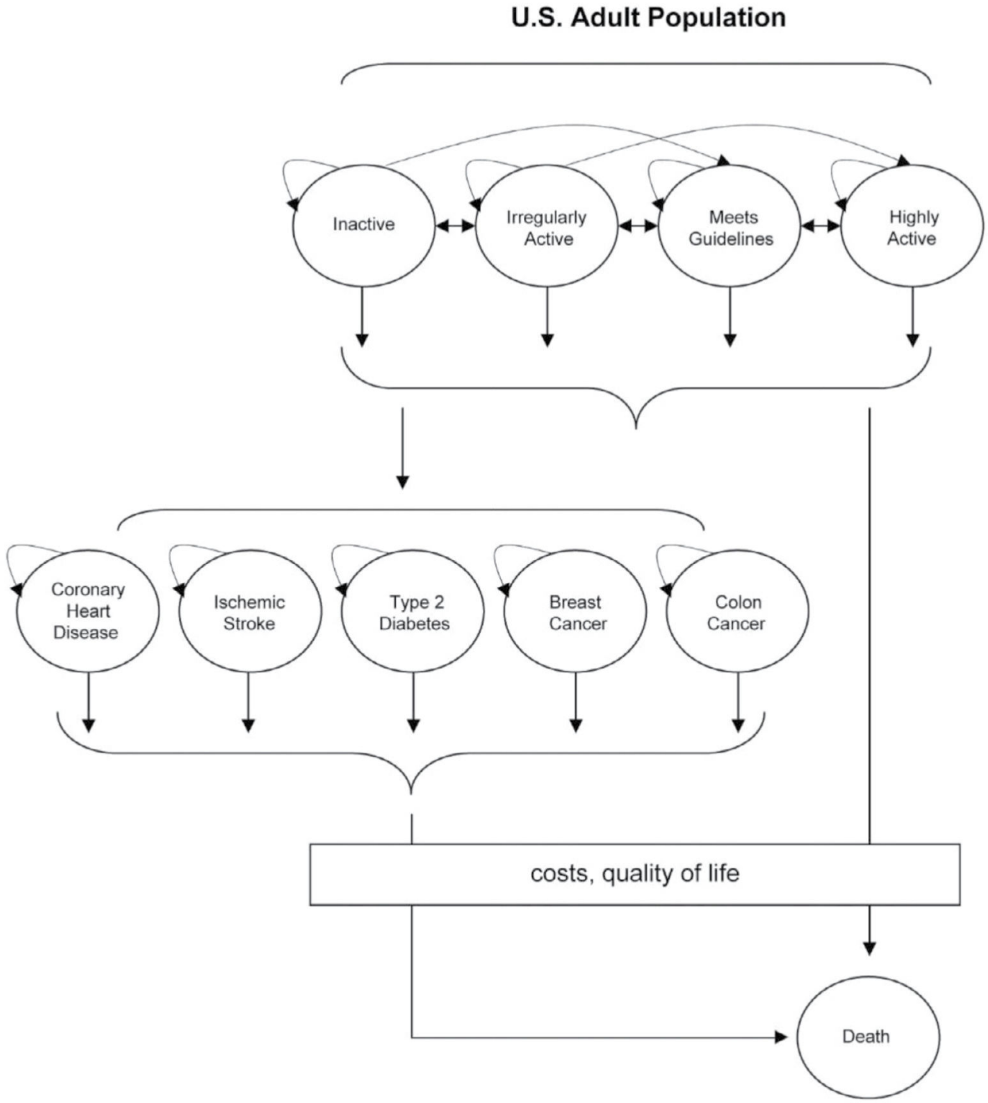

Figure 1 —.

Conceptual overview of the Center for Disease Control Measurement of the Value of Exercise (MOVE) model. The illustration of our 10-state Markov process is represented as a state-transition diagram. In this process, circles represent possible health states, and arrows represent allowed transitions between these discrete health states. In each cycle of the Markov model, transition probabilities denote the likelihood with which people within a particular health state will stay in that state (represented by the tight curvilinear arrows to and from a single circle), transition to a new health state, or die. Death is an absorbing state from which no future transitions are possible. The output from the Markov process is depicted by the box, a running tally of the total costs and quality of life benefits generated during each cycle as a result of being in a series of health states over time.

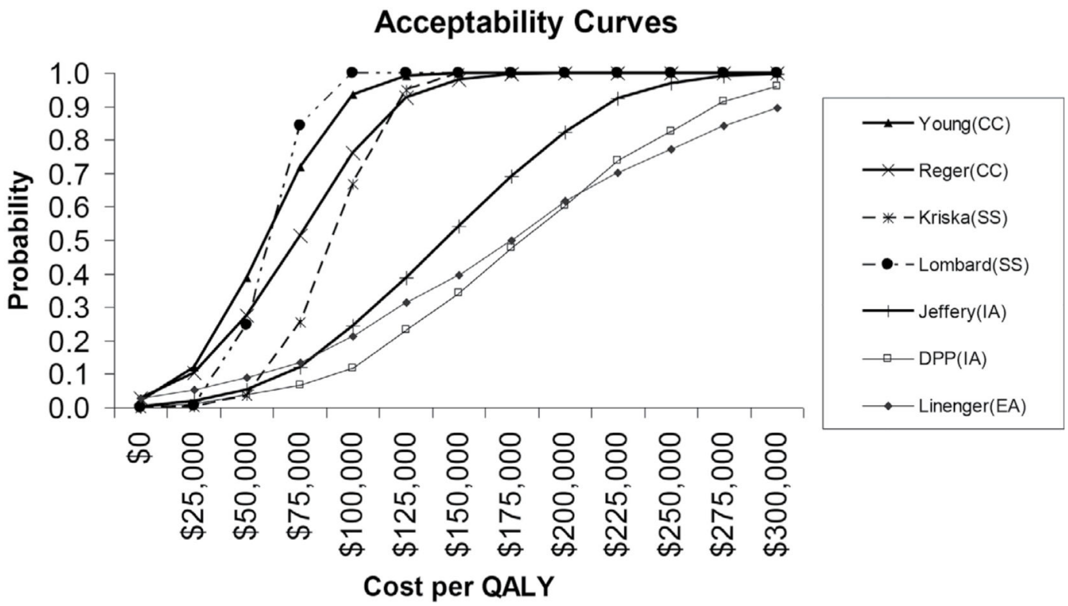

Figure 2 —.

Results from probabilistic sensitivity analyses for the middle-aged cohort (50–64 years). Acceptability curves represent variation of intervention costs and effect sizes. The schematic of curves depicts the probability with which an intervention (despite uncertainties in its associated cost and effect estimates) is deemed an acceptable use of societal resources, on the basis of its cost per quality-adjusted life year (QALY) ratio being less than a given dollar amount. Studies: Young et al[11], Reger et al[10], Kriska et al[7], Lombard et al[9], Jeffery et al[6], Knowler et al[5] (Diabetes prevention program [DPP]), Linenger et al[8]. CC = community-wide campaign; SS = social support; IA = individually-adapted; EA = enhanced access.

Table 1

Cost-Effectiveness of Each Intervention Compared With No Intervention in All Adults (25–64 Years) at 20 Years

Exemplar Study	Intervention Strategy	Total cost, 2003 $US	Total life years	Total QALY	Incremental cost ($)	Incremental life years	Incremental QALY	Cost/LY ($/LY)	Cost/QALY ($/QALY)
	No intervention	61,092	14,389	11.182	—	—	—	—	—
Reger et al[10]	Community-wide campaign	62,292	14,397	11.210	1,200	0.009	0.028	136,341	42,546
Lombard et al[9]	Social support	64,794	14,408	11.244	3,702	0.020	0.063	186,980	59,235
Linenger et al[8]	Enhanced access	62,087	14,393	11.197	995	0.005	0.015	211,787	65,921
Jeffery et al[6]	Individually-adapted health behavior	63,695	14,400	11.218	2,603	0.011	0.037	232,393	71,115
Kriska et al[7]	Social support	62,671	14,394	11.199	1,580	0.005	0.018	298,019	89,744
Knowler et al[5] (DPP)	Individually-adapted health behavior	64,395	14,399	11.215	3,303	0.010	0.033	317,596	99,789
Young et al[11]	Community-wide campaign	62,200	14,391	11.189	1,109	0.002	0.008	461,917	145,868

Note. QALY = quality-adjusted life year; LY = life year; DPP = diabetes prevention program. Values in Table 1 are rounded to no more than 3 decimal places Future cumulative costs and benefits over a 20-year time horizon are reported in table as discounted, average, per person costs, and QALYs.

Table 2

Cost-Effectiveness of Each Intervention Compared With No Intervention in Middle-Aged Adults (50–64 Years) at 20 Years

Exemplar Study	Intervention Strategy	Total cost, 2003 $US	Total life years	Total QALY	Incremental cost ($)	Incremental life years	Incremental QALY	Cost/LY ($/LY)	Cost/QALY ($/QALY)
	No intervention	61,092	14.389	11.182	—	—	—	—	—
Reger et al[10]	Community-wide campaign	61,455	14.394	11.192	363	0.006	0.011	63,737	33,639
Lombard et al[9]	Social support	61,410	14.392	11.187	318	0.003	0.006	105,967	56,768
Linenger et al[8]	Enhanced access	62,243	14.401	11.206	1,151	0.013	0.024	89,217	47,954
Jeffery et al[6]	Individually adapted health behavior	61,916	14.396	11.195	825	0.007	0.014	112,973	59,331
Kriska et al[7]	Social support	61,607	14.392	11.188	515	0.003	0.007	151,500	79,246
Knowler et al[5] (DPP)	Individually-adapted health behavior	62,141	14.395	11.194	1,050	0.007	0.013	156,657	82,646
Young et al[11]	Community-wide campaign	61,449	14.390	11.184	357	0.002	0.003	237,933	127,464

Note. QALY = quality-adjusted life year; LY = life year; DPP = diabetes prevention program. Values in Table 2 are rounded to no more than 3 decimal places. Future cumulative costs and benefits over a 20-year time horizon are reported in table as discounted, average, per person costs, and QALYs.