



Association between television viewing time and risk of incident stroke in a general population: Results from the REGARDS study



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ABSTRACT

Objectives. The purpose of this study was to explore the relationship between TV/video viewing, as a measure of sedentary behavior, and risk of incident stroke in a large prospective cohort of men and women.

Methods. This analysis involved 22,257 participants from the REasons for Geographic And Racial Differences in Stroke (REGARDS) study who reported at baseline the amount of time spent watching TV/video daily. Suspected stroke events were identified at six-monthly telephone calls and were physician-adjudicated. Cox proportional hazards models were used to examine risk of stroke at follow-up.

Results. During 7.1 years of follow-up, 727 incident strokes occurred. After adjusting for demographic factors, watching TV/video ≥ 4 h/day (30% of the sample) was associated with a hazard ratio of 1.37 increased risk of all stroke (95% confidence interval (CI), 1.10–1.71) and incident ischemic stroke (hazard ratio 1.35, CI 1.06–1.72). This association was attenuated by socioeconomic factors such as employment status, education and income.

Conclusions. These results suggest that while TV/video viewing is associated with increased stroke risk, the effect of TV/video viewing on stroke risk may be explained through other risk factors.

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1. Introduction

Regular moderate to vigorous physical activity (MVPA) is associated with better health outcomes, particularly in reducing the risk of premature death (Lollgen et al., 2009) and stroke (McDonnell et al., 2013). However, time spent in MVPA may not be enough to counteract the effects of sedentary behavior, i.e. any waking activities expending < 1.5 metabolic units while in a sitting or reclining posture (Pate et al., 2008; STM, 2015). Recently, evidence is emerging that sedentary behavior is a powerful risk factor for mortality, independent of time spent in MVPA (Dunstan et al., 2011; Koster et al., 2012; Matthews et al., 2012). The association between sedentary behavior and cardiovascular health is particularly strong, with a systematic review reporting a relative risk (RR) of 2.47 for cardiovascular events for those in the most sedentary category, and strong associations were also present for cardiovascular mortality (hazard ratio (HR) 1.90) and diabetes (RR 2.12) (Wilmot et al., 2012).

The association between sedentary behavior and stroke risk has recently been examined in post-menopausal women, where sitting

more than 10 h a day was associated with an increased risk of stroke (multivariable adjusted hazard ratio 1.21) (Chomistek et al., 2013). Prolonged sitting may increase stroke risk through the detrimental effect on cardiometabolic markers such as glycemic control (Dunstan et al., 2007), blood pressure and waist circumference (Healy et al., 2008) which are known stroke risk factors. These associations have been demonstrated in studies focused on television viewing time (Dunstan et al., 2007; Healy et al., 2008) and self-reported sitting time (Staiano et al., 2014). Further research is needed to investigate the effect of sedentary behavior on stroke risk in men and women.

The most common leisure-time sedentary behavior is TV viewing time, again strongly associated with cardiovascular risk factors – independent of leisure time exercise (Dunstan et al., 2010) and moderate-to-vigorous-intensity physical activity (Gardiner et al., 2011; Stamatakis et al., 2011). A life-table analysis has examined the reduction in life expectancy with excessive TV viewing and proposed that every hour of TV watched after the age of 25 years reduces your life expectancy by 22 min, suggesting that sedentary time is comparable in magnitude to other behavioral risk factors such as obesity and smoking (Veerman et al., 2012). Excessive TV viewing, measured via self-report, is also associated with cardiovascular and all-cause mortality (Ikehara et al., 2015; Wijndaele et al., 2011). Due to the strong association between TV viewing and increased cardiovascular events, diabetes and risk of premature death, we propose that TV viewing may also be

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associated with increased risk of stroke. The aim of this study was to explore the relationship between TV viewing and risk of incident stroke in the REGARDS cohort. We propose that TV viewing time is likely to be a conservative measure of sedentary behavior, considering that other seated activities could include screen time for computer use, reading, sitting for transportation etc. However, we have focused on this because of the detrimental effect of TV viewing time on cardiometabolic biomarkers and stroke risk factors.

2. Methods

The REGARDS study has been described in detail elsewhere (Howard et al., 2005). Briefly, 30 239 participants were recruited between 2003 and 2007 from the continental United States to determine the causes for the excess stroke mortality in African Americans and those living in the Southeastern US. Participants aged 45 years and over were recruited by mail and telephone from a commercially available list of residents. Those who consented were interviewed by telephone to collect data on demographic and risk factors, followed by an in-home assessment to collect physical measures, an electrocardiogram (ECG) and self-administered questionnaires. Relevant stroke risk factors included as covariates in this analysis were body mass index (kg/m^2), waist circumference (cm), physical activity levels (self-reported number of times per week engaged in intense physical activity, sufficient to work up a sweat, with categories 0, 1–4 and ≥ 4 times per week), systolic blood pressure (mmHg), self-reported statin use (yes or no), left ventricular hypertrophy or atrial fibrillation (on measured ECG, yes or no), smoking status (never versus past versus current use of cigarettes), alcohol use (heavy, ≥ 7 drinks/wk. for women, ≥ 14 drinks/wk. for men; moderate, 1–7 for women, 1–14 for men; and none) and diabetes mellitus (fasting glucose, ≥ 126 mL/dL or non-fasting glucose ≥ 200 mL/dL, or self-reported use of oral hypoglycemic medications or insulin). Participants, or their proxies, are contacted every six months by telephone to assess potential stroke, with retrieval and central physician adjudication of medical charts of suspected strokes. All involved Institutional Review Boards approved the study methods.

2.1. Assessment of sedentary behavior

Television/video viewing time was determined during the baseline self-administered questionnaire with the question “How many hours do you watch television or video, per day or per week, on average?” Self-reported TV viewing time has been established as a valid (criterion validity = 0.3) and reliable measure among adults (intraclass correlation = 0.82, 95% CI 0.75 to 0.87) (Salmon et al., 2003). Responses were initially categorized into 6 groups: none, 1–6 h per week, 1 h/day, 2 h/day, 3 h/day, and 4 or more h/day. At baseline, 23 703 participants responded to this question, 78.4% of the sample.

2.2. Assessment of incident stroke

Incidence of stroke was confirmed in a three-stage process, as previously described (Howard et al., 2011). Briefly, reports of possible stroke events result in retrieval of medical records which were reviewed by a stroke nurse and then reviewed by at least 2 physician members of a panel of stroke experts in accordance with the World Health Organization (WHO) definition (Aho et al., 1980). Events not meeting this definition due to a duration of symptoms < 24 h and neuroimaging consistent with acute ischemia or hemorrhage were classified as “clinical strokes” or “probable strokes” if adjudicators agreed that the event was likely to a stroke or death related to stroke, but information was incomplete for WHO or clinical classification.

2.3. Statistical analysis

Cox proportional hazards analysis was used to determine the hazard ratios (HR) and 95% confidence intervals (CI) for the association between prior TV viewing and all incident stroke, and incident ischemic stroke during follow-up. The six TV viewing categories were collapsed into three, based on previous studies investigating the link between TV viewing and mortality (Dunstan et al., 2010): < 2 h a day, ≥ 2 to < 4 h/day, ≥ 4 h/day. For the purposes of statistical analysis, TV viewing time was seen as the predictor variable and the reference value was watching TV less than two hours a day. Models were initially adjusted for the demographic factors age, race, sex, and age-race interaction, then for socioeconomic factors (income and education). Additional models adjusted for physical activity levels at baseline, then other factors which may affect TV viewing: self-reported general health (poor, fair, good, very good or excellent), marital status, employment status and depressive symptoms (defined as a score ≥ 4 on the Centers for Epidemiologic Studies of Depression CESD-4 scale (Melchior et al., 1993)). The final model adjusted for other stroke risk factors (body mass index and waist circumference, systolic blood pressure, statin use, left ventricular hypertrophy, atrial fibrillation, alcohol use, smoking and diabetes). Baseline differences between TV viewing categories were determined using analysis of variance for continuous variables, and Chi square tests for categorical data. Interactions between TV viewing and covariates, with stroke as the end point, were conducted using the Wald Chi-square type 3 test. All analyses were conducted using SAS software (version 9.3; SAS Institute Inc., Cary, NC) and results were considered significant at $P < 0.05$.

3. Results

Of the 30 239 participants in the REGARDS study, 56 with data anomalies were excluded. We then excluded individuals with a history of stroke at baseline (2032) and those who had not answered the TV/video viewing question (5984), leaving 22,257 participants for the current analysis.

The characteristics of participants are shown in Table 1, categorized by amount of TV/video viewing. Only 20% of participants watched TV for < 2 h/day and almost a third of participants watched TV ≥ 4 h/day (30%). Those who watched TV ≥ 2 h/day were more likely to be older, African American, unmarried, unemployed, live in urban areas; and less likely to have a higher education or an income \geq US\$35,000. There were also significant trends in stroke risk factor profile, with greater proportions of smoking, physical inactivity, left ventricular hypertrophy, hypertension, obesity and statin use in those who watched more TV.

There were 727 confirmed cases of stroke within a mean follow up of 7.1 ± 2.6 years. There was a statistically significant trend towards greater incidence of total stroke across TV viewing categories, with 363 strokes in the group who watched ≥ 2 to < 4 h of TV/day (3.3% of the total participants in this category), 241 in the group who watched ≥ 4 h/day (3.6%) compared with 123 in the group who watched < 2 h/day (2.7%, analysis of variance, $P = 0.04$). There was no significant difference in the incidence of ischemic stroke ($P = 0.05$).

Participants who watched TV ≥ 4 h/day were significantly more likely to suffer a stroke than those who watched < 2 h/day HR 1.37, 95% (CI 1.10–1.71) in the initial model that adjusted for demographic factors (age, race, sex, region, age-race interaction, see Table 2). Further adjustment for education and income attenuated this effect (HR 1.21, CI 0.96–1.53), with additional multivariable models adjusting for physical activity and general health variables, and stroke risk factors, attenuating the effect further. Similar HRs were observed for incident ischemic stroke (see Table 2), with a significant increase in stroke risk in participants who watched TV ≥ 4 h/day after adjustment for demographic factors (HR 1.35, CI 1.06–1.72). There was a dose-dependent effect, with those watching ≥ 2 to < 4 h of TV/day having a significantly greater risk of ischemic stroke (HR 1.28, CI 1.03–1.60), but not all incident stroke after

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