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Gait Speed as a Guide for Blood Pressure Targets in Older Adults: A Modeling Study

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Abstract

Background/Objectives—The optimal target systolic blood pressure (SBP) in older adults is uncertain; we evaluated the potential for gait speed to inform decision-making in this population.

Design—Forecasting study from 2014–2023 using the Cardiovascular Disease Policy Model, a Markov model.

Setting—U.S. adults, aged 60–94 years.

Participants—The population was stratified into fast walking, slow walking, and poor functioning (non-completers), based on measured gait speed in the National Health and Nutrition Examination Survey.

Intervention—We modeled lowering SBP to a target of 140 or 150 mmHg. We projected increased non-cardiovascular deaths in the slow walking and poor functioning, based on clinical trials and observational studies.

Measurements—Myocardial infarctions (MIs), strokes, deaths, cost, and disability-adjusted life years (DALYs).

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Results—Regardless of gait speed, secondary prevention to a SBP of 140 mmHg is projected to prevent events and save money compared with 150 mmHg. Similarly, primary prevention to 140 mmHg in fast walking adults is projected to prevent events and save money. In slow walking adults, primary prevention to 150 mmHg is projected to prevent MIs and strokes and save DALYs, but is cost-saving only in men; intensification to 140 mmHg is of uncertain benefit in the slow walking. Primary prevention in poor functioning adults to either a target of 140 or 150 mmHg SBP is projected to decrease DALYs.

Conclusion—The most cost-effective SBP target varies by history of cardiovascular disease and gait speed among persons ages 60–94 years. Our projections highlight the need for improved estimates of the benefits and harms of antihypertensive medications among a diverse group of older adults, as the net benefit is sensitive to the characteristics of the population treated.

Keywords

Markov model; cost-benefit analysis; blood pressure; frailty; gait speed

INTRODUCTION

The most recent report from the members appointed to the Eighth Joint National Committee (JNC 8) recommended raising the target systolic blood pressure (SBP) from 140 to 150 mmHg in adults age 60 and older without diabetes or kidney disease. This change from the previous guideline was based on limited randomized controlled trial evidence for the benefits of lower SBP values, and concern about increased harms.(1) Some have questioned this recommendation because a higher treatment target may result in a lost opportunity to prevent cardiovascular disease (CVD) events in this population at higher absolute risk of cardiovascular disease.(2) In contrast, others have expressed concern that the overtreatment of BP in older adults would increase subsequent adverse events. (3)

Evidence on the balance of benefits and harms caused by lowering BP in older adults is mixed, and uncertainty is most pronounced for all-cause mortality. Although lowering BP results in CVD benefit in older adults included in trials, its effects on all-cause mortality have been variable.(4) Furthermore, some observational studies suggest an association of higher BP levels with lower mortality. (5–8)

Although advanced chronologic age has long been used to target higher-risk populations for CVD prevention, older adults comprise a heterogeneous population, and any given age cohort consists of a mixture of people who are successfully aging and those who are nearing death.(9) A standardized assessment of frailty can provide additional information on health status beyond chronologic age,(10, 11) and gait speed is an easily assessed proxy for frailty. (12–14) We have previously demonstrated that reduced gait speed or limitations in activities of daily living can stratify elders into those in whom higher BP is associated an increased risk of mortality and those for whom higher BP is associated with a lower risk of death.(15–17)

In this study, we used the Cardiovascular Disease Policy Model (CVDPM) – a population-based Markov model of U.S. adults - to project the hypothetical impact of gait speed on the

population health benefit and cost-effectiveness of lowering SBP to two different targets, 150 mm Hg or 140 mm Hg, in community-dwelling adults aged 60 years and older.

METHODS

The Model

The Cardiovascular Disease Policy Model (CVDPM) is a state-transition (Markov) model of the incidence, prevalence, mortality, and cost of coronary heart disease and stroke in U.S. adults aged 35 to 94 years (see appendix); the Model has an annual cycle.(18) Additional details regarding the most recent version of the model have been published previously.(19) The present study was limited to adults aged 60–94 years.

Simulation Inputs

Performance on a 20-ft gait speed test was used as a surrogate marker for frailty, as described previously (Table 1).(16) This measure was included in the National Health and Nutrition Examination Survey (NHANES) years 1999–2002, and participants were classified as “fast walking” if their usual gait speed was ≥0.8 m/s, “slow walking” if their usual gait speed was <0.8 m/s, and “poor functioning” if they did not complete the timed gait speed test. These categories have been shown to correlate well with health status and risk of mortality.(16)

We estimated the effect of each medication on change in SBP based on a meta-analysis of randomized trials (Table 1).(20) We modeled equivalent SBP lowering across classes when comparing standard doses, and projected each standard dose had an effect on SBP equivalent to (9.1 + 0.10*[SBP-154]) where SBP is the level prior to adding the dose.(20, 21) We assumed that multiple doses would be required to reach the target SBP in some patients, but reductions from successively added agents were based on the lower SBP resulting from prior drugs.(20)

We modeled the effect of SBP lowering on coronary and stroke outcomes based on a large meta-analysis of randomized trials (Table 1). (21, 22) The effect of SBP lowering on non-CVD death (defined as non-coronary and non-stroke death) is uncertain in the 60 years and older population. In the Systolic Hypertension in the Elderly Program, there was a small, and non-statistically significant adverse effect of BP lowering on non-CVD mortality (hazard ratio [HR]: 1.05, 95% 0.80, 1.38). In a meta-analysis of randomized controlled trials in participants age 80 and older, BP treatment also was associated with a non-statistically significant increased relative risk of 1.06 on total mortality (95% CI: 0.89, 1.25); the effect on non-CVD mortality was not reported. Because no frailty-stratified trial estimates for the effect of BP lowering are available, we estimated the association between SBP and non-CVD mortality based on competing risk regression in NHANES (Table 1). Notably, the overall relative risk of total mortality estimated from this observational data analysis in the 80 and older adults was further in the protective direction compared with the clinical trials meta-analysis estimate, suggesting our estimates are conservative. (Appendix)

BP lowering costs included antihypertensive medications, monitoring of treatment effects, and the cost of monitoring and treatment side effects. Consistent with trial-based

effectiveness inputs, we used a 75% medication adherence rate based on clinical trial data.(21) Medication costs were averages of lowest "Redbook" 2010 average wholesale prices for numbers of standard doses across drug classes, using combination pills when available.(23) Rates of adverse events from medication side effects were based on a meta-analysis of treatment trials for more common events (20) and post-marketing reports for rarer events. Adverse event rates ranged from mild symptoms, amenable to outpatient management, to death; and non-fatal adverse events were translated into quality of life impairments and added costs. All disability weights associated with coronary and stroke event states were based on the Global Burden of Disease Study.(24)

The value of BP lowering in older adults was assessed by dividing incremental changes in costs by incremental changes in disability-adjusted life years (DALYs). An intervention was defined to be of high value if the cost to extend one DALY was less than $50,000, intermediate value if the cost was $50,000 to less than $150,000, and low value if the cost were greater than or equal to $150,000.(25)

Simulations

We assessed the costs and effectiveness of interventions from 2014 through 2023 from the health care system perspective. Costs and DALYs were discounted at 3%/year. Younger persons were not allowed to age into this cohort, so that the only changes in the size of the population were due to mortality. We did not model outcomes among the few survivors who reached age 95 years because of insufficient data; those who achieved this age did not accrue further costs or events in our model. We modeled the impact of treatment to two targets, 150 mmHg and 140 mmHg, for secondary and primary prevention. We stratified the population based on age (60–74 and 75–94 years), sex, and gait speed (fast walking, slow walking, poor functioning).

Since controversy exists as to whether adults aged 60 and older gain the same benefit from SBP lowering in the range below 150 mmHg as in the SBP range above 150 mmHg, one-way sensitivity analyses were conducted assuming one-half and one-quarter the relative risk reduction of lowering SBP to below 140 mmHg compared with lowering it to below 150 mmHg. We also completed a one-way sensitivity analysis assuming median "Redbook" costs of antihypertensive medications. Additionally, we used two-way deterministic sensitivity analyses to examine variation in two parameters: 1) the relative risk of treatment on prevention of CHD and stroke, and 2) the relative risk of treatment on non-CVD mortality. For the "best-case" scenario we used the high 95% CI bound for the relative risk of treatment on prevention of CHD and stroke, and low 95% CI bound for the relative risk of treatment on non-CVD mortality. For the "worst-case" scenario, we used the opposite. Additionally, we used probabilistic sensitivity analyses, and we completed a Monte Carlo simulation with 2000 replications to estimate the variation in the incremental cost-effectiveness ratios accounting for the variation in these two parameters. The natural logarithm of these parameters were assumed to be normally distributed.

RESULTS

The approximately 64 million adults ages 60–94 years of age in the U.S. in 2014 are expected to accrue 4.2 million MIs and 5.4 million strokes over the next 10 years if current CVD risk factor levels remain unchanged. The prevalence of slow walkers ranged from 12.7% in men aged 60–74 years to 59.3% in women aged 85 years and older, and the prevalence of poor functioning adults ranged from 6.5% in men aged 60–74 years to 23.8% in men 85 years and older (Table 1).

Secondary Prevention

Secondary prevention, in which all adults with pre-existing CHD or stroke are treated to a SBP target of 150 mmHg, was projected to prevent events, regardless of gait speed. Overall, this strategy was projected to avoid approximately 244,000 MIs and 346,000 strokes and to be cost saving (Table 2). Treatment to a lower secondary prevention target of 140 mmHg would avoid an additional 83,000 MI and 116,000 strokes and save even more money (Table 2).

Primary Prevention

When added to a secondary prevention goal of 140 mmHg, a primary prevention goal of 150 mmHg would prevent an additional 178,000 MIs and 307,000 strokes in fast walking women and men aged 60–94 years (Table 3). Intensifying the primary prevention goal to 140 mmHg in fast walking men and women would prevent an additional 68,000 MIs and 99,000 strokes, and would be even more cost-saving.

Extending primary prevention to slow walking men and women was projected to prevent MIs and strokes and save DALYs, although the benefits varied by sex (Table 3, Figure 1). In slow walking men aged 60–94 years, treatment to a SBP of 150 mmHg appeared cost-saving, and intensification to a target of 140 mmHg appeared to be of intermediate value (incremental cost effectiveness ratio (ICER) = $78,000). (Figure 1) In slow walking women aged 60–94 years, primary prevention to a target of 150 mmHg was also projected to prevent events and save DALYs, and be of high value (ICER = $50,000). In women, intensifying primary prevention to a goal of 140 mmHg appeared to be of low value in ages 60–74 years, and potentially result in a net DALY loss in ages 75–94 years.

Primary prevention in poor functioning adults was projected to result in a net increase in mortality and loss of DALYs in nearly all sub-groups at both the 150 mmHg and 140 mmHg treatment targets, with the exception of poor functioning men age 60–74 years treated to a target of 150 mmHg. Treatment of poor functioning older adults of any age to either a 150 mmHg or 140 mmHg target was not cost-effective.

Sensitivity Analysis

If the effectiveness of lowering SBP from <150mmHg to <140 mmHg is one-half of the effectiveness of lowering from >150 mmHg to <150 mmHg, intensifying secondary prevention to a target of 140 mmHg would remain cost effective at high value in men and women ($600/DALY and $15,000/DALY, respectively). Under this scenario, primary

prevention to a target of 140 mmHg would be cost-effective at high value in fast walking men and women aged 75–94 years ($18,000/DALY and $21,000/DALY), and of intermediate value in fast walking women aged 60–74 years ($71,000/DALY). In addition, intensification of primary prevention to a target of 140 in slow walking men aged 60–94 years and women aged 60–74 years would not be cost effective, and is projected to result in a net loss of DALYs in slow walking women aged 75–94 years and poor functioning adults aged 60–94 years.

If the effectiveness of lowering SBP to <140 mmHg is one-fourth of the effectiveness of lowering to <150 mmHg, intensifying secondary prevention to a target of 140 mmHg would be cost-effective only in men aged 75–94 years ($130,000/DALY). Under this scenario, primary prevention would be cost-effective only in fast walking men aged 75–94 years ($120,000/DALY). Additionally, intensification to 140 mmHg would be not cost effective or result in a net loss of DALYs in all other groups for secondary or primary prevention.

In a sensitivity analysis using the median drug prices, the qualitative findings are unchanged. Secondary prevention and primary prevention in fast walking elders remain cost-saving or highly cost-effective in all groups. (Table S1) The cost-effectiveness in slow walking elders remains of uncertain benefit, and primary prevention is associated with harm in the poorest functioning elders.

In two-way deterministic sensitivity analyses across variations in effectiveness on CVD-events and the risk on non-CVD death, we found that under the best-case scenario, primary prevention to a target of 140 mmHg in all populations except poor functioning women aged 75–94 years was cost-saving; among this population it was associated with a loss of DALYs. In the worse-case scenario, primary prevention to a target of 150 mmHg was only cost-effective at high value in fast walking and slow walking men aged 60–74 years, and fast walking men aged 75–94 years. In this worst-case scenario, primary prevention to a target of 140 mmHg was cost-effective in no one.

Probabilistic Analysis

In probabilistic sensitivity analyses, primary prevention in fast walking older adults was cost-saving across variations in effectiveness on CVD-events and the risk on non-CVD death. In fast walking elders, 93% of estimates were cost-saving and 98% were of high value (<$50,000 per DALY). The estimates for the cost per DALY saved in slow walking men treated to a target of 150 mmHg were also relatively stable; over 70% of ICER simulations were cost-saving, and 80% were high value. In comparison, estimates for slow walking men intensified to a target of 140 mmHg and primary prevention in slow walking women were sensitive to variations in effectiveness and risk of non-CVD death; only 47% and 51% of the estimates respectively, were high value. Only 14% of the estimates for primary prevention in poor functioning older adults were of high value, even when using a target of 150 mmHg, and 75% of estimates were of a net loss of DALYs.

DISCUSSION

Based on currently available data, we project that the optimal SBP target varies by history of CVD and gait speed among persons ages 60–94 years. Our projections highlight the need for improved estimates of both the benefits and harms of antihypertensive medication use among a diverse group of older adults, as the net benefit is sensitive to the characteristics of the population treated and the incremental benefit of intensifying treatment to a SBP target below 140 mmHg. If the benefit gained is similar to that observed in clinical trials, secondary prevention to a SBP target of 140 mmHg appears to be cost-saving compared with a 150 mmHg target regardless of gait speed, and primary prevention treatment of all fast walking older adults to a target of 140 mmHg is projected to prevent more events and save more DALY's compared with a target of 150 mmHg. By contrast, primary prevention to either 150 mmHg or 140 mmHg is projected to result in a net loss of life among poor functioning older adults. The balance of risk and benefit in slow walking older adults is nuanced, with variations in effectiveness and cost-effectiveness across age, sex, and treatment categories.

There is controversy regarding the benefit of BP lowering in older adults. (1–3, 26, 27) Epidemiologic evidence shows an inverted association between BP and mortality, where higher BP is associated with a lower risk of death, especially over age 80 years. (5–7) Data from randomized controlled trials of antihypertensive drug therapy, however, are inconsistent especially in the very old. The Hypertension in the Very Elderly Trial (HYVET), which included healthy participants age 80 and older, reported a benefit of antihypertensive therapy on all-cause mortality.(28) Nevertheless, a recent meta-analysis of trials in adults aged ≥80 years found no effect of BP treatment on all-cause mortality (relative risk 1.06 (95% confidence interval (CI): 0.89, 1.25), and significant heterogeneity between HYVET and the other trials.(4) Additionally, the population included in HYVET may not be generalizable to the usual population of adults aged 80 years and older in the U.S. (3, 29)

We have previously demonstrated that the prevalence of frailty, as captured by gait speed, may explain this heterogeneity. In NHANES, performance on a 20-ft walk test stratified participants into those in whom higher blood pressure appeared harmful and those in whom it appeared protective.(16) Similar effect modification by frailty status has been observed for CVD outcomes and mortality when frailty was assessed by self-reported walking speed, limitations in activities of daily living, or cognitive function. (15, 17, 30)

Unlike in younger adults, the pathophysiology of hypertension in the very old or in frail older adults is not well understood. (31) The exact manner by which BP lowering may increases harm in frail older adults is not known, but several mechanisms have been postulated. A recent investigation of Medicare enrollees reported an increased risk of serious fall injuries among persons aged 70 years and older treated with antihypertensive medications.(32) An increased risk of fall and fracture may initiate a cascade of events in frail older adults that could result in hospitalization and even death. Frailty may be associated with compromised hemodynamic regulation, vascular stiffening, and sensitivity to central hypotension. Low central BP could result in insufficient cerebral, myocardial, or

renal perfusion. A low diastolic BP may be especially problematic because the heart is perfused during diastole.(17) Others have noted the challenges with accurate measurement of BP in older adults, including the presence of orthostatic hypotention, pseudohypertension, postprandial hypertension, and sleep apnea.(3) Measurement error in BP could contribute to the overtreatment of older adults who have normal ambient daytime blood pressure levels.

BP treatment guidelines are important in older adults, as they are often at a higher risk of disease compared with their younger counterparts. However, primary prevention strategies that treat older adults as a single group and neglect the important heterogeneity of older adults may result in treatment strategies that result in benefit in one group and harm in another.(33) Our findings suggest that gait speed may be a useful tool for risk-stratification. Recently, the Mobility Working Group recommended that gait speed be routinely assessed and documented in the health record as a “vital sign.” (34) Clinical trial data are needed to evaluate the role of frailty in clinical decision making, but in the interim, this analysis can help inform stakeholders on the potential benefit and harms of BP treatment in older slow walking and poor functioning adults.

Our estimates depend on several assumptions that could impact our findings. First, we assumed a linear effect of BP lowering on the risk of CHD, stroke, and mortality in persons with SBPs above 140 mmHg. The recent 2014 Guidelines for Management of High Blood Pressure and the Minority View highlight the controversy regarding this assumption and have concluded that more research is needed to distinguish whether the benefit of SBP control is linear above 140 mmHg or if a higher threshold exists.(1, 2) To address this concern, we conducted sensitivity analyses using an attenuated benefit of lowering SBP below 150 mmHg; if the effectiveness of lowering SBP to <140 mmHg is one-fourth of the effectiveness of lowering to <150 mmHg, intensification to 140 mmHg appears beneficial only in fast walking older men. Second, we assumed that gait speed as measured in NHANES is a valid proxy for frailty, as has been demonstrated by previous literature in the field.(12–14, 16) It is possible that other measurements or biomarkers may better stratify individuals into robust, pre-frail, and frail populations. Nevertheless, gait speed is easy and inexpensive to measure in clinical practice, and is strongly predictive of mortality.(11) Third, we modeled the harms associated with BP lowering by estimating the incidence of rare documented side effects of medication use or of non-CVD mortality. Other potential harms, such as increased risk of falls and fractures and the adverse effects of polypharmacy, were not explicitly modeled, although deaths related to these types of harms would be represented by our estimates of non-CVD death. Further treatment harms such as postural hypotension, near syncope, falls, and related injuries would reduce the benefit of antihypertensive therapy, especially among those at highest risk for these events. Fourth, we assumed effectiveness and adherence rates similar to clinical trials, although real world values of these parameters may vary by patient characteristics. Fifth, although gait speed may identify more homogenous groups, there remains heterogeneity within a given group, and those at the lowest end of the health spectrum may be at risk of treatment-related harm, even in the setting of secondary prevention. Finally, we assumed that the effectiveness of antihypertensives on CHD and stroke, costs, and quality of life associated with CVD events were the same for frail and non-frail elders. Although it is possible that the prevalence of frailty may modify these parameters, we believe there is insufficient evidence to make

alternative assumptions. Although our simulations incorporate the best available data, future research on these parameters among elders with diverse health status are necessary to make informed clinical recommendations.

In summary, health status as captured by age, sex, history of CVD, and gait speed has an important impact on the balance of benefit and harms of BP lowering in older adults. Although primary prevention appears cost-saving in fast walking older adults, it appears to be associated with net harm in poor functioning older adults. Our research demonstrates the need for more data on the effectiveness and adverse effects of BP lowering in a functionally diverse population that is representative of older adults who are potentially eligible for antihypertensive medications.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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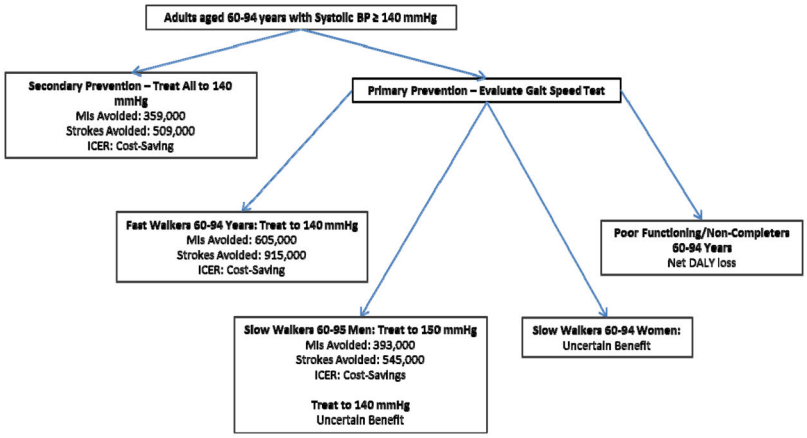

Figure 1.

Treatment Decision algorithm

Decision algorithm is based on simulated prevented events and ICER and guided by gait speed, Simulation was run from 2014–2023 the CVD Policy Model

SBP: Systolic blood pressure

DALY: Disability adjusted life years

ICER: Incremental cost effectiveness ratio

MI: Myocardial infarction

Table 1

Inputs for Analysis

Input			Reference
GAIT SPEED TEST PERFORMANCE	Poor Function (did not complete walk test)	Slow walking (usual walk speed <0·8 m/s)	
Women			NHANES (1999–2002)(35)
60–74	7·4%	21·3%	
75–84	12·7%	41·4%	
85–94	20·3%	59·3%	
Men			
60–74	6·5%	12·7%	
75–84	9·7%	31·6%	
85–94	23·8%	51·3%	
EFFECTIVENESS	*Pre-treatment Blood Pressure*		
Average Systolic Blood Pressure Lowering Effect (mmHg)	140–150 mmHg	150+ mmHg	Law *et al.* 2003 (20)
One Medication	8·2	10·5	
Two Medications		19	
Three Medications		28	
Effect of Blood Pressure Reduction per 10 mmHg	*Age 60–74*	*Age 75–94*	Law *et al.* 2009 (21)
RR of Coronary Events	0·77 (0·74, 0·79)	0·80 (0·77, 0·82)	
RR of Stroke	0·69 (0·64, 0·74)	0·77 (0·73, 0·81)	
RR of Non-CVD Death	*Age 60–94*		Odden *et al.*[15], NHANES (1999–2002)(35)
Fast walking	0·95 (0·86, 1·05)		
Slow walking	1·05 (0·98, 1·15)		
Poor functioning	1·13 (0·99, 1·28)		
COSTS (2014 U.S. dollars)			
Annual Cost of Drugs *	*Low*	*Median*	Red Book(23)
One Medication	$ 161	$351	
Two Medications	$ 231	$548	
Three Medications	$ 346	$822	
Monitoring Costs of Two Clinic Visits per Year	$ 146		CMMS National Physician Fee Schedule(36)
Annual Blood Test	$ 10		CMMS Clinical Lab Fee Schedule(37)
Hospitalization			
Average Cost	$ 11,994		National Inpatient Sample(38)
High Cost	$ 20,680		
POTENTIAL ADVERSE EVENTS (per 100,000 person-years)			
Common, outpatient management			

Input			Reference
One Medication	5,200		Law *et al.* 2009 (21)
Two Medications	7,600		
Three Medications	10,000		
Infrequent, hospitalized			
One Medication	100		Clinical Judgment†
Two Medications	146		
Three Medications	193		
Rare/Severe, hospitalized			
One Medication	1·00		Clinical Judgment†
Two Medications	1·46		
Three Medications	1·93		
Death			
One Medication	0·0100		Clinical Judgment†
Two Medications	0·0146		
Three Medications	0·0193		
UTILITY	*DALY weight penalty*	*Duration*	
Drug side effect, outpatient	0·23	1 day	Montgomery *et al.*(39)
Drug side effect, hospitalization	0·50	1 day	Clinical Judgment
Acute stroke	0·86	1 month	GBD 2010(40)
Chronic stroke survivors	0·85 – 0·88‡	1 year	GBD 2010(40)
Acute myocardial infarction	0·91	1 month	GBD 2010(40)
Acute unstable angina	0·95	1 year	GBD 2010(40)
Chronic CHD	0·91–0·98‡	1 year	GBD 2010(40)

*Average of low prices across classes; includes dispensing fee

†We assumed the ratio of adverse events across number of medications was constant across severity of events

‡Range depends on whether event co-occurs with another event

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Table 2

Projected impact of systolic blood pressure lowering to a target of 150 and 140 mmHg across gait speed, from 2014–2023, among persons with a history of coronary heart disease or stroke (Secondary prevention)

Secondary Prevention Target 150 mmHg	Total MI Prevented (Status Quo = 4,100,000)	Total Stroke Prevented (Status Quo = 5,400,000)	Total Cost (millions) (Status Quo = $7,000,000)	Total DALY Saved (Status Quo = 466,000,000)	CER to Baseline*
WOMEN					
60–74 Years					
Fast walking† 150 mmHg	28,000	41,000	−$2,400	84,000	Cost-saving
Slow walking† 150 mmHg	27,000	40,000	−$2,400	79,000	Cost-saving
Poor functioning† 150 mmHg	5,000	7,000	−$400	15,000	Cost-saving
75–94 Years					
Fast walking† 150 mmHg	17,000	26,000	−$300	109,000	Cost-saving
Slow walking† 150 mmHg	48,000	69,000	−$1,200	294,000	Cost-saving
Poor functioning† 150 mmHg	9,000	12,000	−$200	53,000	Cost-saving
MEN					
60–74 Years					
Fast walking† 150 mmHg	43,000	57,000	−$7,000	149,000	Cost-saving
Slow walking† 150 mmHg	16,000	23,000	−$2,600	54,000	Cost-saving
Poor functioning† 150 mmHg	3,000	4,000	−$400	9,000	Cost-saving
75–94 Years					
Fast walking† 150 mmHg	18,000	26,000	−$1,500	117,000	Cost-saving
Slow walking† 150 mmHg	24,000	33,000	−$1,900	147,000	Cost-saving
Poor functioning† 150 mmHg	6,000	8,000	−$460	37,000	Cost-saving
TOTAL	244,000	346,000	−$20,760	1,147,000	Cost-saving

Secondary Prevention Target 140 mmHg vs. 150 mmHg	Additional MI Prevented	Additional Stroke Prevented	Additional Cost (millions)	Additional DALY	ICER Comparing 140 vs. 150 mmHg
WOMEN					
60–74 Years					
Fast walking† 140 mmHg	10,000	14,000	−$700	30,000	Cost-saving

Secondary Prevention Target 140 mmHg vs. 150 mmHg	Additional MI Prevented	Additional Stroke Prevented	Additional Cost (millions)	Additional DALY	ICER Comparing 140 vs. 150 mmHg
Slow walking† 140 mmHg	7,000	11,000	−$600	20,000	Cost-saving
Poor functioning† 140 mmHg	2,000	3,000	−$200	5,000	Cost-saving
75–94 Years					
Fast walking† 140 mmHg	6,000	8,000	−$100	35,000	Cost-saving
Slow walking† 140 mmHg	10,000	16,000	−$300	66,000	Cost-saving
Poor functioning† 140 mmHg	2,000	4,000	−$40	17,000	Cost-saving
MEN					
60–74 Years					
Fast walking† 140 mmHg	20,000	26,000	−$2,700	68,000	Cost-saving
Slow walking† 140 mmHg	6,000	7,000	−$800	17,000	Cost-saving
Poor functioning† 140 mmHg	1,000	1,000	−$200	4,000	Cost-saving
75–94 Years					
Fast walking† 140 mmHg	8,000	12,000	−$500	51,000	Cost-saving
Slow walking† 140 mmHg	9,000	11,000	−$600	50,000	Cost-saving
Poor functioning† 140 mmHg	2,000	3,000	−$130	13,000	Cost-saving
TOTAL	83,000	116,000	−$6,870	376,000	Cost-saving

*Results reported as cost-saving had lower costs and increased DALYs

†Participants were classified as “fast walking” if their usual gait speed was ≥0.8 m/s, “slow walking” if their usual gait speed was <0.8 m/s, and “poor functioning” if they did not complete the timed gait speed test.

MI = myocardial infarction, DALY = disability-adjusted life-year, CER = cost-effectiveness ratio, ICER = incremental cost-effectiveness ratio

Table 3

Projected impact of systolic blood pressure lowering to a target of 150 and 140 mmHg across gait speed, from 2014–2023, among persons without a history of coronary heart disease or stroke (Primary prevention)

Primary Prevention Target 150 mmHg	Total MI Prevented (Status Quo = 4,100,000)	Total Stroke Prevented (Status Quo = 5,400,000)	Total Cost (millions) (Status Quo = $7,000,000)	Total DALY Saved (Status Quo = 466,000,000)	CER to Baseline*
WOMEN					
60–74 Years					
Fast walking† 150 mmHg	55,000	125,000	−$11,600	312,000	Cost-saving
Slow walking† 150 mmHg	44,000	92,000	$2,700	60,000	$45,000
Poor functioning† 150 mmHg	11,000	24,000	$2,700	−7,000	DALY Loss
75–94 Years					
Fast walking† 150 mmHg	25,000	41,000	−$2,400	223,000	Cost-saving
Slow walking† 150 mmHg	79,000	114,000	$4,500	83,000	$54,000
Poor functioning† 150 mmHg	18,000	26,000	$3,000	−41,000	DALY Loss
MEN					
60–74 Years					
Fast walking† 150 mmHg	78,000	119,000	−$14,100	327,000	Cost-saving
Slow walking† 150 mmHg	29,000	43,000	−$1,300	39,600	Cost-saving
Poor functioning† 150 mmHg	5,000	7,000	$200	371	$540,000
75–94 Years					
Fast walking† 150 mmHg	20,000	22,000	−$2,000	146,000	Cost-saving
Slow walking† 150 mmHg	34,000	32,000	−$300	33,000	Cost-saving
Poor functioning† 150 mmHg	9,000	8,000	$600	−15,000	DALY Loss
TOTAL	407,000	653,000	−$18,000	1,160,971	Cost-saving

Primary Prevention Target 140 mmHg vs. 150 mmHg	Additional MI Prevented	Additional Stroke Prevented	Additional Cost (millions)	Additional DALY	ICER Comparing 140 vs. 150 mmHg
WOMEN					
60–74 Years					
Fast walking† 140 mmHg	19,000	36,000	−$1,900	116,000	Cost-saving

Primary Prevention Target 140 mmHg vs. 150 mmHg	Additional MI Prevented	Additional Stroke Prevented	Additional Cost (millions)	Additional DALY	ICER Comparing 140 vs. 150 mmHg
Slow walking† 140 mmHg	11,000	19,000	$2,700	4,000	$680,000
Poor functioning† 140 mmHg	3,000	7,000	$2,000	−12,000	DALY Loss
75–94 Years					
Fast walking† 140 mmHg	8,000	11,000	−$500	75,000	Cost-saving
Slow walking† 140 mmHg	16,000	22,000	$1,800	−7,000	DALY Loss
Poor functioning† 140 mmHg	5,000	7,000	$1,400	−33,000	DALY Loss
MEN					
60–74 Years					
Fast walking† 140 mmHg	33,000	44,000	−$4,000	152,000	Cost-saving
Slow walking† 140 mmHg	9,000	12,000	$400	7,000	$57,000
Poor functioning† 140 mmHg	3,000	4,000	$500	−3,400	DALY Loss
75–94 Years					
Fast walking† 140 mmHg	8,000	8,000	−$700	67,000	Cost-saving
Slow walking† 140 mmHg	11,000	9,000	$300	2,000	$150,000
Poor functioning† 140 mmHg	4,000	3,000	$300	−11,000	DALY Loss
TOTAL	130,000	182,000	$2,300	356,600	$6,000

*Results reported as cost-saving had lower costs and increased DALYs

†Participants were classified as “fast walking” if their usual gait speed was ≥0.8 m/s, “slow walking” if their usual gait speed was <0.8 m/s, and “poor functioning” if they did not complete the timed gait speed test.

MI = myocardial infarction, DALY = disability-adjusted life-year, CER = cost-effectiveness ratio, ICER = incremental cost-effectiveness ratio