Potato consumption and risk of cardiovascular disease: 2 prospective cohort studies[1,2]

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ABSTRACT

Background: Whether consumption of potatoes, which are rich in potassium and have a high glycemic index and glycemic load, is associated with the risk of cardiovascular disease (CVD) is unknown.

Objective: The aim was to examine the association between potato consumption and risk of total and specific CVD events as well as mortality from CVD in 2 prospective cohorts of Swedish adults, a population with a high consumption of potatoes.

Design: Information on potato consumption was available from 69,313 men and women, free of CVD and diabetes, in the Cohort of Swedish Men and the Swedish Mammography Cohort. Nonfatal and fatal cases of CVD diagnosed over 13 y of follow-up were identified by linkage with the Swedish National Patient and Cause of Death Registers. Analyses were conducted by using a Cox proportional hazards regression model, controlled for potential confounders.

Results: We ascertained 10,147 major CVD events [myocardial infarction (MI), heart failure (HF), and stroke] and 4003 deaths due to CVD. Total potato consumption was not associated with the risk of major CVD events, specific CVD endpoints, or CVD mortality in either men or women. Multivariable HRs (95% CIs) per an increment of 3 servings/wk of total potato consumption (boiled potatoes, fried potatoes, and French fries) were 1.00 (0.97, 1.02) for major CVD events, 1.01 (0.97, 1.04) for MI, 0.97 (0.93, 1.02) for HF, 1.01 (0.97, 1.05) for stroke, and 0.99 (0.95, 1.03) for CVD mortality. There were no significant trends between the consumption of boiled potatoes, fried potatoes, or French fries and risk of any CVD outcome.

Conclusion: Potato consumption was not associated with the risk of CVD in this population. The Swedish Mammography Cohort and the Cohort of Swedish Men are registered at clinicaltrials.gov as NCT01127698 and NCT01127711, respectively. *Am J Clin Nutr* 2016;104:1245–52.

Keywords: cardiovascular disease, heart failure, myocardial infarction, potatoes, prospective studies, stroke

INTRODUCTION

Potatoes are the most frequently consumed noncereal staple food globally (1). They are high in starch and have a high glycemic index and glycemic load. High–glycemic index and high–glycemic load diets have been associated with an increased risk of cardiovascular disease (CVD)[3] in some, but not all, prospective studies, with a more consistent positive association in women than in men (2, 3). In addition to starch, potatoes are rich in potassium, which may play a role in reducing blood pressure (4–6) and has been inversely associated with the risk of stroke (6, 7). French fries may be a source of dietary sodium, which could outweigh the potential blood pressure–lowering effects of potassium. Results from 3 prospective cohorts of US men and women showed that a high consumption of French fries was associated with an increased risk of hypertension (8). In the same study, the consumption of boiled, baked, or mashed potatoes was also positively associated with the risk of hypertension but only in women (8). The consumption of French fries has been associated with increased risks of obesity and type 2 diabetes (9), which are risk factors for CVD. To our knowledge, no previous prospective study has investigated the association between potato consumption and total CVD incidence or mortality.

We examined the association of potato consumption with total and specific CVD events, including myocardial infarction (MI), heart failure (HF), and stroke, as well as CVD-specific mortality in the Cohort of Swedish Men (COSM) and the Swedish Mammography Cohort (SMC). In this population, potatoes are the second major contributor to glycemic load after white bread (10).

METHODS

Study population

Details about the COSM and the SMC, which are population-based prospective cohort studies in Swedish men and women, respectively, have been described previously (11). In brief, the

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[2] Supplemental Figure 1 and Supplemental Tables 1 and 2 are available from the "Online Supporting Material" link in the online posting of the article and from the same link in the online table of contents at http://ajcn.nutrition.org.

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[3] Abbreviations used: COSM, Cohort of Swedish Men; CVD, cardiovascular disease; FFQ, food-frequency questionnaire; HF, heart failure; mDASH, modified Dietary Approaches to Stop Hypertension; MI, myocardial infarction; SMC, Swedish Mammography Cohort.

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study population included 48,850 men and 39,227 women who, in the late autumn of 1997, answered a 350-item questionnaire that solicited information on diet and other risk factors for CVD and other noncommunicable diseases. For the present analysis, we excluded those with a missing or incorrect personal identification number, those who died before the start of follow-up, those with a CVD or cancer diagnosis before baseline, those with implausible values for total energy intake (i.e., 3 SDs from the $\log_e$-transformed mean total energy intake) or missing data on potato consumption, and those with diabetes at baseline because they may have changed their potato consumption (**Supplemental Figure 1**). After exclusions, 69,313 individuals (36,508 men aged 45–79 y and 32,805 women aged 49–83 y) remained for analysis. The study was approved by the Regional Ethical Review Board at Karolinska Institutet in Stockholm, Sweden. The SMC and the COSM are registered at clinicaltrials.gov as NCT01127698 and NCT01127711, respectively.

Diet assessment

In the autumn of 1997, all of the participants completed a food-frequency questionnaire (FFQ) that inquired about their usual consumption of 96 foods and food items during the past year. The FFQ had 8 predefined frequency categories: never, 1–3 times/mo, 1–2 times/wk, 3–4 times/wk, 5–6 times/wk, 1 time/d, 2 times/d, and ≥3 times/d. The consumption of potatoes was assessed with 3 categories: boiled potatoes, fried potatoes, and French fries. Total potato consumption was calculated as the sum of the 3 potato items. Potato consumption was assessed at baseline only. The FFQ used in the present study has been validated for nutrient intake; the Spearman correlation coefficients between FFQ-based estimates and the mean of fourteen 24-h recall interviews were, on average, 0.65 for macronutrients and 0.62 for micronutrients (12). A similar FFQ was validated for food intake in a random sample of 129 women from the SMC; the Spearman correlation coefficient between FFQ-based estimates and four 1-wk diet records was, on average, 0.52 for 60 foods and food items (A Wolk, unpublished data, 1992).

Assessment of covariates

Information on potential confounders, including BMI (calculated as weight in kilograms divided by the square of height in meters), physical activity, smoking history, family history of MI before 60 y of age, aspirin use, alcohol consumption, and history of hypertension and hypercholesterolemia, was obtained through the questionnaire completed by participants at baseline. Self-reported information on hypertension was supplemented with data from the Swedish National Patient Register and the Swedish National Diabetes Register. We calculated pack-years of smoking history by multiplying the number of packs of cigarettes smoked daily by the number of years of smoking.

Case ascertainment and follow-up

Nonfatal and fatal cases of CVD were identified by linkage with the Swedish National Patient Register and the Swedish Cause of Death Register by using the following International Classification of Diseases, 10th Revision, codes: I21 for MI, I50 and I11.0 for HF, I63 for ischemic stroke, I60 (subarachnoid hemorrhage) and I61 (intracerebral hemorrhage) for hemorrhagic stroke, and I62 for unspecified stroke. For each endpoint, only the first event during follow-up and the event listed as the primary diagnosis (underlying cause) were classified as a case. The primary outcome of this study was a composite endpoint of nonfatal and fatal MI, HF, and stroke. Secondary outcomes were individual endpoints of MI, HF, and stroke (and ischemic and hemorrhagic stroke separately) as well as CVD mortality. In the main analyses, participants were followed up from 1 January 1998 until the date of diagnosis of CVD, date of death, or 31 December 2010, whichever came first.

Statistical analysis

Participants were classified into quintiles of total potato consumption (<3.5 times/wk, 3.5–4.4 times/wk, 4.5–5.4 times/wk, 5.5–7.0 times/wk, and >7 times/wk) on the basis of the distribution in the whole study population. To examine a broader range of total potato consumption, we also grouped participants into the following categories: <2.4 times/wk (<10th percentile), 2.4–7.9 times/wk, and >7.9 times/wk (>90th percentile). Moreover, we analyzed potato consumption as a continuous variable (per 3 servings/wk, corresponding to 1 SD). Because of a lower consumption of individual potato items and an uneven distribution of participants across the frequency categories, we grouped participants into 4 categories by their consumption of boiled potatoes (≤2 times/wk, 3–4 times/wk, 5–6 times/wk, and ≥7 times/wk), fried potatoes (≤3 times/mo, 1–2 times/wk, 3–4 times/wk, and ≥5 times/wk), and French fries (≤3 times/mo, 1–2 times/wk, 3–4 times/wk, and ≥5 times/wk).

Cox proportional hazards regression models stratified on age and sex (in the pooled analyses of both cohorts) were used to calculate HRs with 95% CIs. In addition to age (y) and sex, the first multivariable model was adjusted for the following variables: education (less than high school, high school, or university), family history of MI before 60 y of age (yes or no), smoking status and pack-years of smoking (never; past: <20 or ≥20 pack-years; or current: <20, or ≥20 pack-years), aspirin use (never, 1–6 tablets/wk, or ≥7 tablets/wk), walking/bicycling (in quartiles), exercise (in quartiles), BMI (in kg/m^2; <25, 25 to <30, or ≥30), history of hypertension (yes or no), history of hypercholesterolemia (yes or no), alcohol consumption (never drinkers, past drinkers, or current drinkers of <1 drink/wk, 1–6 drinks/wk, 7–14 drinks/wk, 14–21 drinks/wk, or >21 drinks/wk), and total energy intake (kilocalories per day; continuous). In a second multivariable model (primary model), we further adjusted for a modified Dietary Approaches to Stop Hypertension (mDASH) diet score (in quartiles) (13). In a separate analysis, we controlled for the individual food groups of the mDASH diet score (i.e., fruit, vegetables, legumes, whole grains, red and processed meat, low-fat dairy products, and sweetened beverages) in place of this diet score. We also adjusted for rice and pasta intake. Missing values (6.2% for exercise and <4% for all other variables) were assigned to a missing indicator category.

Tests for trend were performed by assigning the median value to each category of potato consumption and by modeling this variable as a continuous variable. We conducted stratified analyses by sex, BMI (<25 or ≥25), and history of hypertension (yes or no) and used the likelihood ratio test to test the significance of the interactions. We carried out the following sensitivity analyses: *1*) excluding individuals diagnosed with CVD

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TABLE 1
Baseline characteristics according to total potato consumption in the COSM and the SMC[1]

	Total potato consumption									
	COSM					SMC				
	0–3.4 times/wk	3.5–4.4 times/wk	4.5–5.4 times/wk	5.5–7.0 times/wk	>7 times/wk[2]	0–3.4 times/wk	3.5–4.4 times/wk	4.5–5.4 times/wk	5.5–7.0 times/wk	>7 times/wk[2]
n	5952	10,038	6617	6414	7487	5927	10,474	4658	5841	5905
Age, y	55.8 ± 8.4[3]	58.4 ± 9.2	59.2 ± 9.5	60.5 ± 9.6	59.5 ± 9.2	58.3 ± 8.4	60.6 ± 8.9	62.9 ± 9.2	62.7 ± 9.0	61.9 ± 8.9
BMI, kg/m^2	25.8 ± 3.3	25.6 ± 3.1	25.7 ± 3.1	25.5 ± 3.2	25.6 ± 3.2	24.9 ± 3.8	24.9 ± 3.9	24.9 ± 3.9	24.8 ± 3.8	25.1 ± 4.0
Postsecondary education, %	22.2	18.4	17.0	18.1	14.6	25.7	20.9	18.1	19.0	14.4
Family history of MI, %	14.8	14.3	14.9	13.9	13.5	16.7	16.0	16.0	17.0	16.2
Current smokers, %	26.0	22.3	25.8	24.1	26.8	27.0	22.9	23.5	21.5	23.9
Aspirin use of ≥7 tablets/wk, %	5.2	4.8	4.7	4.9	4.8	8.7	7.6	8.9	9.0	7.9
Walk or bicycle ≥40 min/d, %	32.7	33.6	31.6	32.5	31.9	37.0	36.4	36.1	35.7	35.5
Exercise ≥2 h/wk, %	58.2	61.1	58.0	58.2	54.9	56.3	58.4	56.4	57.0	55.2
Hypertension, %	17.6	18.8	18.4	17.6	18.4	18.4	19.1	19.5	18.4	19.7
Hypercholesterolemia, %	9.4	11.3	9.6	10.5	11.0	6.7	7.5	7.8	7.6	7.1
Total energy intake, kcal/d	2400 ± 800	2600 ± 730	2800 ± 800	2800 ± 790	3100 ± 920	1600 ± 480	1700 ± 470	1800 ± 500	1800 ± 510	2000 ± 580
Alcohol intake,[4] drinks/wk	9.2 ± 14.0	8.3 ± 9.3	9.5 ± 14.0	9.1 ± 10.7	9.8 ± 13.0	4.0 ± 5.6	3.7 ± 5.6	3.8 ± 4.4	3.8 ± 5.6	3.7 ± 4.4
mDASH diet score	20.3 ± 4.2	21.0 ± 4.2	20.4 ± 4.2	20.7 ± 4.4	20.9 ± 4.4	22.1 ± 4.2	22.8 ± 4.2	22.1 ± 4.2	22.8 ± 4.3	22.8 ± 4.3

[1] Values are age-standardized to the age distribution of the study population at baseline. COSM, Cohort of Swedish Men; mDASH, modified Dietary Approaches to Stop Hypertension; MI, myocardial infarction; SMC, Swedish Mammography Cohort.
[2] Median (IQR) potato consumption in this category was 8.5 times/wk (7.5–9.0 times/wk) in the COSM and 7.9 times/wk (7.5–9.0 times/wk) in the SMC.
[3] Mean ± SD (all such values).
[4] In current drinkers.

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TABLE 2
HRs (95% CIs) for CVD outcomes according to total potato consumption in the COSM and the SMC, 1998−2010[1]

	Total potato consumption					
	0–3.4 times/wk	3.5–4.4 times/wk	4.5–5.4 times/wk	5.5–7.0 times/wk	>7 times/wk	*P*-trend[2]
Major CVD events						
COSM						
Cases, *n*	805	1552	1157	1226	1356	
Age-adjusted	1.00	0.90 (0.82, 0.99)	0.96 (0.88, 1.06)	0.96 (0.88, 1.05)	0.99 (0.91, 1.08)	0.18
Multivariable model 1[3]	1.00	0.92 (0.84, 1.00)	0.96 (0.88, 1.06)	0.99 (0.90, 1.08)	0.99 (0.91, 1.09)	0.29
Multivariable model 2[4]	1.00	0.92 (0.86, 0.98)	0.96 (0.90, 1.04)	0.98 (0.91, 1.05)	1.00 (0.91, 1.09)	0.29
SMC						
Cases, *n*	596	1186	676	827	766	
Age-adjusted	1.00	0.89 (0.81, 0.98)	0.97 (0.86, 1.08)	0.92 (0.83, 1.02)	0.90 (0.81, 1.01)	0.29
Multivariable model 1[3]	1.00	0.91 (0.82, 1.01)	0.99 (0.89, 1.11)	0.96 (0.86, 1.07)	0.92 (0.82, 1.03)	0.49
Multivariable model 2[4]	1.00	0.92 (0.83, 1.01)	0.99 (0.88, 1.11)	0.96 (0.86, 1.07)	0.92 (0.82, 1.06)	0.46
Pooled[5]						
Multivariable model 2[4]	1.00	0.92 (0.86, 0.98)	0.97 (0.90, 1.04)	0.98 (0.91, 1.05)	0.96 (0.90, 1.03)	0.76
MI						
COSM						
Cases, *n*	396	765	561	584	673	
Age-adjusted	1.00	0.94 (0.84, 1.07)	1.01 (0.89, 1.15)	1.00 (0.88, 1.14)	1.06 (0.94, 1.21)	0.10
Multivariable model 1[3]	1.00	0.96 (0.85, 1.08)	1.00 (0.88, 1.14)	1.02 (0.89, 1.16)	1.04 (0.92, 1.19)	0.23
Multivariable model 2[4]	1.00	0.96 (0.85, 1.08)	1.00 (0.88, 1.14)	1.02 (0.89, 1.16)	1.05 (0.92, 1.19)	0.23
SMC						
Cases, *n*	211	421	254	284	267	
Age-adjusted	1.00	0.90 (0.76, 1.06)	1.05 (0.87, 1.26)	0.91 (0.76, 1.09)	0.90 (0.75, 1.08)	0.47
Multivariable model 1[3]	1.00	0.94 (0.79, 1.11)	1.11 (0.92, 1.33)	0.98 (0.82, 1.18)	0.97 (0.80, 1.17)	0.88
Multivariable model 2[4]	1.00	0.95 (0.80, 1.12)	1.10 (0.91, 1.33)	0.99 (0.82, 1.18)	0.97 (0.80, 1.17)	0.92
Pooled[5]						
Multivariable model 2[4]	1.00	0.95 (0.86, 1.05)	1.02 (0.92, 1.14)	1.00 (0.90, 1.12)	1.02 (0.91, 1.13)	0.36
Heart failure						
COSM						
Cases, *n*	179	381	274	303	326	
Age-adjusted	1.00	0.89 (0.74, 1.06)	0.89 (0.73, 1.07)	0.89 (0.74, 1.08)	0.94 (0.78, 1.13)	0.84
Multivariable model 1[3]	1.00	0.92 (0.77, 1.10)	0.87 (0.72, 1.05)	0.91 (0.75, 1.10)	0.90 (0.74, 1.08)	0.34
Multivariable model 2[4]	1.00	0.93 (0.78, 1.12)	0.87 (0.72, 1.05)	0.92 (0.76, 1.11)	0.91 (0.75, 1.10)	0.38
SMC						
Cases, *n*	156	352	187	249	233	
Age-adjusted	1.00	0.98 (0.81, 1.18)	0.93 (0.75, 1.15)	0.97 (0.80, 1.19)	1.00 (0.81, 1.22)	0.95
Multivariable model 1[3]	1.00	1.02 (0.84, 1.23)	0.96 (0.78, 1.20)	1.03 (0.84, 1.27)	1.01 (0.81, 1.24)	0.94
Multivariable model 2[4]	1.00	1.02 (0.84, 1.24)	0.96 (0.77, 1.19)	1.04 (0.84, 1.27)	1.01 (0.82, 1.25)	0.95
Pooled[5]						
Multivariable model 2[4]	1.00	0.97 (0.85, 1.11)	0.91 (0.79, 1.05)	0.97 (0.84, 1.11)	0.95 (0.82, 1.09)	0.51
Total stroke						
COSM						
Cases, *n*	331	628	482	512	556	
Age-adjusted	1.00	0.86 (0.75, 0.98)	0.95 (0.82, 1.09)	0.93 (0.81, 1.07)	0.96 (0.84, 1.10)	0.66
Multivariable model 1[3]	1.00	0.88 (0.77, 1.01)	0.96 (0.84, 1.10)	0.97 (0.84, 1.12)	1.00 (0.86, 1.15)	0.39
Multivariable model 2[4]	1.00	0.89 (0.77, 1.01)	0.96 (0.83, 1.11)	0.97 (0.84, 1.12)	1.00 (0.87, 1.15)	0.38
SMC						
Cases, *n*	309	577	331	427	378	
Age-adjusted	1.00	0.84 (0.73, 0.96)	0.93 (0.79, 1.08)	0.94 (0.81, 1.09)	0.88 (0.75, 1.02)	0.54
Multivariable model 1[3]	1.00	0.84 (0.73, 0.96)	0.92 (0.78, 1.07)	0.94 (0.81, 1.09)	0.85 (0.73, 1.00)	0.38
Multivariable model 2[4]	1.00	0.84 (0.73, 0.97)	0.91 (0.78, 1.07)	0.94 (0.81, 1.09)	0.86 (0.73, 1.00)	0.37
Pooled[5]						
Multivariable model 2[4]	1.00	0.87 (0.79, 0.95)	0.94 (0.85, 1.05)	0.96 (0.87, 1.06)	0.94 (0.84, 1.04)	0.89
Ischemic stroke						
COSM						
Cases, *n*	243	472	345	377	397	
Age-adjusted	1.00	0.88 (0.75, 1.03)	0.93 (0.78, 1.09)	0.94 (0.80, 1.11)	0.94 (0.80, 1.10)	0.92
Multivariable model 1[3]	1.00	0.90 (0.77, 1.05)	0.94 (0.80, 1.12)	0.98 (0.83, 1.15)	0.98 (0.83, 1.15)	0.70
Multivariable model 2[4]	1.00	0.90 (0.77, 1.05)	0.94 (0.80, 1.12)	0.98 (0.83, 1.15)	0.98 (0.83, 1.16)	0.69

(Continued)

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TABLE 2 (*Continued*)

	Total potato consumption					
	0–3.4 times/wk	3.5–4.4 times/wk	4.5–5.4 times/wk	5.5–7.0 times/wk	>7 times/wk	*P*-trend[2]
SMC						
Cases, *n*	218	442	254	324	270	
Age-adjusted	1.00	0.90 (0.76, 1.06)	1.00 (0.82, 1.19)	0.99 (0.83, 1.17)	0.87 (0.73, 1.04)	0.46
Multivariable model 1[3]	1.00	0.90 (0.76, 1.06)	0.97 (0.81, 1.17)	0.99 (0.83, 1.18)	0.85 (0.70, 1.02)	0.33
Multivariable model 2[4]	1.00	0.90 (0.77, 1.06)	0.97 (0.81, 1.16)	0.99 (0.83, 1.18)	0.85 (0.70, 1.02)	0.31
Pooled[5]						
Multivariable model 2[4]	1.00	0.90 (0.81, 1.01)	0.96 (0.85, 1.08)	0.99 (0.88, 1.12)	0.93 (0.82, 1.05)	0.79
Hemorrhagic stroke						
COSM						
Cases, *n*	51	90	82	75	91	
Age-adjusted	1.00	0.86 (0.61, 1.22)	1.15 (0.81, 1.63)	1.00 (0.70, 1.43)	1.11 (0.79, 1.57)	0.25
Multivariable model 1[3]	1.00	0.89 (0.63, 1.26)	1.15 (0.81, 1.65)	1.03 (0.71, 1.48)	1.13 (0.79, 1.61)	0.28
Multivariable model 2[4]	1.00	0.90 (0.63, 1.27)	1.15 (0.81, 1.64)	1.03 (0.72, 1.48)	1.13 (0.79, 1.62)	0.28
SMC						
Cases, *n*	51	84	44	50	61	
Age-adjusted	1.00	0.81 (0.57, 1.15)	0.87 (0.58, 1.30)	0.78 (0.53, 1.16)	0.99 (0.68, 1.44)	0.99
Multivariable model 1[3]	1.00	0.83 (0.58, 1.18)	0.88 (0.59, 1.33)	0.80 (0.54, 1.20)	1.00 (0.68, 1.48)	0.98
Multivariable model 2[4]	1.00	0.83 (0.59, 1.19)	0.88 (0.58, 1.32)	0.80 (0.54, 1.20)	1.00 (0.67, 1.47)	0.99
Pooled[5]						
Multivariable model 2[4]	1.00	0.86 (0.67, 1.10)	1.02 (0.78, 1.33)	0.91 (0.70, 1.20)	1.05 (0.81, 1.36)	0.46
CVD mortality						
COSM						
Cases, *n*	286	560	443	489	512	
Age-adjusted	1.00	0.79 (0.68, 0.91)	0.85 (0.73, 0.99)	0.84 (0.73, 0.99)	0.88 (0.76, 1.02)	0.74
Multivariable model 1[3]	1.00	0.82 (0.71, 0.95)	0.83 (0.72, 0.97)	0.87 (0.75, 1.00)	0.87 (0.75, 1.01)	0.39
Multivariable model 2[4]	1.00	0.83 (0.72, 0.96)	0.83 (0.72, 0.97)	0.87 (0.75, 1.01)	0.88 (0.75, 1.02)	0.42
SMC						
Cases, *n*	226	510	295	359	323	
Age-adjusted	1.00	0.95 (0.82, 1.12)	0.96 (0.80, 1.14)	0.92 (0.78, 1.09)	0.93 (0.78, 1.10)	0.36
Multivariable model 1[3]	1.00	0.97 (0.83, 1.14)	0.99 (0.83, 1.18)	0.97 (0.82, 1.15)	0.93 (0.78, 1.14)	0.48
Multivariable model 2[4]	1.00	0.98 (0.83, 1.15)	0.99 (0.83, 1.18)	0.97 (0.82, 1.15)	0.94 (0.79, 1.12)	0.50
Pooled[5]						
Multivariable model 2[4]	1.00	0.90 (0.81, 1.00)	0.90 (0.80, 1.02)	0.92 (0.82, 1.03)	0.91 (0.81, 1.02)	0.31

[1] COSM, Cohort of Swedish Men; CVD, cardiovascular disease; mDASH, modified Dietary Approaches to Stop Hypertension; MI, myocardial infarction; SMC, Swedish Mammography Cohort.

[2] Calculated by assigning the median value to each category and treating this variable as a continuous variable.

[3] Calculated by using Cox proportional hazards regression models and adjusted for age, education, family history of MI before 60 y of age, smoking status and pack-years of smoking, aspirin use, walking or bicycling, exercise, BMI, history of hypertension, history of hypercholesterolemia, alcohol consumption, and total energy intake.

[4] Adjusted for the same variables as in multivariable model 1 and further adjusted for mDASH diet score. The pooled analysis was additionally adjusted for sex.

[5] *P* values for interaction by sex were 0.61 for major CVD events, 0.40 for MI, 0.78 for heart failure, 0.88 for total stroke, 0.70 for ischemic stroke, 0.80 for hemorrhagic stroke, and 0.30 for CVD mortality.

during the first 2 y of follow-up; and *2*) restricting the analysis to the first 7 y of follow-up (1998–2004) to reduce potential misclassification of potato consumption because of possible changes in consumption during follow-up. All of the tests were 2-sided and considered significant at $P < 0.05$. SAS software (version 9.3; SAS Institute) was used for all analyses.

RESULTS

Median (IQR) total potato consumption was 5.5 times/wk (4.0–7.0 times/wk) in the COSM and 4.5 times/wk (3.5–6.5 times/wk) in the SMC. Only 2% of participants consumed potatoes <1 time/wk. For boiled potatoes, the median (IQR) consumption was 3.5 times/wk (3.5–5.5 times/wk) in both cohorts. Compared with men and women with low total potato consumption, those with a high consumption were, on average, older and less likely to have a postsecondary education and be current smokers (women only) (**Table 1**).

Over 13 y of follow-up, 10,147 major CVD events (COSM: n = 6096; SMC: n = 4051), 4416 MI cases (COSM: n = 2979; SMC: n = 1437), 2640 HF cases (COSM: n = 1463; SMC: n = 1177), and 4531 stroke cases (COSM: n = 2509; SMC: n = 2022) were diagnosed in the cohorts. A total of 4003 deaths (COSM: n = 2290; SMC: n = 1713) due to CVD occurred. There were no significant trends between total potato consumption and the risk of major CVD events, specific CVD endpoints, or mortality due to CVD; and none of the associations were modified by sex (P-interaction ≥ 0.30) (**Table 2**). When we examined a broader

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TABLE 3

Multivariable HRs (95% CIs) for CVD outcomes according to consumption of boiled potatoes, fried potatoes, and French fries in a pooled analysis of the COSM and the SMC, 1998−2010[1]

	Category of potato consumption[2]				
	1	2	3	4	*P*-trend[3]
Major CVD events					
Boiled potatoes					
Cases, *n*	1500	4291	2157	2199	
HR (95% CI)	1.00	0.95 (0.89, 1.01)	0.96 (0.90, 1.03)	0.99 (0.92, 1.06)	0.86
Fried potatoes					
Cases, *n*	2648	4141	2957	401	
HR (95% CI)	1.00	0.93 (0.89, 0.98)	0.99 (0.93, 1.04)	1.01 (0.91, 1.13)	0.43
French fries					
Cases, *n*	6238	3355	485	69	
HR (95% CI)	1.00	0.99 (0.95, 1.05)	1.06 (0.96, 1.17)	0.90 (0.71, 1.14)	0.95
MI					
Boiled potatoes					
Cases, *n*	666	1873	950	927	
HR (95% CI)	1.00	0.96 (0.88, 1.05)	1.00 (0.90, 1.11)	1.00 (0.90, 1.11)	0.60
Fried potatoes					
Cases, *n*	1057	1871	1317	171	
HR (95% CI)	1.00	0.99 (0.92, 1.08)	1.03 (0.95, 1.12)	1.03 (0.87, 1.21)	0.46
French fries					
Cases, *n*	2591	1551	240	34	
HR (95% CI)	1.00	0.97 (0.90, 1.04)	1.06 (0.92, 1.22)	1.01 (0.71, 1.42)	0.76
Heart failure					
Boiled potatoes					
Cases, *n*	353	1120	537	630	
HR (95% CI)	1.00	0.95 (0.85, 1.06)	0.91 (0.81, 1.03)	1.03 (0.91, 1.17)	0.93
Fried potatoes					
Cases, *n*	785	1030	703	122	
HR (95% CI)	1.00	0.90 (0.83, 0.99)	0.87 (0.78, 0.96)	0.95 (0.79, 1.15)	0.23
French fries					
Cases, *n*	1808	712	92	28	
HR (95% CI)	1.00	0.97 (0.89, 1.06)	0.99 (0.81, 1.22)	1.27 (0.88, 1.83)	0.25
Total stroke					
Boiled potatoes					
Cases, *n*	674	1880	995	982	
HR (95% CI)	1.00	0.91 (0.84, 1.00)	0.97 (0.88, 1.07)	0.97 (0.87, 1.07)	0.79
Fried potatoes					
Cases, *n*	1219	1810	1334	168	
HR (95% CI)	1.00	0.92 (0.85, 0.99)	1.02 (0.94, 1.11)	0.99 (0.84, 1.17)	0.30
French fries					
Cases, *n*	2854	1456	198	23	
HR (95% CI)	1.00	1.00 (0.93, 1.08)	1.05 (0.91, 1.23)	0.70 (0.46, 1.05)	0.47
CVD mortality					
Boiled potatoes					
Cases, *n*	550	1660	815	978	
HR (95% CI)	1.00	0.92 (0.83, 1.01)	0.86 (0.77, 0.96)	0.94 (0.85, 1.05)	0.46
Fried potatoes					
Cases, *n*	1271	1429	1106	197	
HR (95% CI)	1.00	0.86 (0.80, 0.93)	0.89 (0.82, 0.97)	1.10 (0.94, 1.29)	0.79
French fries					
Cases, *n*	2874	936	156	37	
HR (95% CI)	1.00	0.96 (0.88, 1.04)	1.22 (1.03, 1.45)	1.19 (0.86, 1.66)	0.09

[1] HRs (95% CIs) were calculated by using Cox proportional hazards regression models and were adjusted for age, sex, education, family history of MI before 60 y of age, smoking status and pack-years of smoking, aspirin use, walking or bicycling, exercise, BMI, history of hypertension, history of hypercholesterolemia, alcohol consumption, total energy intake, and mDASH diet score. Boiled potatoes, fried potatoes, and French fries were mutually adjusted by inclusion in the same model. COSM, Cohort of Swedish Men; CVD, cardiovascular disease; mDASH, modified Dietary Approaches to Stop Hypertension; MI, myocardial infarction; SMC, Swedish Mammography Cohort.

[2] Consumption categories were ≤2 times/wk, 3–4 times/wk, 5–6 times/wk, and ≥7 times/wk for boiled potatoes and ≤3 times/mo, 1–2 times/wk, 3–4 times/wk, and ≥5 times/wk for fried potatoes and French fries for categories 1–4, respectively.

[3] Calculated by assigning the median value to each category and treating this variable as a continuous variable.

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range of potato consumption, the multivariable HR of major CVD events for the highest decile (>7.9 times/wk) compared with the lowest decile (<2.4 times/wk) was 0.98 (95% CI: 0.90, 1.08) in the pooled analysis. When total potato consumption was analyzed as a continuous variable, the multivariable HRs (95% CIs) per an increment of 3 servings/wk of consumption were 1.00 (0.97, 1.02) for major CVD events, 1.01 (0.97, 1.04) for MI, 0.97 (0.93, 1.02) for HF, 1.01 (0.97, 1.05) for stroke, and 0.99 (0.95, 1.03) for CVD mortality.

Adjustment for individual food groups that constituted the mDASH diet score, in place of the mDASH diet score, as well as for rice and pasta consumption also yielded null results. For example, the multivariable HR of major CVD events was 0.97 (95% CI: 0.90, 1.04) for the highest compared with the lowest quintile of total potato consumption. The association between total potato consumption and the risk of major CVD events was not modified by BMI (*P*-interaction = 0.42) or history of hypertension (*P*-interaction = 0.51) (**Supplemental Table 1**).

In a sensitivity analysis, a null association of total potato consumption with CVD risk was observed when cases that occurred during the first 2 y of follow-up were removed; the multivariable HR of major CVD events for the highest compared with the lowest quintile of total potato consumption was 0.97 (95% CI: 0.90, 1.04). Furthermore, the lack of association of total potato consumption with CVD outcomes persisted when the follow-up was restricted to the first 7 y of follow-up (**Supplemental Table 2**).

We observed no significant trends between the consumption of boiled potatoes, fried potatoes, or French fries and any CVD outcome (**Table 3**). Likewise, no associations were observed for the highest compared with the lowest category of consumption of the 3 potato items.

DISCUSSION

In these 2 prospective cohort studies in Swedish adults with a high consumption of boiled potatoes, we observed no evidence that potato consumption was associated with the risk of major CVD events or mortality from CVD. As in the present study, no association between potato consumption and ischemic stroke risk was observed in a prospective study in 38,683 US men and 75,596 US women, including 570 ischemic stroke cases diagnosed over 8 (men) to 14 (women) y of follow-up (14). We are not aware of any prospective study of potato consumption in relation to the risk of MI, HF, hemorrhagic stroke, or total CVD incidence or mortality.

Total potato consumption has been observed to be inversely associated with the risk of type 2 diabetes in Dutch, Finnish, and Chinese cohorts (9). In contrast, the consumption of potatoes, in particular French fries, has been positively associated with the risk of type 2 diabetes (9, 15) as well as with hypertension (8), weight gain (16), and BMI (17) in studies conducted in the United States. The disparate results may, at least in part, be related to the cooking method, with adverse health outcomes mainly observed for French fries (9). French fry consumption was not associated with an increased risk of any CVD outcome in the current study, but we had limited statistical power to assess the association with a very high consumption of French fries. We also observed no association with the consumption of fried potatoes. Unlike boiled potatoes, French fries and fried potatoes contribute to dietary fat intake. French fries are deep-fried in oil, whereas fried potatoes are cooked in a frying pan, and the source of fat used for frying may be a vegetable oil, butter, or margarine. A high consumption of French fries and fried potatoes could potentially increase the risk of CVD and promote weight gain by their contribution to dietary fat intake. Moreover, French fries may contribute to dietary intake of salt (sodium), which could increase blood pressure and thus the risk of CVD.

The strengths of this study are its prospective design, the large number of cases of CVD, the objective assessment of CVD endpoints by record linkage, and the completeness of follow-up by linkage with population-based Swedish registers. This study is limited by its observational design. We therefore cannot entirely exclude the possibility that residual confounding may explain the lack of observed association between potato consumption and CVD risk. Another shortcoming is that potato consumption was assessed with a self-administered FFQ and only at baseline. Some participants may therefore have been misclassified into the wrong exposure category, which could have caused attenuated risk estimates. Because this study population had a high consumption of boiled potatoes but a low consumption of French fries, findings from this study may not be applicable to populations in whom potatoes are mainly consumed as French fries.

In conclusion, the consumption of potatoes, mainly boiled potatoes, was not associated with the risk of major CVD events or CVD mortality in this population. Further prospective studies of potato consumption and CVD risk in other populations are needed to confirm our results.

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