

Television Viewing Time and All-cause and Cardiovascular Disease Mortality Among Japanese Adults with and without a History of Stroke or Myocardial Infarction

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Aims: We examined the association between television (TV) viewing time and all-cause and cardiovascular disease (CVD) mortality among Japanese adults with and without a history of stroke or myocardial infarction (MI).

Methods: In the Japan Collaborative Cohort Study, 76,572 participants (851 stroke survivors, 1,883 MI survivors, and 73,838 persons without a history of stroke or MI), aged 40–79 years at baseline (1988–1990), completed a lifestyle, diet, and medical history questionnaire, and were followed up regarding mortality until 2009. The Cox proportional hazard model was used to calculate the multivariable-adjusted hazard ratios (HRs) with 95% confidence intervals (CIs) of all-cause and CVD mortality.

Results: During the 19.3-year median follow-up period, 17,387 deaths were documented. TV viewing time was positively associated with all-cause and CVD mortality regardless of stroke or MI history. The multivariable-adjusted HRs of all-cause mortality with 95% CIs for TV viewing time of 3–4.9 h, 5–6.9 h, and ≥ 7 h were 1.18 (0.95–1.48), 1.12 (0.86–1.45), and 1.61 (1.12–2.32) for stroke survivors; 0.97 (0.81–1.17), 1.40 (1.12–1.76), and 1.44 (1.02–2.03) for MI survivors; and 1.00 (0.96–1.03), 1.07 (1.01–1.12), and 1.22 (1.11–1.34) for persons without a history of stroke or MI, respectively, compared with < 3 h.

Conclusions: Prolonged TV viewing time was associated with higher risks of all-cause and CVD mortality in stroke or MI survivors and in persons without a history of them. It may be recommended to reduce sedentary time for stroke or MI survivors, independent of the level of physical activity.

Key words: Stroke, Myocardial infarction, TV viewing time, Sedentary time, Cohort study

Non-Standard Abbreviations and Acronyms: CVD: Cardiovascular disease, BMI: Body mass index, HRs: Hazard ratios, CIs: Confidence intervals, JACC Study: Japan Collaborative Cohort Study for Evaluation of Cancer Risk

Introduction

Television (TV) viewing is a standard leisure-time sedentary behavior in many populations¹. Previous studies, including our previous study², have shown that sedentary behavior, including TV watching time, can be positively associated with risks

of all-cause and cardiovascular disease (CVD) mortality in the general population, independent of physical activity levels^{1, 3, 4}. The American Heart Association's scientific statement on sedentary behavior emphasized reducing sedentary behavior for the primary prevention of CVD⁵. However, it remains unclear whether reducing sedentary behaviors

can improve the prognosis of stroke or MI survivors⁶), although scientific evidence for better lifestyles among stroke or MI survivors is warranted given their substantially improved case fatality rate^{7, 8}).

Few studies have examined the association between sedentary behavior and the risk of mortality among MI survivors. In the Kailuan study of 989 Chinese MI survivors with a mean follow-up of 7.46 years, prolonged sedentary time (4–8 h/day) was associated with a higher risk of mortality after MI compared with <4 h⁹). In the Women's Health Initiative Observational Study with 553 female MI survivors, every 1 h/day increase in sitting time after MI was associated with a 9% increased risk of all-cause mortality among those with pre-MI levels of sitting time <8 h/day¹⁰). These results suggest that prolonged TV viewing time can be a risk factor for mortality among MI survivors.

To our knowledge, no previous study has examined the association between TV viewing time and mortality among stroke survivors. Furthermore, no comparative data are available on the impact of TV viewing time on mortality among stroke or MI survivors and persons without a history of stroke or MI. Therefore, the present study aimed to examine and compare the association between TV viewing time and all-cause and CVD mortality among persons with and without a history of stroke or MI using data from a large long-term cohort study of Japanese people of both sexes.

Methods

Study Population

The Japan Collaborative Cohort Study for Evaluation of Cancer Risk (JACC) is a nationwide community-based prospective study that started between 1988–1990 and enrolled 110,585 individuals (46,395 men and 64,190 women) aged 40–79 years, living in 45 communities across Japan. The methodology of the JACC study has been described elsewhere¹¹). Briefly, a total of 110,585 participants were asked to complete self-administered questionnaires that collected information on their demographic characteristics, medical history, lifestyle, and diet. Before completing the questionnaire, informed individual consent was obtained from each participant in 36 of the 45 study areas (written consent in 35 areas and oral consent in one area).

Group consent was obtained from each area leader for the remaining nine areas. The study protocol was approved by the ethics committees of Hokkaido University, Nagoya University, and Osaka University

From 110,585 cohort participants, we excluded 16,442 participants (7,146 men and 9,296 women) living in 8 study areas because questions on TV viewing time were not included in the questionnaire. We also excluded 13,895 participants (5,576 men and 8,319 women) because of missing information on the history of stroke or MI. Furthermore, 958 participants (285 men and 673 women) with a history of cancer and 120 participants (70 men and 50 women) with a history of stroke and MI were excluded. Finally, we excluded 2,598 participants (874 men and 1724 women) due to missing or inappropriate responses (> 12 h) regarding their TV viewing time. A total of 76,572 participants (32,444 men and 44,128 women) were included in the analyses. According to the self-reported history of stroke and MI, we classified the participants into three groups: “history of stroke,” “history of MI,” and “no history of stroke or MI”¹²).

Assessment of TV Viewing Time

We asked participants about their average daily time spent viewing TV at baseline using the following question: ‘On average, how many hours do you watch TV?’ The participants reported their time spent viewing TV per day: “approximately h/day.” According to their responses, we classified them into four categories: <3 h, 3–4.9 h, 5–6.9 h, and ≥ 7 h/day. We defined <3 h as a reference because a recent meta-analysis concluded that 3–4 h/day of TV viewing was a threshold above which all-cause and CVD mortality risk increased¹³).

Assessment of Covariates

A self-administered questionnaire was used to collect the demographic and lifestyle information. Baseline covariates included age, sex, height, weight, past medical history (such as diabetes and hypertension), smoking and alcohol drinking status, exercise and walking habits, mental status, educational level, occupation, and eating habits. Body mass index (BMI) was calculated as body weight (kg) divided by height in meters squared (m²).

Mortality Surveillance

A systematic review of death certificates was

conducted for each area to determine the cause of death. Mortality data were sent to the Ministry of Health and Welfare through the local public health center, and the underlying cause of death was coded for the National Vital Statistics according to the International Classification of Diseases, 10th revision (ICD10). The endpoints of death in this study were all causes and CVD (ICD-10 codes I01–I99). In 37 areas, the end of the follow-up was the end of 1999 in three areas, the end of 2003 in one area, the end of 2008 in two areas, and the end of 2009 in the remaining 31 areas. The date of moving from the community was verified using population registration documents. If participants died after moving from their original community, they were treated as having withdrawn as censored from the study when they moved out.

Statistical Analysis

Person-years of follow-up were calculated as the duration from the date of the baseline questionnaire to the date of death, emigration from the community, or the end of follow-up, whichever occurred first. Baseline characteristics were reported as mean (standard deviation) for continuous variables and percentages for categorical variables. According to TV viewing time, hazard ratios (HRs) with 95% confidence intervals (CIs) of all-cause and CVD mortality were calculated using Cox proportional hazards regression models. In multivariable analyses, we adjusted for age (continuous), sex (women or men), hours of exercise (seldom, 1–4 h, or ≥ 5 h per week), hours of walking (seldom, 0.5 h, or >0.5 h per day) (model 1). We further adjusted for history of hypertension (yes or no), history of diabetes (yes or no), BMI (sex-specific quintile), smoking status (never, ex-smoker, current smoker of 1–19, or a current smoker of ≥ 20 cigarettes per day), alcohol consumption (never drinker, ex-drinker, current drinker of 0.1–45.9, or ≥ 46.0 g ethanol per day), perceived mental stress (low, moderate, or high), educational level (≤ 18 or ≥ 19 years of age upon completion of education), employment status (unemployed or employed), frequency of consuming vegetables, fish, and fruits, soybean intakes (quintile) (model 2). In the sensitivity analyses, we repeated the analyses by excluding all participants who died during the first five years of follow-up to account for potential bias due to reverse causality. We also conducted a stratified analysis by sex. SAS version 9.4 (SAS, Inc., Cary, NC, USA) was used for all statistical analyses.

Results

Table 1 presents the baseline characteristics of the participants according to TV viewing time. Persons with longer TV viewing time were more likely to be older, unemployed, and drink less regardless of a history of stroke or MI. Stroke survivors with longer TV viewing time were less educated and were less likely to walk. In comparison, MI survivors with longer TV viewing time were more likely to be female and diabetic, eat more fruit, and less fish.

Risk of All-Cause and CVD Mortality According to TV Viewing Time

During the 19.3 years of median follow-up, a total of 17,387 deaths were documented. In age- and sex-adjusted analyses, TV viewing time was associated with higher risks of all-cause mortality among persons with and without a history of stroke or MI (**Table 2**). After adjustment for hours of exercise and walking, the association was slightly attenuated but remained statistically significant. Further adjustment for the other potential confounding factors did not alter the association materially. The multivariable-adjusted HRs of all-cause mortality for TV viewing time of 3–4.9 h, 5–6.9 h, and ≥ 7 h were 1.18 (0.95–1.48), 1.12 (0.86–1.45), and 1.61 (1.12–2.32) for persons with a history of stroke; 0.97 (0.81–1.17), 1.40 (1.12–1.76), and 1.44 (1.02–2.03) for persons with a history of MI; and 1.00 (0.96–1.03), 1.07 (1.01–1.12), and 1.22 (1.11–1.34) for persons without a history of stroke or MI, respectively, compared with a TV viewing time of <3 h. A two-hour increment in TV viewing time was associated with an increased risk of all-cause mortality. The multivariable-adjusted HRs were 1.12 (1.03–1.23) for persons with a history of stroke, 1.10 (1.01–1.20) for persons with a history of MI, and 1.04 (1.02–1.06) for persons without a history of stroke or MI.

Similar positive associations of TV viewing time with CVD mortality were observed among persons with a history of stroke or MI, while a borderline increased risk of CVD mortality was observed for TV viewing time ≥ 7 h/day among persons without a history of stroke or MI. Similar positive associations were observed between each two-hour increment in TV viewing time and the risk of CVD mortality; the multivariable-adjusted HRs were 1.12 (0.99–1.27) for persons with a history of stroke, 1.14 (1.01–1.30) for persons with a history of MI, and 1.04 (1.00–1.08) for persons without a history of stroke or MI.

In the sensitivity analyses, after excluding all participants who died during the first five years of follow-up ($n=2,500$), the excess risk of all-cause

Table 1. Baseline characteristics of participants according to television viewing time

	Television viewing time (h/day)				P for trend
	<3	3-4.9	5-6.9	≥ 7	
History of stroke					
No. of participants	292	334	165	60	
Age, y	65.0 ± 8.8	64.5 ± 8.3	66.3 ± 7.1	68.0 ± 8.3	0.003
Sex, % of women	37.0	35.6	41.2	40.0	0.53
Body mass index, kg/m ²	22.7 ± 3.2	23.1 ± 3.2	22.8 ± 3.5	22.9 ± 5.1	0.83
History of hypertension, %	47.6	53.0	53.1	58.3	0.18
History of diabetes mellitus, %	9.3	8.1	12.8	5.0	0.42
Current smoker, %	20.8	22.0	23.7	34.6	0.02
Current drinker, %	36.7	37.8	28.7	22.6	0.02
High mental stress, %	21.0	17.9	16.1	24.4	0.51
College or higher education, %	16.5	11.5	9.2	6.0	0.06
Unemployed, %	48.6	47.7	73.1	82.5	<0.001
Walking ≥ 60min/day, %	42.8	45.3	36.2	9.1	<0.001
Exercise ≥ 1h/week, %	30.7	34.2	40.0	22.8	0.23
Vegetable intake, times/week	15.2 ± 8.4	13.9 ± 8.1	15.9 ± 9.2	13.7 ± 8.8	0.50
Fish intake, times/week	6.3 ± 4.0	5.6 ± 3.9	6.0 ± 3.7	6.5 ± 4.0	0.47
Fruits intake, times/week	7.0 ± 4.3	7.0 ± 4.6	7.4 ± 4.9	8.1 ± 5.3	0.11
Soybeans intake, times/week	5.3 ± 3.4	4.9 ± 3.3	5.6 ± 3.4	5.2 ± 2.9	0.79
History of MI					
No. of participants	690	782	306	105	
Age, y	62.7 ± 9.2	63.7 ± 8.4	65.7 ± 7.6	65.8 ± 8.0	<0.001
Sex, % of women	53.0	54.7	59.2	67.6	0.004
Body mass index, kg/m ²	23.1 ± 2.9	23.2 ± 3.2	23.1 ± 3.1	23.4 ± 3.5	0.42
History of hypertension, %	45.5	46.1	53.0	49.0	0.39
History of diabetes mellitus, %	9.7	10.6	11.8	18.5	0.007
Current smoker, %	22.7	20.9	21.3	29.3	0.10
Current drinker, %	41.1	37.1	34.8	18.6	<0.001
High mental stress, %	27.7	21.4	19.8	23.1	0.51
College or higher education, %	16.7	12.0	12.9	11.1	0.31
Unemployed, %	26.5	33.5	48.3	65.0	<0.001
Walking ≥ 60min/day, %	46.3	43.6	34.1	30.9	0.003
Exercise ≥ 1h/week, %	29.6	27.2	29.4	21.6	0.13
Vegetable intake, times/week	15.3 ± 8.2	14.7 ± 8.1	14.9 ± 7.8	13.6 ± 7.7	0.11
Fish intake, times/week	6.0 ± 4.1	6.0 ± 3.7	5.5 ± 3.4	4.7 ± 3.1	0.003
Fruits intake, times/week	7.4 ± 4.6	7.6 ± 4.6	8.1 ± 4.3	8.8 ± 4.4	0.005
Soybeans intake, times/week	5.0 ± 3.1	5.2 ± 3.1	4.9 ± 3.4	5.0 ± 3.1	0.76
No history of stroke or MI					
No. of participants	35873	29301	7214	1450	
Age, y	55.2 ± 10.0	57.2 ± 9.8	60.8 ± 9.6	63.1 ± 9.7	<0.001
Sex, % of women	56.2	57.2	66.7	71.4	<0.001
Body mass index, kg/m ²	22.7 ± 2.9	22.9 ± 3.0	23.1 ± 3.3	23.1 ± 3.5	<0.001
History of hypertension, %	16.7	19.3	24.6	26.6	<0.001
History of diabetes mellitus, %	3.5	4.3	5.3	7.4	<0.001
Current smoker, %	25.2	27.3	24.7	24.0	0.09
Current drinker, %	43.5	40.4	32.5	29.7	<0.001
High mental stress, %	24.5	18.9	15.9	16.3	<0.001
College or higher education, %	15.4	11.9	9.8	10.5	<0.001
Unemployed, %	12.7	17.8	32.6	45.9	<0.001
Walking ≥ 60min/day, %	52.6	51.2	45.3	37.1	<0.001
Exercise ≥ 1h/week, %	26.8	27.3	27.0	23.6	0.006
Vegetable intake, times/week	14.6 ± 7.8	14.3 ± 7.8	14.4 ± 7.7	14.2 ± 8.0	0.15
Fish intake, times/week	6.6 ± 4.0	6.5 ± 4.0	6.4 ± 4.0	6.2 ± 4.0	0.001
Fruits intake, times/week	7.4 ± 4.5	7.6 ± 4.5	7.9 ± 4.6	8.3 ± 4.5	<0.001
Soybeans intake, times/week	5.1 ± 3.1	5.0 ± 3.1	5.1 ± 3.2	5.0 ± 3.2	0.67

Data are mean ± standard deviation for continuous variables and percentages for categorical variables.

Table 2. Hazard ratios (95% confidence intervals) of all-cause and CVD mortality according to television viewing time

	Television viewing time (h/day)				P for trend	Increment by 2 h/day
	<3	3-4.9	5-6.9	≥ 7		
History of stroke						
Person-years	3694	4131	1917	537		
All-cause						
No. of cases	155	187	108	47		
Mortality rate (per 1000 person-years)	42.0	45.3	56.3	87.5		
Age- and sex-adjusted HR (95%CI)	Ref	1.14 (0.92-1.41)	1.22 (0.96-1.56)	2.06 (1.48-2.87)	<0.001	1.21 (1.11-1.32)
Model 1	Ref	1.15 (0.92-1.42)	1.18 (0.92-1.51)	1.70 (1.21-2.38)	0.004	1.16 (1.06-1.26)
Model 2	Ref	1.18 (0.95-1.48)	1.12 (0.86-1.45)	1.61 (1.12-2.32)	0.03	1.12 (1.03-1.23)
CVD						
No. of cases	74	93	52	27		
Mortality rate (per 1000 person-years)	20.0	22.5	27.1	50.2		
Age- and sex-adjusted HR (95%CI)	Ref	1.19 (0.87-1.61)	1.23 (0.86-1.75)	2.32 (1.48-3.62)	0.001	1.23 (1.10-1.39)
Model 1	Ref	1.20 (0.88-1.63)	1.17 (0.82-1.67)	1.81 (1.15-2.87)	0.03	1.16 (1.03-1.31)
Model 2	Ref	1.28 (0.93-1.77)	1.12 (0.76-1.63)	1.77 (1.08-2.91)	0.08	1.12 (0.99-1.27)
History of MI						
Person-years	9564	10397	3517	1158		
All-cause						
No. of cases	234	257	138	46		
Mortality rate (per 1000 person-years)	24.5	24.7	39.2	39.7		
Age- and sex-adjusted HR (95%CI)	Ref	1.00 (0.84-1.19)	1.45 (1.17-1.79)	1.63 (1.18-2.24)	<0.001	1.16 (1.06-1.25)
Model 1	Ref	0.99 (0.82-1.18)	1.41 (1.14-1.75)	1.61 (1.17-2.23)	<0.001	1.14 (1.05-1.24)
Model 2	Ref	0.97 (0.81-1.17)	1.40 (1.12-1.76)	1.44 (1.02-2.03)	0.001	1.10 (1.01-1.20)
CVD						
No. of cases	103	116	63	26		
Mortality rate (per 1000 person-years)	10.8	11.2	17.9	22.5		
Age- and sex-adjusted HR (95%CI)	Ref	1.02 (0.78-1.33)	1.49 (1.09-2.04)	2.03 (1.32-3.14)	<0.001	1.20 (1.07-1.36)
Model 1	Ref	1.00 (0.77-1.31)	1.44 (1.04-1.98)	1.98 (1.28-3.08)	<0.001	1.19 (1.05-1.34)
Model 2	Ref	1.00 (0.76-1.32)	1.40 (1.00-1.96)	1.88 (1.17-3.03)	0.002	1.14 (1.01-1.30)
No history of stroke or MI						
Person-years	607856	484737	110369	19959		
All-cause						
No. of cases	6996	6637	2076	506		
Mortality rate (per 1000 person-years)	11.5	13.7	18.8	25.4		
Age- and sex-adjusted HR (95%CI)	Ref	1.02 (0.99-1.05)	1.14 (1.09-1.20)	1.37 (1.25-1.49)	<0.001	1.08 (1.05-1.10)
Model 1	Ref	1.02 (0.98-1.05)	1.13 (1.08-1.19)	1.33 (1.22-1.46)	<0.001	1.07 (1.05-1.09)
Model 2	Ref	1.00 (0.96-1.03)	1.07 (1.01-1.12)	1.22 (1.11-1.34)	<0.001	1.04 (1.02-1.06)
CVD						
No. of cases	2036	1901	667	167		
Mortality rate (per 1000 person-years)	3.3	3.9	6.0	8.4		
Age- and sex-adjusted HR (95%CI)	Ref	0.98 (0.92-1.04)	1.16 (1.06-1.27)	1.37 (1.17-1.60)	<0.001	1.09 (1.05-1.13)
Model 1	Ref	0.98 (0.92-1.04)	1.15 (1.06-1.26)	1.33 (1.14-1.56)	<0.001	1.08 (1.05-1.12)
Model 2	Ref	0.95 (0.89-1.01)	1.06 (0.97-1.16)	1.18 (1.00-1.38)	0.03	1.04 (1.00-1.08)

HR, hazard ratio; CI, confidence interval; CVD, cardiovascular disease; MI, myocardial infarction

Model 1: adjusted for age, sex, hours of exercise, and hours of walking

Model 2: model 1 + adjusted for history of hypertension, history of diabetes, body mass index, smoking status, alcohol consumption, perceived mental stress, educational level, regular employment and dietary intakes of vegetable, fish, fruits and soybeans.

mortality for TV viewing time ≥ 7 h/day remained statistically significant among stroke survivors and persons without any history of stroke or MI (**Supplementary Table 1**). The excess risk of all-cause mortality became of borderline statistical significance among MI survivors. Conversely, the excess risk of CVD mortality for TV viewing time ≥ 7 h/day did not change materially among MI survivors, whereas the excess risk was attenuated among persons without any history of stroke or MI. The association was more evident for men than women regardless of a history of stroke and MI (**Supplementary Table 2**).

Discussion

In this large prospective study of Japanese men and women aged 40–79 years with a median follow-up of 19.3 years, we observed that stroke survivors, MI survivors, and persons without stroke or MI who watched TV for ≥ 7 h/day had approximately 60%, 40%, and 20% higher risks of all-cause mortality, respectively, than those who watched TV for < 3 h/day.

To the best of our knowledge, this is the first study to find associations between TV viewing time and all-cause and CVD mortality among stroke survivors, and TV viewing time with CVD mortality among MI survivors. Our results suggest that prolonged TV viewing time can reduce the prognosis of stroke or MI survivors, independent of other physical activities, such as walking and exercise.

The positive associations between TV viewing time and all-cause and CVD mortality among MI survivors were consistent with the findings of previous studies. A cohort study of 989 Chinese MI survivors with a mean follow-up of 7.46 years showed that prolonged sedentary time (4–8 h per day) was associated with a higher risk of all-cause mortality after MI compared with < 4 h, whereas no such association was found between sedentary time of > 8 h per day and all-cause mortality probably due to the limited number of cases (6 cases); the respective multivariable-adjusted HRs were 1.62 (1.14–2.31) and 1.19 (0.48–2.95)⁹. In another cohort study of 553 female MI survivors from the Women's Health Initiative Observational Study¹⁰, sitting time > 5 to < 8 h/day and ≥ 8 h/day tended to be associated with higher risks of all-cause and CVD mortality compared to ≤ 5 h/day. They reported that a 1 h/day increase in sitting time was associated with an increased risk of all-cause mortality. Compared to these previous studies, the larger sample size of stroke or MI survivors in the present study allowed to assess the robust impact of sitting time on mortality.

The underlying mechanisms of the deleterious impacts of prolonged TV viewing time on CVD occurrence and prognosis might be attributable to the increased total cholesterol, triglycerides, waist circumference, decreased glucose uptake, and decreased skeletal muscle lipoprotein lipase activity^{14, 15}. Also, prolonged TV viewing time may lead to systemic inflammation, increased plasma viscosity, and platelet aggregation, resulting in vascular mortality^{16, 17}. A previous experimental study reported that 3 h of sitting resulted in significant impairment of superficial femoral artery flow-mediated dilation, leading to endothelial dysfunction and an elevated risk of vascular mortality¹⁸.

The strengths of the present study are that the prospective study design minimizes recall bias of the exposure assessment and the large sample size of stroke and MI survivors enables us to assess their mortality.

However, this study had several limitations. First, since TV viewing time and a history of stroke or MI were self-reported, false reporting could be a potential problem. However, the reliability of self-reported TV viewing time at home was moderate to high¹⁹. Second, we did not have information on multiple measurements of TV viewing time. During the long follow-up period, TV viewing time may have changed. Further studies with multiple evaluations of TV viewing time are important to reduce measurement errors and better assess the temporal relationship between TV viewing time and mortality. Third, despite adjusting for potential confounding factors, we cannot rule out the effects of unmeasured factors or residual confounding, such as blood pressure, blood glucose, and cholesterol levels, and the degree of disability attributable to the first stroke or MI. Stroke or MI survivors could spend more time viewing TV because of such disabilities due to the first stroke or MI. Covariates adjusted in the multivariable models, such as hours of exercise and walking and employment status after first stroke or MI, can serve as a proxy for disability. To assess the remaining impact of unmeasured confounders that our present covariates did not capture, we calculated the E-values in the primary analysis²⁰. The E-values for the association between TV viewing time of ≥ 7 h and all-cause mortality were 2.13 for stroke survivors and 1.89 for MI survivors. Therefore, an unmeasured confounder must be associated with a TV viewing time of ≥ 7 h and all-cause mortality by approximately two-fold for stroke and MI survivors, while adjusting for other covariates, to explain the observed HR in the primary analyses. Fourth, reverse causation could have led to the observed associations. However, the association between TV viewing time and mortality remained

statistically significant when deaths during the first five years were excluded. Finally, since the present study was an observational study, the causality of prolonged TV viewing time with protective cardiovascular health cannot be determined.

Conclusions

Prolonged TV viewing time was associated with higher risks of all-cause and CVD mortality regardless of a history of stroke or MI after adjustment for physical activities, such as walking, exercise, and other confounding factors. Prolonged TV viewing time can be detrimental among stroke or MI survivors, although confounding due to the severity of the first non-fatal stroke or non-fatal MI and sequelae cannot be ruled out.

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Disclosures

None.

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Supplementary Table 1. Hazard ratios (95% confidence intervals) of all-cause and CVD mortality according to television viewing time, excluding the death cases during the first five years of follow-up

	Television viewing time (h/day)				<i>P</i> for trend
	< 3	3–4.9	5–6.9	≥ 7	
History of stroke					
Person-years	3580	4037	1849	488	
All-cause					
No. of cases	115	148	77	26	
Mortality rate (per 1000 person-years)	32.1	36.7	41.6	53.2	
Age- and sex-adjusted HR (95%CI)	Ref	1.22 (0.95–1.55)	1.17 (0.88–1.56)	1.77 (1.15–2.72)	0.03
Model 1	Ref	1.23 (0.96–1.57)	1.13 (0.85–1.51)	1.54 (0.99–2.40)	0.11
Model 2	Ref	1.25 (0.97–1.61)	1.09 (0.80–1.49)	1.60 (1.00–2.57)	0.14
CVD					
No. of cases	51	70	33	14	
Mortality rate (per 1000 person-years)	14.2	17.3	17.8	28.7	
Age- and sex-adjusted HR (95%CI)	Ref	1.30 (0.91–1.87)	1.12 (0.72–1.73)	2.01 (1.11–3.67)	0.09
Model 1	Ref	1.31 (0.91–1.89)	1.08 (0.70–1.68)	1.65 (0.89–3.05)	0.28
Model 2	Ref	1.41 (0.96–2.07)	1.06 (0.66–1.70)	1.87 (0.97–3.62)	0.24
History of MI					
Person-years	9436	10266	3400	1130	
All-cause					
No. of cases	190	204	97	36	
Mortality rate (per 1000 person-years)	20.1	19.9	28.5	31.9	
Age- and sex-adjusted HR (95%CI)	Ref	1.00 (0.82–1.21)	1.33 (1.04–1.70)	1.70 (1.18–2.43)	< 0.001
Model 1	Ref	0.99 (0.81–1.21)	1.30 (1.02–1.67)	1.71 (1.19–2.46)	< 0.001
Model 2	Ref	0.95 (0.77–1.17)	1.22 (0.93–1.59)	1.44 (0.97–2.14)	0.02
CVD					
No. of cases	82	86	45	19	
Mortality rate (per 1000 person-years)	8.7	8.4	13.2	16.8	
Age- and sex-adjusted HR (95%CI)	Ref	0.97 (0.72–1.32)	1.43 (0.99–2.06)	2.03 (1.23–3.36)	0.001
Model 1	Ref	0.95 (0.70–1.29)	1.39 (0.96–2.01)	2.01 (1.21–3.35)	0.002
Model 2	Ref	0.94 (0.68–1.29)	1.35 (0.91–2.00)	1.88 (1.07–3.31)	0.01
No history of stroke or MI					
Person-years	605263	482258	109410	19663	
All-cause					
No. of cases	6094	5779	1721	400	
Mortality rate (per 1000 person-years)	10.1	12.0	15.7	20.3	
Age- and sex-adjusted HR (95%CI)	Ref	1.02 (0.98–1.06)	1.11 (1.05–1.17)	1.30 (1.17–1.44)	< 0.001
Model 1	Ref	1.02 (0.98–1.06)	1.10 (1.04–1.16)	1.28 (1.15–1.41)	< 0.001
Model 2	Ref	1.00 (0.96–1.03)	1.04 (0.98–1.10)	1.17 (1.06–1.30)	0.005
CVD					
No. of cases	1796	1650	562	129	
Mortality rate (per 1000 person-years)	3.0	3.4	5.1	6.6	
Age- and sex-adjusted HR (95%CI)	Ref	0.97 (0.90–1.03)	1.13 (1.03–1.25)	1.25 (1.05–1.50)	0.001
Model 1	Ref	0.97 (0.90–1.03)	1.13 (1.02–1.24)	1.23 (1.03–1.47)	0.003
Model 2	Ref	0.93 (0.87–1.00)	1.03 (0.94–1.14)	1.09 (0.91–1.30)	0.31

HR, hazard ratio; CI, confidence interval; CVD, cardiovascular disease; MI, myocardial infarction

Model 1: adjusted for age, sex, hours of exercise, and hours of walking

Model 2: model 1 + adjusted for history of hypertension, history of diabetes, body mass index, smoking status, alcohol consumption, perceived mental stress, educational level, regular employment and dietary intakes of vegetable, fish, fruits and soybeans.

Supplementary Table 2. Hazard ratios (95% confidence intervals) of all-cause and CVD mortality according to television viewing time, stratified by sex

	Television viewing time (h/day)				<i>P</i> for trend
	< 3	3-4.9	5-6.9	≥ 7	
History of stroke					
Men					
Person-years	2282	2630	1131	246	
All-cause					
No. of cases	103	133	69	32	
Mortality rate (per 1000 person-years)	45.1	50.6	61.0	130.2	
Age- and sex-adjusted HR (95%CI)	Ref	1.18 (0.91-1.53)	1.19 (0.88-1.61)	2.97 (1.99-4.43)	<0.001
Model 1	Ref	1.21 (0.93-1.57)	1.15 (0.84-1.56)	2.46 (1.63-3.72)	<0.001
Model 2	Ref	1.27 (0.96-1.69)	1.13 (0.81-1.57)	2.14 (1.34-3.43)	0.01
CVD					
No. of cases	44	60	33	19	
Mortality rate (per 1000 person-years)	19.3	22.8	29.2	77.3	
Age- and sex-adjusted HR (95%CI)	Ref	1.24 (0.84-1.83)	1.33 (0.84-2.09)	3.88 (2.26-6.68)	<0.001
Model 1	Ref	1.27 (0.86-1.89)	1.26 (0.80-1.98)	3.02 (1.71-5.31)	0.001
Model 2	Ref	1.46 (0.95-2.25)	1.24 (0.75-2.04)	2.64 (1.40-4.98)	0.01
Women					
Person-years	1412	1501	786	292	
All-cause					
No. of cases	52	54	39	15	
Mortality rate (per 1000 person-years)	36.8	36.0	49.6	51.5	
Age- and sex-adjusted HR (95%CI)	Ref	1.07 (0.73-1.57)	1.31 (0.87-1.99)	1.17 (0.66-2.08)	0.33
Model 1	Ref	1.09 (0.74-1.60)	1.30 (0.85-1.99)	1.02 (0.56-1.84)	0.59
Model 2	Ref	0.88 (0.56-1.38)	0.99 (0.59-1.66)	0.66 (0.31-1.39)	0.43
CVD					
No. of cases	30	33	19	8	
Mortality rate (per 1000 person-years)	21.2	22.0	24.2	27.4	
Age- and sex-adjusted HR (95%CI)	Ref	1.14 (0.69-1.87)	1.11 (0.62-1.97)	1.07 (0.49-2.35)	0.85
Model 1	Ref	1.13 (0.68-1.87)	1.11 (0.62-1.99)	0.89 (0.40-1.98)	0.83
Model 2	Ref	1.00 (0.54-1.82)	0.87 (0.43-1.78)	0.53 (0.18-1.54)	0.23
History of MI					
Men					
Person-years	4517	4540	1321	320	
All-cause					
No. of cases	134	162	82	21	
Mortality rate (per 1000 person-years)	29.7	35.7	62.1	65.5	
Age- and sex-adjusted HR (95%CI)	Ref	1.10 (0.87-1.38)	1.64 (1.24-2.16)	1.88 (1.18-2.98)	<0.001
Model 1	Ref	1.09 (0.87-1.38)	1.59 (1.19-2.11)	1.96 (1.22-3.14)	<0.001
Model 2	Ref	1.08 (0.84-1.38)	1.69 (1.24-2.30)	1.72 (1.02-2.89)	<0.001
CVD					
No. of cases	57	70	36	16	
Mortality rate (per 1000 person-years)	12.6	15.4	27.3	49.9	
Age- and sex-adjusted HR (95%CI)	Ref	1.12 (0.79-1.59)	1.73 (1.13-2.64)	3.37 (1.93-5.90)	<0.001
Model 1	Ref	1.13 (0.79-1.61)	1.67 (1.08-2.57)	3.56 (2.02-6.28)	<0.001
Model 2	Ref	1.07 (0.74-1.56)	1.67 (1.04-2.66)	3.06 (1.60-5.84)	<0.001

(Cont. Supplementary Table 2)

	Television viewing time (h/day)				P for trend
	<3	3-4.9	5-6.9	≥7	
Women					
Person-years	5047	5857	2196	837	
All-cause					
No. of cases	100	95	56	25	
Mortality rate (per 1000 person-years)	19.8	16.2	25.5	29.9	
Age- and sex-adjusted HR (95%CI)	Ref	0.88 (0.66-1.16)	1.28 (0.92-1.77)	1.43 (0.92-2.21)	0.03
Model 1	Ref	0.88 (0.66-1.17)	1.25 (0.90-1.74)	1.34 (0.85-2.09)	0.06
Model 2	Ref	0.83 (0.61-1.12)	1.20 (0.84-1.70)	1.37 (0.83-2.25)	0.07
CVD					
No. of cases	46	46	27	10	
Mortality rate (per 1000 person-years)	9.1	7.9	12.3	11.9	
Age- and sex-adjusted HR (95%CI)	Ref	0.95 (0.63-1.43)	1.37 (0.85-2.20)	1.22 (0.62-2.43)	0.24
Model 1	Ref	0.94 (0.62-1.42)	1.30 (0.81-2.10)	1.11 (0.55-2.23)	0.41
Model 2	Ref	1.10 (0.70-1.73)	1.44 (0.86-2.40)	1.59 (0.72-3.52)	0.12
No history of stroke or MI					
Men					
Person-years	260431	202958	34473	5092	
All-cause					
No. of cases	4104	3797	1008	220	
Mortality rate (per 1000 person-years)	15.8	18.7	29.2	43.2	
Age- and sex-adjusted HR (95%CI)	Ref	1.03 (0.99-1.08)	1.20 (1.12-1.29)	1.48 (1.29-1.70)	<0.001
Model 1	Ref	1.03 (0.99-1.08)	1.19 (1.11-1.28)	1.46 (1.27-1.67)	<0.001
Model 2	Ref	1.00 (0.96-1.05)	1.10 (1.03-1.18)	1.30 (1.13-1.50)	<0.001
CVD					
No. of cases	1105	1011	289	68	
Mortality rate (per 1000 person-years)	4.2	5.0	8.4	13.4	
Age- and sex-adjusted HR (95%CI)	Ref	1.01 (0.93-1.10)	1.22 (1.07-1.38)	1.58 (1.24-2.02)	<0.001
Model 1	Ref	1.01 (0.93-1.10)	1.21 (1.06-1.38)	1.56 (1.22-1.99)	<0.001
Model 2	Ref	0.97 (0.89-1.06)	1.09 (0.95-1.24)	1.32 (1.03-1.69)	0.03
Women					
Person-years	347425	281780	75896	14867	
All-cause					
No. of cases	2892	2840	1068	286	
Mortality rate (per 1000 person-years)	8.3	10.1	14.1	19.2	
Age- and sex-adjusted HR (95%CI)	Ref	1.00 (0.95-1.05)	1.08 (1.01-1.16)	1.26 (1.11-1.42)	<0.001
Model 1	Ref	1.00 (0.95-1.05)	1.07 (1.00-1.15)	1.22 (1.08-1.38)	<0.001
Model 2	Ref	0.98 (0.93-1.03)	1.03 (0.96-1.10)	1.13 (1.00-1.28)	0.07
CVD					
No. of cases	931	890	378	99	
Mortality rate (per 1000 person-years)	2.7	3.2	5.0	6.7	
Age- and sex-adjusted HR (95%CI)	Ref	0.95 (0.87-1.04)	1.12 (0.99-1.26)	1.21 (0.99-1.49)	0.01
Model 1	Ref	0.95 (0.87-1.04)	1.11 (0.98-1.25)	1.17 (0.95-1.44)	0.03
Model 2	Ref	0.92 (0.84-1.01)	1.04 (0.92-1.18)	1.07 (0.86-1.32)	0.34

HR, hazard ratio; CI, confidence interval; CVD, cardiovascular disease; MI, myocardial infarction

Model 1: adjusted for age, hours of exercise, and hours of walking

Model 2: model 1 + adjusted for history of hypertension, history of diabetes, body mass index, smoking status, alcohol consumption, perceived mental stress, educational level, regular employment and dietary intakes of vegetable, fish, fruits and soybeans.