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Optimal Levels of All Major Cardiovascular Risk Factors in Younger Age and Functional Disability in Older Age: The Chicago Heart Association Detection Project in Industry (CHA) 32-Year Follow-up Health Survey

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Abstract

Background—The associations of optimal levels of all major cardiovascular disease (CVD) risk factors, i.e., low-risk, in younger age with subsequent CVD morbidity and mortality have been well documented. However, little is known about associations of low-risk profiles in younger age with functional disability in older age.

Methods and Results—The sample included 6,014 participants from the CHA Study. Low-risk status, defined as untreated SBP/DBP 120/ 80 mmHg, untreated serum total cholesterol <5.18 mmol/l, not smoking, BMI < 25 kg/m², and no diabetes, was assessed at baseline (1967–73). Functional disability, categorized as: 1) any disability in activities of daily living (ADLs), 2) any disability in instrumental ADLs (IADLs) but no ADL, or 3) no disability, was assessed from the 2003 health survey. There were 39% women, 4% Black, with a mean age of 43 and 6% low-risk status at baseline. After 32 years, 7% reported having limitations in performing any ADL and 11% in any IADL only. The prevalence of any ADL limitation was lowest in low-risk persons and increased in a graded fashion with less favorable risk-factor groups (p-trend <0.001). Compared to those with 2+ high-risk factors, the multivariable-adjusted odds of having any disability in ADLs vs. no disability in persons with low-risk, any moderate-risk, and 1 high-risk factor at baseline were lower by 58%, 48%, and 37%, respectively. Results were similar for IADLs, in both men and women.

Conclusions—Having an optimal CVD risk factor profile at younger age is associated with the lowest rate of functional disability in older age.

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Keywords

activities of daily living; aging; quality of life; risk factor

Introduction

Functional disability, defined as limitation in the ability to carry out basic functional activities, is common in older age. An estimated 35% of men and 38% of women age 65 years and over had some type of disability in the United States in 2011.¹ Disability affects not only the quality of life (QOL) of older individuals, but it may also strain resources of their families and the health care system through required assistance, care and rehabilitation.² The proportion of the population age 65 years and over in the United States is growing rapidly, and it is projected to rise from 13 percent of the total population in 2010 to about 20 percent (88.5 million) in 2050.³ Therefore, prevention of disability to improve quality of life in older age is critical, and is part of the overarching goals of the Healthy People 2020.⁴

Many epidemiological studies have found that major cardiovascular disease (CVD) risk factors assessed singly are also risk factors for disability in older age, including obesity,⁵⁻⁷ smoking,^{5, 7-9} elevated blood pressure,⁵⁻⁷ and diabetes.^{8, 10, 11} Previous studies have observed a strong association for the beneficial effects of the combination of the optimal level of all major CVD risk factors, i.e., low-risk in younger age, on lower subsequent CVD morbidity,^{12, 13} mortality,¹⁴⁻¹⁶ health care costs,¹⁷ and less subclinical atherosclerosis.^{18, 19} However, the association between low-risk profiles in younger age with functional disability later in life has not been thoroughly investigated. Some previous studies used the combination approach for CVD risk factors but focused on the predictive role of lifestyle factors such as smoking, body mass index (BMI), exercise and alcohol consumption only,²⁰⁻²² or focused only on a specific population with small sample sizes and short follow-up time.²³

The Chicago Heart Association Detection Project in Industry (CHA) Follow-up Health Surveys provided an opportunity to examine whether low-risk profile in younger age is inversely associated with functional disability status later in life using data from a large population-based cohort of both men and women with long time of follow-up. Specifically, we assessed associations between baseline CVD risk profiles and functional disability as measured 32 years later by activities of daily living (ADLs) and instrumental ADLs (IADLs) in 3,669 men and 2,345 women ages 65 years or older, taking into account the impact of baseline age, race, sex, and education, and the comorbid conditions at follow-up. The associations of individual baseline CVD risk factors with subsequent ADLs/IADLs were also investigated.

Methods

CHA Study and Baseline Examination

The CHA Study is a public health program and prospective epidemiologic study of 39,565 men and women ages 18–74 conducted in 1967–73 to identify higher-risk adults in work places throughout the Chicago area. Details of the CHA study have been previously published.¹³ Briefly, baseline examination involved collection of demographic, smoking history, medical history, and medical treatment data by questionnaires; measurement of height, weight, supine blood pressure, resting electrocardiograms (ECGs); and blood collection for measurement of serum total cholesterol, uric acid, and plasma glucose.

CHA 32-Year Follow-up Health Survey

In 1996, a health survey was mailed to surviving CHA participants who were Medicare-eligible (i.e., 65 years and older) to assess their interim and current health status. Vital status was based on last received data from National Death Index and the Centers for Medicare and Medicaid Services (CMS) records. Details of the survey's recruitment procedures are given elsewhere²⁴. Following the 1996 survey, two succeeding health surveys were mailed in 2001 and 2003, to surviving CHA Medicare-eligible participants, excluding those who did not respond to prior surveys. The Activities of Daily Living (ADL) questionnaire to obtain functional disability was available only in the 2001 and 2003 surveys. We used the data from the 2003 survey (the 32 Year Follow-up Survey) for this current research. Of the 10,689 questionnaires sent to the participants in 2003, 6,716 questionnaires were completed and returned (see Supplementary Figure) for an overall response rate of 62.8%.

The 2003 health questionnaire included assessments of socio-demographic status, smoking history, alcohol consumption, habitual exercise pattern, current and prior weight, history of chronic diseases and conditions, and current medication use for hypertension, hypercholesterolemia, diabetes, and hormone therapy (for women), short form (SF) -36 health survey, and ADL questions. The health surveys were approved by the Northwestern University Institutional Review Board.

Exclusions

Of the 6,716 participants who returned the questionnaire, 702 were excluded for the following reasons: prevalent diseases at baseline (i.e., history of physician-diagnosed or ECG evidence of MI [n = 34] and major ECG abnormalities [n = 391]); missing data on baseline risk factors (n = 122); missing follow-up questionnaire on activities of daily living (n = 52); or missing values on covariates (i.e., baseline age, race, sex, education, and current morbidity status [n=103]). Thus, the analysis sample for the present study included 2,345 women and 3,669 men 65 years and older at follow-up (average age 76.6 years).

Definition of Risk Status

Baseline CVD risk profiles were classified into 4 categories:

1. Low-risk was defined as having optimal level of all major CVD RFs, i.e., systolic/diastolic blood pressure (SBP/DBP) 120/ 80 mmHg and not

taking antihypertensive medication, serum total cholesterol <200 mg/dl (5.18 mmol/l) and not taking cholesterol-lowering medication, not overweight or obese (BMI <25 kg/m²), no diabetes, and not currently smoking;

2. Moderate-risk was defined as not smoking, no diabetes and having one or more unfavorable/borderline levels of untreated SBP 121–139 mmHg or DBP 81–89 mmHg, or untreated serum total cholesterol 200–239 mg/dl (5.18–6.21 mmol/l), or BMI 25.0–29.9 kg/m²;
3. 1 high-risk factor; or
4. 2+ high-risk factors. High-risk factors were defined as SBP ≥140 or DBP ≥90 mmHg or taking antihypertensive medication, serum cholesterol ≥240 mg/dL (6.22 mmol/l) or taking cholesterol-lowering medication, BMI >30 kg/m², current smoker, or having diabetes.

Follow-up Functional Disability

The Activities of Daily Living questionnaire was used to obtain functional disability. First defined by Katz,²⁵ ADLs are used to determine self-care capacity. The ADLs encompass six basic functions: bathing, dressing, toileting, transfer, continence, and feeding. The IADL scale was later developed to expand the assessment to homemaking skills necessary for independent living.²⁶ The eight IADL items include shopping, doing laundry, doing light housework, managing money, food preparation, managing medication, using the telephone, and getting around outdoor. For each item, participants who reported inability to perform unassisted were considered as having a disability for that item. Based on the answer to each item and the severity levels of IADLs and ADLs, a functional disability index was categorized as follows: 1= no disability, 2=having any disability in IADLs only but no ADL, and 3= having any disability in ADLs.

Covariates

Covariates included baseline age, race (black vs. non-black), sex, and educational attainment that were collected by questionnaires. In addition, current comorbidity status was assessed using the total number of diseases reported from the follow-up questionnaire listing different chronic diseases. We further created five categories of chronic diseases: cancer (e.g., lung, stomach, intestinal, rectal, breast, ovarian, uterine, prostate, leukemia, or skin cancer); diabetes mellitus; CVD (including heart attack, angina, congestive heart failure, heart disease, stroke, and arteriosclerosis); arthritis, sciatica, or hip fracture; and other major disease (e.g., Alzheimer's disease, cataract, deafness, pneumonia, emphysema, liver disease, or kidney disease).

Data Analyses

Descriptive characteristics, current chronic diseases, and prevalence rates of ADLs and IADLs for single disabilities and for the combined index were computed for all participants and compared across baseline CVD risk profile categories using F tests for continuous variables or Chi-square tests for binary variables.

Multinomial logistic regression models were used to examine the associations of baseline low-risk profile with prevalence of any ADL or IADL at follow-up, using no disability as the reference category. Analyses were adjusted for baseline age, race, sex, and educational attainment (Model 1). Since chronic diseases are correlated with disability,²⁷ analyses were further adjusted for the current number of chronic diseases to assess whether the association of baseline risk factor profile with subsequent risk of ADLs/IADLs could be explained by number of current comorbidity status (Model 2). A sensitivity analysis was adjusted for five categories of major comorbid conditions instead of the number of comorbid conditions. Dose-response associations across risk-factor strata were tested using logistic regression, with risk-factor status as an ordinal variable ranging from 1 (2+ high-risk factors group) to 4 (low-risk group).

Models substituting individual risk factors for the combined risk factor profile groups were also used, with having only one individual risk factor in the model then simultaneously adjusted for the other risk factors to examine the association of each risk factor separately with disability outcomes.

Finally, although the interaction term between sex and risk factor profile in predicting disability in ADLs or IADLs is not significant (p -value > 0.05), because some comorbidities may have different relationships with cardiovascular factors in men and women, analyses stratified by sex were performed to assess possible effects of sex on the association.²⁸ All analyses were conducted using SAS statistical software version 9.4 (SAS Institute Inc, Cary, NC).

Results

Of the 6,014 CHA participants aged 65 years or older in 2003, 40% were women, 4.1% were African American, baseline mean age was 43.3 years, current mean age was 76.6 years, 5.8 % had a low-risk profile and 28.3% had 2+ high-risk factors at baseline. As shown in Table 1, hypertension was the most prevalent baseline RF (44.2%). Low-risk participants tended to be female, white, and better educated than other groups. At follow-up, 93% of participants reported having at least one chronic disease. Those with baseline low-risk profile were less likely to report currently having any chronic disease; diabetes mellitus; any CVD disease; any arthritis, sciatica, or hip fracture; or any other major diseases, as well as having a lower total number of diseases compared to other baseline risk profile groups.

The prevalence of disabilities considered singly ranged from 5.8% (cannot manage medication) to 11.0% (cannot prepare meals) for IADLs, and from 4.3% (need help with eating) to 6.3% (need help with taking bath or shower) for ADLs (Table 2). When using the combined ADL and IADL approach, the prevalence of having one or more disabilities in ADLs at follow up was 7.3% and of having one or more disabilities in IADLs only was 11.4%. In general, the prevalence of disabilities in ADLs or IADLs at follow-up, assessed singly or in combination, was lowest among the low-risk group and was higher with higher risk factor burden at baseline. For example, the prevalence of having 1 or more disability in ADLs was 4.0%, 5.5%, 7.0%, and 10.0% for low-risk, moderate-risk, 1 high-risk factor, and 2+ high-risk factors, respectively.

With adjustment for baseline age, sex, race, and educational attainment, a more favorable baseline risk profile was associated with a substantially lower likelihood of having one or more disabilities in ADLs or IADLs at follow up. As shown in Table 3, compared to those with 2+high-risk factors, the odds of having any ADL disability vs. no disability in persons with baseline low-risk, moderate-risk, and 1 high-risk factor were lower by about 60%, 50%, and 40%, respectively (p-trend <.001). Similar results were observed for having any IADL disability only. The associations of baseline risk profile with ADLs or IADLs at follow-up were attenuated somewhat with further adjustment for the number of current chronic diseases (Table 3, Model 2) but still remained significant (p-trend <.001 for any ADL vs. no disability, and =.015 for any IADL only vs. no disability).

In the sensitivity analysis, similar results were observed when the five categories of major current chronic diseases were used instead of the number of current chronic diseases in the sensitivity analysis. For instance, the odds (95% CI) of having ADL disability in the low-risk group was 0.48 (0.26–0.87) in the model with adjustment for the number of current chronic diseases; with adjustment for categories of chronic diseases, it was 0.53 (0.29–0.97) (data not tabulated).

In analyses of individual risk-factors (Table 4), baseline BMI appeared to be the most powerful predictor in predicting disability and its association is independent from other risk factors. For example, age-sex-race-education adjusted odds ratio (95% CI) of having any ADLs was 0.38 (0.28–0.52) for BMI < 25 kg/m² vs. BMI ≥ 30 kg/m² in the model with only BMI as the risk factor; it was only slightly attenuated when other risk factors were added simultaneously into the model (results not tabulated); with adjustment for all other risk factors, it was 0.39 (0.29–0.54). Similarly, baseline cigarette smoking, and higher blood pressure levels were also independently associated with having disability at follow-up, especially having any disability in ADLs. For example, with adjustment for all other risk factors, odds ratios (95% CI) of having any follow-up disability in ADLs were: 0.61 (0.48–0.79) for never smoking vs. current smokers and 0.62 (0.47–0.82) for favorable blood pressure vs. blood pressure ≥ 140/90 mmHg or on blood pressure-lowering medication. Baseline cholesterol did not show any association with follow-up ADLs and IADLs. Although the odds of having any disability in ADLs or IADLs later in life were higher among those with baseline diabetes, this association was not significant.

In sex-specific analyses (Table 5), the associations in both men and women were similar to that in the main analyses: the more favorable the risk profile at baseline, the lower the likelihood of having any disability in ADLs or IADLs at follow-up. For example, compared to those with 2+ high-risk factors, the odds of having any ADL disability vs. no disability in men with baseline low-risk, moderate-risk, and 1 high-risk factor were lower by about 77%, 43%, and 45%, respectively (p-trend<.001); and the odds of having any IADL only disability vs. no disability in women with baseline low-risk, moderate-risk, and 1 high-risk factor were lower by about 55%, 46%, and 43%, respectively (p-trend=.004).

Discussion

This study of 6,014 men and women baseline ages 29–68, free at baseline of a history of MI and of ECG abnormalities, showed that the odds of having any ADL or IADL limitation 32 years later was lowest in those with favorable levels of all baseline major CVD risk factors and increased in a graded fashion with less favorable risk factor profiles. These associations were independent of baseline age, sex, race, and educational attainment. They were attenuated with further adjustment for current comorbidity status but still remained strongly significant. The associations were similar for men and women, and were mainly and independently driven by baseline BMI, smoking status and blood pressure levels.

The important role of the combined effects of favorable levels of all major CVD risk factors in young adulthood and middle age, on other subsequent health outcomes at older age has been well documented. The low-risk profile is associated with increased longevity, lower CVD and total mortality,^{14–16} lower long-term and lifetime risks of CVD and other chronic diseases,^{14,15} lower health care costs,¹⁷ and less subclinical atherosclerosis.^{18, 19} The focus on the low-risk profile and the evidence of its health benefits has served as the foundation of new strategic directions for the American Heart Association in its impact goals for CVD health promotion and disease prevention, especially primordial prevention, through 2020 and beyond.²⁹

However, data on the association of low-risk profiles with subsequent functional disability (which is of critical importance for understanding healthy aging) are sparse. Previous studies in this area have mostly focused on the association of single CVD risk factors on subsequent functional disability.^{5–8} There have been few longitudinal studies addressing the association of low-risk status with functional disability, these studies focused on lifestyle factors only, such as physical activity, BMI, smoking, drinking, or sleeping.^{20–22} To our knowledge, the only prior study that reported the association of major CVD risk profile and subsequent disability is the Zutphen Elderly Study in Netherlands. This study examined the association in older white men (ages 64–84) with small sample sizes (337, 232, and 118 men with 5, 10, and 15 years of follow-up, respectively). This study did not address the impact of having all favorable levels of major CVD risk factors; its low-risk definition was having fewer than two of 5 major risk factors.²³ Our study benefited from being able to examine the association of having all favorable levels of major CVD risk factors in young adulthood/early middle age with functional disability 32 years later using data from a large population-based prospective cohort study of men and women of varied race/ethnicity and a broad range of socio-economic status.

Our results strongly support the hypothesis that low-risk profile in younger age is an important independent predictor of functional disability in older age. Our results are consistent with those reported from the Zutphen Elderly Study.²³ That study reported an odds of having functional disability at 15 year follow-up in those with high-risk status (2 risk factors) 2–2.5 time higher than in those with low-risk status (having < 2 risk factors).

Our results regarding the associations of individual CVD risk factors with functional disability outcomes were also consistent with findings from previous studies. Baseline

cigarette smoking status, BMI, and/or blood pressure levels were all independent predictors of physical disability at follow-up, whereas serum cholesterol was not.^{5–8} Although diabetes is strongly associated with physical disability,¹⁰ we did not find a significant association in the current study. Perhaps this is because the study population included only 1.7% people with diabetes at baseline and thus lacked statistical power to detect the association.

Finally, sex differences in functional disability have been suggested by some studies.^{28, 30} For example, women appear more likely to report limitations, use of assistance, and a greater degree of disability,³⁰ especially among IADL categories, but this may be explained by their differences in disability-related health conditions.²⁸ We did not find any significant differences between men and women in the association of low-risk profile and functional disability.

This study has several limitations. First, it shares a common selection bias in longitudinal studies with decades-long follow-up that was related to the response rate to the questionnaires. As noted previously, those who had a lower number of baseline risk factors were more likely to respond to the survey,²⁴ and those who were high risk at baseline were more likely to die before the survey.¹⁴ Hence, our follow-up cohort was healthier than the original cohort as well as the non-responding cohort, which likely led to an underestimation of the true associations between low-risk status and functional disability (see Supplementary Table). Nevertheless, we noted a significant association even after adjusting for current comorbidities. Second, information on functional disability at baseline was not available. However CHA participants were all employed at baseline in 1967–73, before widespread availability of employment opportunities for individuals with disabilities due to the Americans with Disabilities Act in 1990, and as mentioned above, respondents of the CHA survey were more likely to be healthier than the original CHA cohort, therefore the rates of functional disability at baseline in the CHA cohort were likely low. Finally our data on functional disability are self-reported, therefore the accuracy of the data may be limited. However, self-reported disability measures have been extensively evaluated and generally found to be highly reliable,² hence they have been the most commonly used instruments in studies involving older adults, especially in large-scale studies.³¹

In conclusion, our study highlights the importance of having optimal levels of all major CVD RFs in younger age for better functional ability in older age, including functions for self-care capacity and for living independently in the community. Our findings extend previous observations on the benefits of the low-risk profile early in life to include inverse associations with functional disabilities in older age. Our findings are consistent with the hypothesis that achievement of low-risk status in young adulthood/middle age may be an important mechanism to reduce loss of independence and improve quality of life in older adults. The study also suggests that CVD and non-CVD-related health outcomes may share some common causes and be responsive to the same preventive measures. This may encourage public health efforts to accomplish a progressive increase in the prevalence of low CVD risk profile, given it is still very low in the US (7.5% from 1999 to 2004).³² Thus, our study not only supports the goals to improve the cardiovascular health of all Americans by 20% as indicated in the 2020 Strategic Impact Goals of the American Heart Association to prevent or delay the onset of CVD later in life,²⁹ but also provides strong support to help

achieve the goals of Healthy People 2020, the official national effort to attain high quality, long lives free of preventable disease and disability.⁴

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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What is Known

- There is a lack of comprehensive information on the long-term association of low-risk and functional disability.
- The focus on low risk has served as the foundation of new strategic directions for the American Heart Association in its impact goals for CVD health promotion and disease prevention.

What the Study Adds

- The study reinforces previous findings on the association of low risk and subsequent functional disability through the use of more comprehensive data from a large population-based cohort of both men and women with a long follow-up time.
- The study suggests that CVD and non-CVD-related health outcomes may share some common causes and may be responsive to the same preventive strategies.
- The study supports the goal to improve cardiovascular health.

Table 1 Selected Baseline (1967–73) Characteristics of the Study Sample, Overall and by Baseline Risk Factor Status

Variables (Mean or %)	All	Baseline Risk Factor Status				P-value [§]
		Low-Risk* 348	Moderate-Risk [†] 1500	1 High-Risk Factor [‡] 2467	2+High-Risk Factors [‡] 1699	
<i>No. of people</i>	6014					
Baseline Characteristics						
Age, mean, yr	43.3	41.8	42.9	43.5	43.6	<.001
Female, (%)	40.0	63.8	39.9	40.5	30.9	<.001
Black, (%)	4.1	2.9	3.8	3.7	5.1	.064
Education, mean, yr	13.6	13.9	13.9	13.6	13.2	<.001
Current Smoker, (%)	29.9	0.0	0.0	32.5	58.7	–
BMI, mean (kg/m ²)	25.7	22.3	25.0	25.1	27.8	–
BMI 30.0 kg/m ² , (%)	10.9	0.0	0.0	4.9	31.6	–
SBP, mean, mmHg	133.1	114.5	123.8	134.0	143.9	–
DBP, mean, mmHg	79.3	70.7	74.3	79.5	85.0	–
Hypertension [‡] , (%)	44.2	0.0	0.0	49.4	84.5	–
Serum cholesterol, mean, mg/dL ^{***}	206.9	173.2	197.6	202.9	227.7	–
Hypercholesterolemia [‡] , (%)	17.9	0.0	0.0	12.2	45.6	–
Diabetes mellitus, (%)	1.7	0.0	0.0	1.1	4.3	–
Current chronic disease Status						
Diabetes mellitus, (%)	13.4	3.7	8.5	12.3	21.1	<.001
CV diseases, // (%)	33.5	20.4	28.0	31.7	43.5	<.001
Cancer, # (%)	20.4	18.4	20.7	20.8	19.8	.655
Arthritis/sciatica/hip fracture, ^{**} (%)	55.8	54.3	55.1	54.1	59.3	.007
Other major diseases, ^{††} (%)	30.9	28.5	27.7	31.5	33.4	.003
Number of chronic diseases, ^{**} mean	2.9	2.7	3.0	3.4	4.0	<.001
Any chronic diseases, (%)	89.1	83.3	87.5	89.0	91.9	<.001

BMI indicates body mass index; SBP, systolic blood pressure; DBP, diastolic blood pressure;

* Favorable level of all major CVD risk factors (BP 120/ 80 mmHg and no antihypertensive medication, serum cholesterol <200mg/dl and no lipid-lowering medication, not smoking, BMI<25 kg/m², no diabetes).

[†] Having one or more unfavorable/borderline levels of untreated SBP 121–139 mmHg or DBP 81–89 mmHg, or untreated serum total cholesterol 200–239 mg/dL, or BMI 25.0–29.9 kg/m², not smoking, no diabetes.

[‡] High SBP/DBP (140/90) or using antihypertensive medication, serum total cholesterol 240 mg/dl or using lipid-lowering medication, smoking, BMI 30.0 kg/m², diabetes.

[§] P values for overall group comparisons based on χ^2 or F-test except for RF components.

//CV, cardiovascular diseases including heart attack, angina, congestive heart failure, stroke, arteriosclerosis, or other heart disease.

Cancer includes lung, stomach, intestinal, rectal, breast, ovarian, uterine, prostate, leukemia, or other cancer.

[¶] Other major diseases include pneumonia, emphysema, liver disease, kidney disease, Alzheimer's disease and others.

** Sum of diseases listed in the above categories.

*** Multiply with 0.0259 to convert to mmol/l.

Table 2
Prevalence of IADLs and ADLs at Follow-up, Overall and by Baseline Risk Factor Status

Variables (Mean or %)	All	Baseline Risk Factor Status			P-value**	
		Low-Risk* 348	Moderate-Risk† 1500	1 High-Risk Factor‡ 2467		2+ High-Risk Factors‡ 1699
No. of people	6014	348	1500	2467	1699	
ADLs*** (%)						
Taking bath or shower	6.3	3.5	4.7	6.1	8.7	<.001
Dressing	5.4	2.9	4.1	5.2	7.4	<.001
Eating	4.3	2.3	2.9	4.4	6.0	<.001
Getting in or out of bed or chairs	5.3	2.9	3.6	5.1	7.5	<.001
Walking indoors, around home	4.8	2.6	3.2	4.7	6.7	<.001
Getting to and using the toilet	4.5	2.6	3.1	4.4	6.4	<.001
IADLs*** (%)						
Shopping for groceries or clothes	10.4	6.6	8.2	10.0	13.7	<.001
Doing laundry	9.7	5.5	7.3	9.3	13.3	<.001
Doing light housework	8.2	4.9	6.3	7.5	11.7	<.001
Preparing meals	11.0	6.9	8.4	10.7	14.4	<.001
Getting around outside	9.6	5.2	6.9	9.4	13.2	<.001
Managing money	9.5	6.0	7.5	9.4	12.2	<.001
Managing medication	7.8	4.3	5.7	7.3	11.0	<.001
Using telephone	5.8	2.9	4.4	5.6	7.8	<.001
Functional Disability Index***						<.001
No disability	81.3	87.9	85.2	81.7	76.0	
Any 1 or more IADLs only	11.4	8.1	9.3	11.3	14.0	
Any 1 or more ADLs	7.3	4.0	5.5	7.0	10.0	
Total count of IADLs and ADLs (mean)	1.03	0.59	0.76	0.99	1.40	<.001

ADL indicates Activity of Daily Living; IADL, Instrument Activity of Daily Living.

* Favorable level of all major CVD risk factors (BP 120/ 80 mmHg and no antihypertensive medication, serum cholesterol <200mg/dl and no lipid-lowering medication, not smoking, BMI<25 kg/m², no diabetes).

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[‡] Having one or more unfavorable/borderline levels of untreated SBP 121–139 mmHg or DBP 81–89 mmHg, or untreated serum total cholesterol 200–239 mg/dL, or BMI 25.0–29.9 kg/m², not smoking, no diabetes.

[‡] High SBP/DBP (140/90) or using antihypertensive medication, serum total cholesterol 240 mg/dl or using lipid-lowering medication, smoking, BMI 30.0 kg/m², diabetes.

** P values for overall group comparisons based on χ^2 or F-test except for risk factor components.

*** ADL or IADL items were scored as disabled if the respondents indicated they could not perform the task without help. Functional Disability Index used the combined ADLs/IADLs scoring approach.

Adjusted* Odds Ratios (95% CI) for Functional Disability at Follow-up (2003–04) by Baseline (1967–73) Risk Factor Profile and by Individual Baseline Risk Factors.

Table 3

Baseline RF Profile*	N	Functional Disability*** at Follow-up	
		Any ADL vs.no disability	Any IADL only vs. no disability
Model 1			
Low-Risk [‡]	348	0.42 (0.24–0.75)	0.65 (0.43–1.00)
Moderate-Risk [‡]	1500	0.52 (0.39–0.69)	0.65 (0.51–0.82)
1 High-Risk Factor [§]	2467	0.63 (0.49–0.79)	0.77 (0.63–0.93)
2+ High-Risk Factors ^{§§}	1699	1.00	1.00
P Trend		<.001	<.001
Model 2			
Low-Risk [‡]	348	0.48 (0.26–0.87)	0.74 (0.48–1.14)
Moderate-Risk [‡]	1500	0.62 (0.46–0.83)	0.72 (0.57–0.91)
1 High-Risk Factor [§]	2467	0.71 (0.55–0.90)	0.83 (0.68–1.01)
2+ High-Risk Factors ^{§§}	1699	1.00	1.00
P Trend		<.001	.015

CI indicates confidence interval; ADL indicates Activity of Daily Living; IADL, Instrument Activity of Daily Living.

* Model 1 adjusted for baseline age, sex, race, and educational attainment. Model 2 adjusted for all variables from model 1 plus the number of current chronic diseases.

[‡] Favorable level of all major CVD risk factors (systolic/diastolic blood pressure 120/ 80 mmHg and no antihypertensive medication, serum total cholesterol <200 mg/dl and no lipid-lowering medication, not smoking, BMI < 25 kg/m², no diabetes).

[§] Borderline levels of untreated SBP 121–139 mmHg or DBP 81–89 mmHg, or untreated serum total cholesterol 200–239 mg/dL, or BMI 25.0–29.9 kg/m², not smoking, no diabetes.

^{§§} High SBP/DBP (140/90) or using antihypertensive medication, serum total cholesterol 240 mg/dl or using lipid-lowering medication, smoking, BMI 30.0 kg/m², or diabetes.

^{||} P value for graded association across 4 baseline risk factor groups with risk factor status as an ordinal variable.

*** ADL or IADL items were scored as disabled if the respondents indicated they could not perform the task without help. Functional Disability Index used the combined ADLs/IADLs scoring approach.

Table 4

Adjusted* Odds Ratios (95% CI) for Functional Disability at Follow-up (2003–04) by Individual Baseline Risk Factors.

Individual Baseline Risk Factors	N	Functional Disability [†] at Follow-up				
		Separate models for individual risk factors		Model included all five risk factors		
		Any ADL vs. no disability	Any IADL only vs. no disability	Any ADL vs. no disability	Any IADL only vs. no disability	Any IADL only vs. no disability
Smoking Status						
Never Smoker	2356	0.66 (0.51–0.85)	0.91 (0.74–1.11)	0.61 (0.48–0.79)	0.88 (0.71–1.08)	
Former Smoker	1859	0.70 (0.53–0.92)	0.86 (0.69–1.07)	0.65 (0.50–0.86)	0.83 (0.67–1.03)	
Current Smoker (reference)	1799	1.00	1.00	1.00	1.00	
BP Level/Medication Use (meds)						
120/80 mmHg, no meds	1707	0.55 (0.42–0.73)	0.76 (0.62–0.94)	0.62 (0.47–0.82)	0.82 (0.67–1.02)	
>120/80 and 140/90, no meds	1652	0.98 (0.77–1.25)	0.80 (0.65–0.98)	1.07 (0.84–1.37)	0.84 (0.69–1.04)	
140/90 or on meds (reference)	2655	1.00	1.00	1.00	1.00	
Cholesterol Level/Medication Use						
<200 mg/dl [‡] , no meds	2623	0.97 (0.74–1.28)	0.97 (0.77–1.22)	1.10 (0.83–1.46)	1.04 (0.83–1.32)	
200 and <240, no meds	2316	0.94 (0.72–1.23)	1.03 (0.83–1.29)	1.01 (0.77–1.32)	1.08 (0.86–1.35)	
240 or on meds (reference)	1075	1.00	1.00	1.00	1.00	
BMI(kg/m ²)						
< 25	2631	0.38 (0.28–0.52)	0.53 (0.40–0.68)	0.39 (0.29–0.54)	0.54 (0.41–0.71)	
25 and <30	2667	0.43 (0.32–0.59)	0.61 (0.48–0.79)	0.44 (0.33–0.60)	0.63 (0.49–0.81)	
30 (reference)	656	1.00	1.00	1.00	1.00	
Diabetes	100	1.12 (0.54–2.35)	1.24 (0.69–2.23)	1.18 (0.56–2.49)	1.27 (0.71–2.29)	

CI indicates confidence interval; ADL indicates Activity of Daily Living; IADL, Instrument Activity of Daily Living; BP, blood pressure; BMI, body mass index.

* Models adjusted for baseline age, sex, race, and educational attainment.

[†] ADL or IADL items were scored as disabled if the respondents indicated they could not perform the task without help. Functional Disability Index used the combined ADL/IADL scoring approach.

[‡] Multiply with 0.0259 to convert to mmol/l.

Table 5

Sex-Specific Adjusted* Odds Ratios (95% CI) for Functional Disability[†] at Follow-up (2003–04) by Baseline (1967–73) Risk Factor Status.

Baseline Risk Factor Group	Men		Women			
	N	Functional Disability at Follow-up		N	Functional Disability at Follow-up	
		ADL vs.no Disability	IADL only vs.no Disability		ADL vs.no Disability	IADL only vs.no Disability
Low-Risk [‡]	126	0.23 (0.06–0.97)	0.99 (0.55–1.78)	222	0.51 (0.27–1.00)	0.45 (0.24–0.84)
Moderate-Risk	902	0.57 (0.38–0.86)	0.65 (0.48–0.87)	598	0.49 (0.33–0.75)	0.64 (0.44–0.92)
1 High-Risk Factor [§]	1467	0.55 (0.39–0.78)	0.84 (0.66–1.07)	1000	0.69 (0.50–0.97)	0.67 (0.48–0.92)
2+ High-Risk Factors	1174	1.00	1.00	525	1.00	1.00
P Trend [#]		<.001	.022		<.001	.004

CI indicates confidence interval; ADL indicates Activity of Daily Living; IADL, Instrument Activity of Daily Living.

* Adjusted for baseline age, race, and education attainment.

[†] ADL or IADL items were scored as disabled if the respondents indicated they could not perform the task without help. Functional Disability Index used the combined ADL/IADL scoring approach.

[‡] Favorable level of all major CVD risk factors (systolic/diastolic blood pressure 120/ 80 mmHg and no antihypertensive medication, serum total cholesterol <200 mg/dl and no lipid-lowering medication, not smoking, BMI < 25 kg/m², and no diabetes).

[§] Borderline of untreated SBP/DBP 121–139 mmHg or DBP 81–89 mmHg, or untreated serum total cholesterol 200–239 mg/dL, not smoking, BMI 25.0–29.9 kg/m², no diabetes.

^{||} High SBP/DBP (140/90) or using antihypertensive medication, serum total cholesterol 240 mg/dl or using lipid-lowering medication, smoking, BMI 30.0 kg/m², or diabetes.

[#] P values for trend across 4 baseline risk factor groups.