

# Television viewing and venous thrombo-embolism: a systematic review and meta-analysis <sup>FREE</sup>

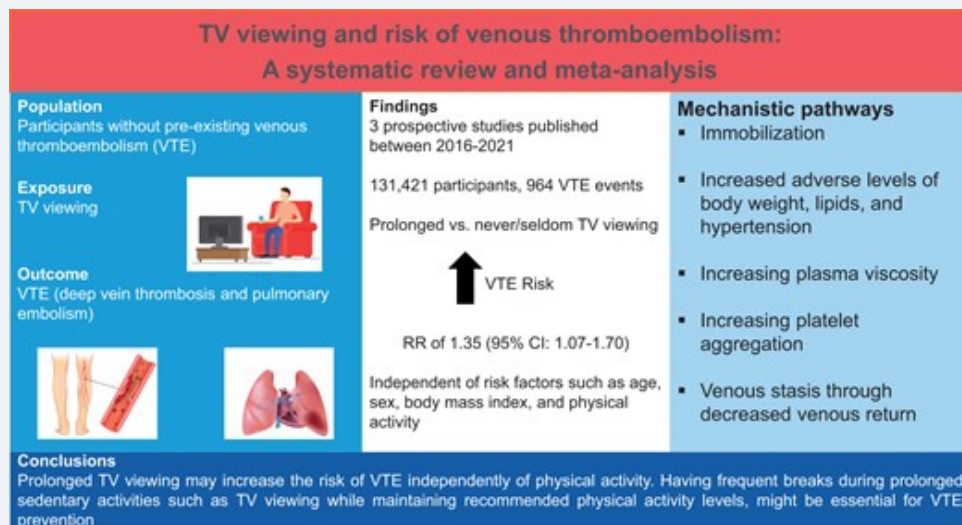
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## Graphical Abstract



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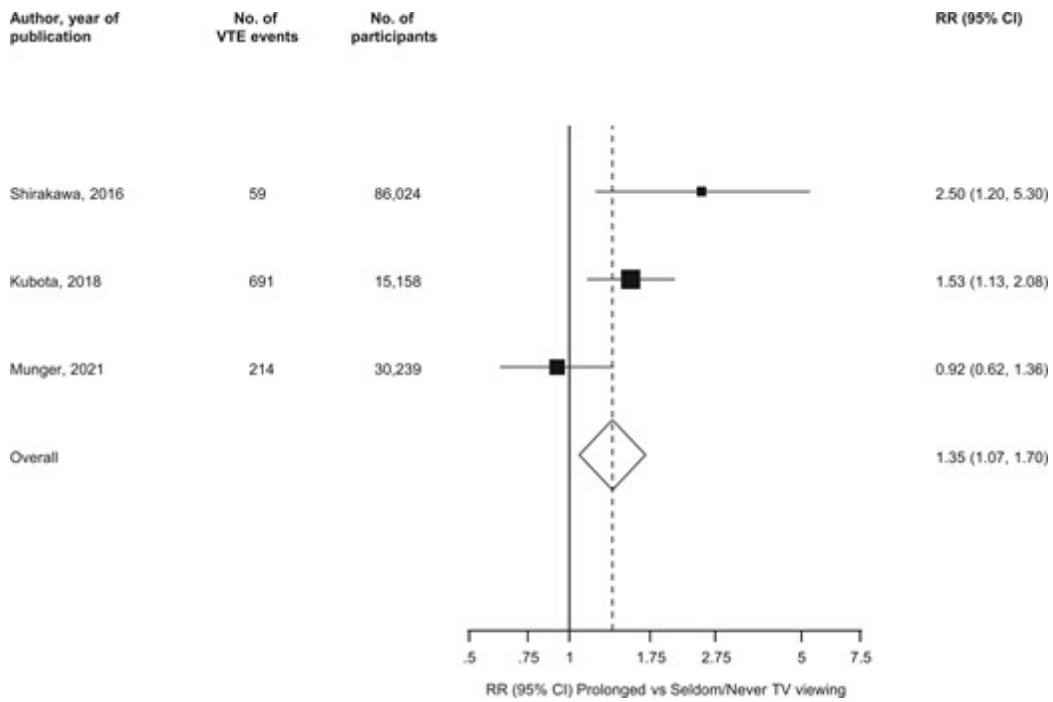
Arterial thrombotic disease (atherosclerotic cardiovascular disease, CVD) and venous thrombo-embolism (VTE; comprising of deep vein thrombosis and pulmonary embolism) are two closely related diseases, which share common risk factors (obesity and smoking) and pathophysiological pathways (such as coagulation, platelet activation, and dyslipidaemia).<sup>1</sup> Both disease states are associated with substantial morbidity, premature mortality, and high healthcare costs. It is well established that physical activity has an inverse and

dose–response relationship with atherosclerotic CVD.<sup>2</sup> Conversely, physical inactivity or prolonged sedentary behaviour is consistently associated with an increased risk of vascular diseases including atherosclerotic CVD.<sup>3</sup> Though the evidence on the relationship between physical activity and VTE risk has mostly been inconsistent,<sup>4,5</sup> a recent pooled analysis of 14 population-based prospective studies showed that regular physical activity was also associated with a reduced risk of VTE compared with physical inactivity.<sup>6</sup> Physical activity and physical inactivity are not the same risk factor, but the evidence suggests that physical inactivity may also be associated with an increased risk of VTE. Television (TV) viewing is a major component of leisure sedentary time (physical inactivity) and there is documented evidence on its relationship with atherosclerotic CVD.<sup>7</sup> Given the overall evidence, it is plausible that prolonged TV viewing may be associated with an increased VTE risk. However, the evidence so far has been inconsistent. Whereas some studies have reported an increased risk of VTE with prolonged TV viewing,<sup>8,9</sup> others have reported no significant evidence of an association.<sup>10</sup> Given the sparse and divergent evidence, there is a need for aggregation of the previous evidence, which will provide more power (in a larger sample of participants) to re-evaluate the association. In this context, using a systematic review and meta-analysis of all published observational cohort studies conducted on the topic, we sought to evaluate the nature and magnitude of the prospective association between TV viewing and VTE risk.

This review was registered in the PROSPERO prospective register of systematic reviews (CRD42021255057) and was conducted based on a pre-defined protocol and conducted in accordance with PRISMA and MOOSE guidelines ([Supplementary material online, S1 and S2](#)). We searched MEDLINE and Embase from inception to 1 July 2021 for published observational population-based prospective (cohort, case cohort, or nested case-control) studies that had examined the relation of TV viewing with the risk of first VTE events in general adult populations and had at least 1 year of follow-up. Details of the search strategy are reported in [Supplementary material online, S3](#). The summary measure was presented as a relative risk (RR) with 95% confidence intervals (CIs) with pooling done using a fixed-

effects model, given the limited number of studies. To enable a consistent approach to the meta-analysis and enhance comparison and interpretation of the findings, the extreme groups (i.e. prolonged vs. never or seldom TV viewing) were used for the analyses.<sup>6,11</sup> STATA release MP 16 (StataCorp LP, College Station, TX, USA) was used for all statistical analyses.

Of the 28 identified potentially relevant citations, 3 articles representing 3 unique prospective cohort studies were eligible for the analysis ([Supplementary material online, S4](#)).<sup>8-10</sup> The studies published between 2016 and 2021 comprised 131 421 general population participants and 964 VTE events. Two were based in the USA and one in Japan. The average age at baseline ranged from 54 to 65 years. The average duration of follow-up ranged from 5.1 to 19.8 years. All studies assessed TV viewing time through self-reported questionnaires, but its categorization varied across studies. Though there was a slight variation in the degree of covariate adjustment, all three studies adjusted for established risk factors such as age, sex, body mass index, and physical activity ([Table 1](#)). All three studies were at moderate risk of bias using the Cochrane Risk of Bias in Non-randomized Studies—of Interventions (ROBINS-I) tool ([Supplementary material online, S5](#)). The pooled multivariable-adjusted RR (95% CI) of VTE comparing prolonged vs. never/seldom TV viewing groups was 1.35 (1.07–1.70; [Figure 1](#)). Using the Grading of Recommendations Assessment, Development and Evaluation (GRADE) tool, the quality of the evidence was high ([Supplementary material online, S6](#)).

**Figure 1**

Observational cohort studies of TV viewing and risk of venous thrombo-embolism. The summary estimate presented was calculated using a fixed-effects models and was based on fully adjusted estimates; sizes of data markers are proportional to the inverse of the variance of the relative ratio. CI, confidence interval (bars); RR, relative risk; TV, television; VTE, venous thrombo-embolism.

**Table 1** Baseline characteristics of eligible studies

<b>Shirakawa et al.<sup>9</sup></b>	
Study name	JACC
Country	Japan
Baseline year	1988–90
Population source	Population register
Study design	Prospective cohort
Baseline age (years)	NR
Age range (years)	40–79
Males (%)	41.9
Follow-up (years)	19.2

TV assessment	Self-reported
VTE outcome	Mortality from PE
VTE ascertainment	Death records
Unit of TV assessment	Hours/day
No. of VTE events	59
No. of participants	86 024
Covariates adjusted for	Age, sex, BMI, history of hypertension, history of diab

ARIC, Atherosclerosis Risk in Communities; BMI, body mass index; CRP, C-reactive protein; CVD, cardiovascular disease; DVT, deep vein thrombosis; GFR, glomerular filtration rate; JACC, Japanese Collaborative Cohort Study; NR, not reported; PA, physical activity; PE, pulmonary embolism; REGARDS, REasons for Geographic and Racial Differences in Stroke; TV, television; VTE, venous thrombo-embolism.

In pooled analysis of three cohort studies, prolonged TV viewing was associated with an increased VTE risk, which was regardless of physical activity. Television viewing is a common sedentary behaviour, and it is well known to be associated with adverse health outcomes including atherosclerotic CVDs. The current findings add to the existing evidence that physical inactivity may be another common lifestyle factor shared by VTE and atherosclerotic CVD. Prolonged TV viewing, which involves immobilization (a strong risk factor for VTE), may increase VTE development via (i) increasing adverse levels of risk factors such as body weight, hypertension, and lipids; (ii) increasing systemic inflammation; (iii) increasing plasma viscosity and platelet aggregation; and (iv) promoting venous stasis through inhibiting venous blood return from the lower extremities during prolonged sitting.<sup>12</sup> Though physical activity has also been shown to reduce the risk of VTE, the overall findings suggest that the increased risk of VTE due to TV viewing is independent of physical activity. The study by Kubota *et al.*<sup>8</sup> showed that achieving recommended physical activity levels did not eliminate the increased VTE risk associated with frequent TV viewing. It has also been observed that accounting for physical activity attenuates but does not eliminate the increased risk of death associated with prolonged TV

viewing time.<sup>13</sup> In contrast, high levels of moderate-intensity physical activity seemed to eliminate the increased risk of death associated with high sitting time.<sup>13</sup> The excess risk due to TV viewing could be due to the very prolonged nature of this activity in a cramped position, which is detrimental for VTE development; as opposed to sitting time which is characterized by breaks. Consistent with this plausibility, another report demonstrated that regular exercise did not mitigate the increased risk of mortality due to prolonged sitting time if individuals sat for extended periods between short bouts of exercise.<sup>3</sup> Another potential explanation for the excess risk due to TV viewing could be due to the unhealthy dietary behaviours associated with TV viewing, such as snacking.

There were several limitations to this meta-analysis which were all inherent. These included (i) the small number of studies available for pooling which is likely due to the fact that the exposure (TV viewing) and outcome (VTE) are unique and rarely assessed in existing population-based cohort studies; (ii) misclassification bias due to the self-reported assessment of TV viewing; (iii) wide variability in categorization of TV viewing time and definition of prolonged TV viewing; (iv) residual confounding; (v) reverse causation bias; (vi) potential for regression dilution bias due to the use of a single baseline measurement of the exposure; and (vii) inability to investigate the reported relationship in subgroups of individuals. Furthermore, we could not investigate the dose-response relationship between TV viewing and VTE risk, so it is uncertain which duration of TV viewing is most likely to influence the development of VTE.

New evidence based on a meta-analysis of available observational prospective cohort studies may support an association between prolonged TV viewing and increased risk of VTE, which is independent of physical activity. Having frequent breaks during prolonged sedentary activities such as TV viewing while maintaining recommended physical activity levels, might be essential for VTE prevention. Further large-scale studies with high VTE event rates are still needed to explore the association.

# Supplementary material

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[Supplementary material](#) is available at *European Journal of Preventive Cardiology* online.

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**Conflict of interest:** The authors declare no conflict of interest.

## Data availability

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No new data were generated or analysed in support of this research.

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## Supplementary data

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[zwab220\\_Supplementary\\_Data](#) - docx file

## Comments

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