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TV Viewing from Young Adulthood to Middle Age and Cardiovascular Disease Risk

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Abstract

Introduction: Few studies have longitudinally examined TV viewing trajectories and cardiovascular disease risk factors. The objective of this study was to determine the association between level and annualized changes in young adult TV viewing and the incidence of cardiovascular disease risk factors from young adulthood to middle age.

Methods: In 2023, prospective community-based cohort data of 4,318 Coronary Artery Risk Development in Young Adults study participants (1990–1991 to 2015–2016) were analyzed. Individualized daily TV viewing trajectories for each participant were developed using linear mixed models.

Results: Every additional hour of TV viewing at age 23 years was associated with higher odds of incident hypertension (AOR=1.16; 95% CI=1.11, 1.22), diabetes (AOR=1.19; 95% CI=1.11, 1.28), high triglycerides (AOR=1.17; 95% CI=1.08, 1.26), dyslipidemia (AOR=1.10; 95% CI=1.03, 1.16), and obesity (AOR=1.12; 95% CI=1.06, 1.17). In addition, each hourly increase in daily TV viewing was associated with higher annual odds of incident hypertension (AOR=1.26; 95% CI=1.16, 1.37), low high-density lipoprotein cholesterol (AOR=1.15; 95% CI=1.03, 1.30), high triglycerides (AOR=1.32; 95% CI=1.15, 1.51), dyslipidemia (AOR=1.22; 95% CI=1.11, 1.34), and obesity (AOR=1.17; 95% CI=1.07, 1.27) over the follow-up period.

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Jason M. Nagata: Conceptualization, Investigation, Writing – original draft, Writing – review & editing. **Eric Vittinghoff:** Conceptualization, Formal analysis, Writing – review & editing. **Erin E. Dooley:** Conceptualization, Formal analysis, Writing – review & editing. **Feng Lin:** Data curation, Writing – review & editing. **Jamal S. Rana:** Writing – review & editing. **Stephen Sidney:** Writing – review & editing. **Kelley Pettee Gabriel:** Conceptualization, Formal analysis, Writing – review & editing.

Conclusions: In this prospective cohort study, higher TV viewing in young adulthood and annual increases in TV viewing were associated with incident hypertension, high triglycerides, and obesity. Young adulthood as well as behaviors across midlife may be important time periods to promote healthful TV viewing behavior patterns.

INTRODUCTION

Despite evidence for inverse associations between sedentary behavior (e.g., TV viewing) and cardiovascular disease (CVD) risk factors,[1, 2, 3] there is a paucity of data on the specific trajectories (behavioral patterns over age and time) of TV viewing during young adulthood and the association of TV viewing trajectory groups with adult-onset CVD risk factors. TV viewing could be linked to CVD risk through the displacement of physical activity and excess caloric intake while viewing TV.[4, 5, 6] From 2013 to 2017, 80% of U.S. adults watched TV on a given day, which accounted for 55% of all time spent in leisure and sports.[7] Therefore, TV viewing represented the most commonly used leisure screen modality in adults, despite the advent of smartphones and other devices.[7]

The 2018 HHS *Physical Activity Guidelines for Americans* identified important evidence gaps related to sedentary behavior and young adulthood.[1,2] Little is known about the association between young adult sedentary behavior, independent of physical activity, and CVD risk (evidence grade: limited), and thus, the HHS guidelines did not provide a recommendation on sedentary behavior in young adulthood.[1,2] Furthermore, the HHS guidelines additionally determined that there was insufficient evidence to determine whether the relationship between sedentary behavior and CVD risk varies by sex and race.[2]

Prior research from the Coronary Artery Risk Development in Young Adults (CARDIA) study has demonstrated associations between TV viewing and CVD risk factors in young adulthood[8]; however, the study was cross-sectional. Another analysis found that reducing or maintaining early midlife levels of TV viewing is associated with less pericardial adipose tissue accumulation.[9] However, these studies lacked repeated measures and sufficient follow-up to examine trajectories of TV viewing from young adulthood to middle age.

To address the gaps identified by the HHS guidelines and literature, this study aims to determine the independent associations of daily TV viewing in young adulthood and subsequent increases in TV viewing through the transition to midlife and incidence of CVD risk factors (hypertension, diabetes, high low-density lipoprotein [LDL] cholesterol, low high-density lipoprotein [HDL] cholesterol, high triglycerides, dyslipidemia, and obesity). Second, the study examines whether the associations differ by sex and race. Young adulthood may set TV viewing trajectories for the rest of adulthood and represent an important window for early intervention.[10]

METHODS

Study Population

The CARDIA study recruited Black and White young adults (N=5,115) from 4 urban sites (Birmingham, AL; Chicago, IL; Minneapolis, MN; and Oakland, CA). Baseline data

collection occurred in 1985–1986. Participants have been followed up for more than 30 years. The cohort was designed to be approximately balanced within each center by age (18–24 years and 25–30 years), self-identified race (Black and White), sex (male and female), and educational level (high school or less or higher than high school) at baseline. After baseline examination, one participant requested to be excluded from further analyses. Retention was 86%, 81%, 77%, 74%, 72%, 72%, and 71% at Years 5, 7, 10, 15, 20, 25, and 30, respectively. Additional details about the study design are described elsewhere.[11] The current analysis included 4,318 participants who reported TV viewing data from the Year 5 examination (the first year TV viewing was measured) onward. The IRBs at each study site (University of Alabama at Birmingham, Northwestern University, University of Minnesota, and Kaiser Foundation Research Institute) approved study procedures, and all participants provided written informed consent.

Measures

TV viewing was ascertained by the interviewer-administered CARDIA Physical Activity History Questionnaire at Years 5, 10, 15, 20, 25, and 30.[12] Participants were asked, *During leisure time do you watch TV or other video programming?* Response options included never, seldom, sometimes, often, and very often. For responses other than never (e.g., seldom, sometimes, often, or very often), participants were asked, *on the average, about how many hours per day do you watch TV or other video programming?* This reported number (or 0 for never) was used to calculate the average number of hours per day.

Hypertension was calculated from blood pressure measured at each of the CARDIA examinations. Resting systolic and diastolic blood pressure were measured 3 times at 1-minute intervals. To ensure the comparability of the measurements for Years 0–15 (Hawksley random zero sphygmomanometer) and 20–30 (Omron automated oscillometric blood pressure monitor),[13,14] an average of the calibrated values of the second and third blood pressure measurements was used. *Hypertension* was defined per 2017 American College of Cardiology/American Heart Association guidelines as systolic blood pressure ≥130 mmHg, diastolic blood pressure ≥80 mmHg,[15] or participants' report of taking antihypertensive medications.

Diabetes was assessed from blood drawn and processed at the central laboratory according to standard procedures during each of the CARDIA examinations. Glucose was assayed using the hexokinase method. *Diabetes* was defined as fasting glucose ≥126 mg/dL or on diabetes medications but not pregnant for examinations before May 2011.[11,16] For examinations after May 2011, *diabetes* was defined as HbA1c ≥6.5%, fasting glucose ≥126 mg/dL, 2-hour glucose tolerance test ≥200 mg/dL, or being on diabetes medications but not pregnant.

Fasting lipid measurements were collected at each of the examinations. Total cholesterol was measured enzymatically and defined as high if levels were ≥240 mg/dL.[11] Triglycerides were measured enzymatically and defined as high if levels were ≥200 mg/dL.[11] HDL cholesterol was determined after precipitation with dextran sulfate-magnesium chloride and defined as low if levels were <35 mg/dL for males or <45 mg/dL for females. LDL cholesterol was calculated using the Friedewald equation and defined as high if levels were

≥160 mg/dL.[17] *Dyslipidemia* was defined as triglycerides ≥150 mg/dL or HDL <35 mg/dL for males or triglycerides ≥150 mg/dL or HDL <45 mg/dL for females.

Height and weight were measured at each examination and used to calculate BMI. *Obesity* was defined as a BMI ≥30.

Age (years), race (Black or White), sex (male or female), physical activity (exercise units from the CARDIA Physical Activity History Questionnaire),[12,16] smoking status (never, former, or current), alcohol use (milliliter of alcohol consumed per day), educational attainment (highest grade of school completed), and family history of CVD (yes or no) were reported through standardized questionnaires. These variables were considered potential confounders for the association between TV viewing and CVD risk factors based on previous literature.[18,19]

Statistical Analysis

TV viewing trajectories were modeled among all CARDIA participants. Concise summaries of TV viewing patterns over time were generated using a linear mixed model for repeated measures of TV viewing.[18,19] The TV viewing slopes were estimated using all observations of daily hours of TV viewing before CVD risk factor onset with the goal of using as much of the data per participant as possible (i.e., if data were missing for 1 or more year[s], data from the remaining years available were used) and stabilizing the best linear unbiased predictions. The linear mixed model had random effects for participant and age, with unstructured covariance, as well as fixed effects for a 4-level joint categorization of sex and race, continuous age, and their interactions. The expected daily hours of TV viewing at the age of 23 years (youngest age at Year 5 examination) and the annual change for each participant are calculated on the basis of the fixed and random effects estimates from the models. The linear mixed models provide consistent estimates as long as the data are missing at random, given the observed outcomes and the covariates included in the model. Although covariates differ by loss to follow-up (Appendix Table 1, available online) and expected TV hours at the age of 23 years are independently predictive of loss to follow-up (Appendix Table 2, available online), these covariates are in the final adjusted model.

For modeling the association of TV viewing with incident CVD risk, Kaplan–Meier methods were used to estimate the unadjusted cumulative incidence of CVD risk factors (hypertension, diabetes, high LDL cholesterol, low HDL cholesterol, high triglycerides, high total cholesterol, dyslipidemia, or obesity) by sex and race/ethnicity. The data for each participant were then expanded to include a record for each age between study entry and either CVD risk factor onset, which was assumed to occur at the first visit at which it was detected, or at censoring by the end of the study or loss to follow-up. Pooled logistic models were used to estimate the independent associations of the expected daily hours of TV viewing at the age of 23 years and subsequent annual change with the onset of CVD risk. For each outcome, Model 1 adjusted for age, sex, and race. Model 2 adjusted for potential confounders, including age, race, sex, education, family history of CVD, smoking status, alcohol, physical activity, and BMI (except for obesity outcome). Physical activity, smoking status, alcohol use, and BMI were time-varying (i.e., data from each year of the covariate throughout the follow-up were used), with the last observation carried forward if a covariate

was missing data at a particular year. These covariates have been adjusted for in prior analyses of TV viewing and CVD risk factors.[18,19] After the primary analysis, models with 4 copies of each of the 2 TV viewing variables (level and change), 1 copy for each sex–race group, were fit. Wald tests for the quality of the corresponding 4 regression coefficients were conducted. All analyses were conducted using Stata 17.0 (StataCorp, College Station, TX).

RESULTS

The baseline demographic and health characteristics of the 4,318 participants (48.8% Black and 45.1% male) included in the sample are displayed in Table 1. Figure 1 portrays the average TV viewing trajectories from young adulthood to middle age by race and sex. Appendix Figures 1-7 show the cumulative incidence of CVD risk factor outcomes by race and sex.

Pooled logistic regression model estimates for the associations between CVD risk factor incidence and the 2 TV viewing summaries (daily hours of TV viewing at the age of 23 years and subsequent increases in daily hours of TV viewing) are shown in Table 2. In the fully adjusted model (Model 2), every additional hour of TV viewing at the age of 23 years was associated with higher odds of incident hypertension (AOR=1.16; 95% CI=1.11, 1.22), incident diabetes (AOR=1.19; 95% CI=1.11, 1.28), incident high triglycerides (AOR=1.17; 95% CI=1.08, 1.26), dyslipidemia (AOR=1.1; 95% CI =1.03, 1.16), and obesity (AOR=1.12; 95% CI=1.06, 1.17). Each additional hour increase of daily TV viewing annually was associated with higher annual odds of hypertension incidence (AOR=1.26; 95% CI=1.16, 1.37), high triglycerides incidence (AOR=1.32; 95% CI=1.15, 1.51), low HDL cholesterol (AOR=1.15; 95% CI=1.03, 1.30), dyslipidemia (AOR=1.22; 95% CI=1.11, 1.34), and obesity (AOR=1.17; 95% CI=1.07, 1.27). In the fully adjusted model, neither TV viewing at the age of 23 years nor annual change was associated with incident high LDL cholesterol or diabetes.

Sex and race categories did not modify the effect of TV viewing (level and change) on incident CVD risk factors (p>0.05), except for the associations between TV viewing level at the age of 23 years and high LDL cholesterol and the level and change of TV viewing and obesity (Appendix Table 3). The association between TV viewing at the age of 23 years (AOR=1.55; 95% CI=1.33, 1.80) and annual increases in TV viewing (AOR=1.52; 95% CI=1.29, 1.79) and obesity were strongest among White women.

DISCUSSION

In this prospective cohort study spanning young adulthood to middle age across 4 urban sites in the U.S., higher TV viewing during young adulthood was associated with incident hypertension, diabetes, elevated triglyceride levels, and obesity. Therefore, reducing TV viewing engagement during young adulthood may be an important time for intervention to prevent CVD risk factors. Furthermore, for any given TV viewing level in young adulthood, annual increases in TV viewing were also associated with incident hypertension, diabetes, high triglycerides, and obesity. Thus, discouraging the escalation of TV viewing habits throughout the adult life course may also offer cardiovascular health benefits. Overall, these

findings indicate the significance of fostering healthy TV viewing habits during young adulthood and minimizing increases later in life as a means of preventing the onset of CVD.

The 2018 HHS *Physical Activity Guidelines for Americans* Scientific Report identified notable gaps in the existing evidence for the association between young adult sedentary behavior (including TV viewing), independent of physical activity, and CVD risk. Thus, the HHS guidelines refrained from providing a recommendation on sedentary behavior in young adulthood.[1,2] This study addresses this gap by finding that young adult TV viewing is prospectively associated with later adult CVD risk. The findings are consistent with those of prior research, which has found associations between TV viewing and higher blood pressure,[20,21] diabetes,20, 21, 22 and high triglycerides[20,21] in the general adult population as well as those of a prior cross-sectional study from CARDIA that focused on young adults but did not include follow-up.[8] This study extends the current evidence by examining longitudinal TV viewing trajectories from young adulthood to middle age and investigating their prospective relationship with CVD risk factor outcomes.

Several mechanisms offer potential explanations for the association between TV viewing and CVD risk factors. Time spent watching TV may displace time that could be allocated for moderate-to-vigorous intensity physical activity, which is generally protective of CVD and related risk factors.[18,19,23] Furthermore, TV viewing is primarily sedentary, and sedentary behavior is a risk factor for CVD independent of physical activity.[24] This study supports previous studies because adjusted models found that TV viewing was associated with incident CVD risk factors even after adjusting for physical activity. In addition, findings suggest that TV viewing in young adulthood and annual increases in viewing behavior across young adulthood into midlife are independently associated with CVD risk factors, irrespective of physical activity.[24] The association between TV viewing and greater caloric consumption has also been observed.[25] This can be explained by more exposure to food advertisements on TV, distracted eating, and eating in the absence of hunger while watching TV.[26,27] More TV viewing has been associated with diets including more sugar and fat content, which could lead to diabetes and high triglycerides.[28] BMI may be a mediator rather than a confounder for the association between TV viewing and diabetes and hypertension. However, the associations between TV viewing and most CVD risk factors remain significant and are only slightly attenuated after adjusting for BMI.

The HHS guidelines Scientific Report additionally acknowledged that there was insufficient evidence to determine whether the relationship between sedentary behavior and CVD risk factors varies by sex and race.[2] This study did not find evidence that sex and race modified the effect of TV viewing (level or change) on incident CVD risk factors. However, Black young adults, on average, reported higher levels of TV viewing than their White counterparts, and these disparities persisted throughout adulthood, consistent with prior studies.[29,30] Black men and women also had a high incidence of hypertension and diabetes, which was most pronounced by the end of the follow-up around the age of 60 years for hypertension.

Limitations

Limitations should be noted. The study focuses exclusively on TV viewing as a form of screen exposure. In the 1990s (study baseline) and throughout most of the study, TV viewing was the only or primary form of screen exposure. TV viewing remains the most commonly used leisure screen time in adults today,[7] and it is noteworthy that TV viewing times remain mostly stable from young adulthood to midlife. However, it is important to acknowledge that the emergence of new technologies has introduced more options for leisure screen use, such as computers, tablets, and smartphones, which have not been accounted for in this study, and current rates of screen time are higher than that of TV viewing reported in the CARDIA cohort[31,32]; thus, the retrospective data may underestimate harms associated with excessive viewing in current generations. The measurement of TV viewing relied on self-reporting, which may be subject to social desirability bias; however, this would likely underestimate TV viewing estimates, which could bias findings toward the null hypothesis. Information bias, including recall bias due to the reliance on a 12-month recall period, may also be a factor in this self-reported data. The possibility of unmeasured confounders (e.g., employment) should be acknowledged, although the analysis adjusted for many potential confounders, including physical activity, age, sex, race, education, family history, smoking status, and alcohol. Despite these limitations, the study has the unique strength of including repeated measures of exposures and outcomes collected across the follow-up period in 4 urban sites across the U.S.

Clinicians may consider assessing for TV viewing and other sedentary behaviors during health maintenance visits and encourage physical activity during leisure time. Given that findings indicate that TV viewing habits tend to remain stable beyond young adulthood, counseling young adults about limiting TV viewing and promoting activity during leisure time could be recommended during health maintenance visits. The American Academy of Pediatrics encourages a family media use plan, which could include discussions of screen-free times, such as during family meals or before bedtime.[33] Similar strategies to curtail excessive TV viewing could be implemented for young adults. Educational institutions (e.g., community colleges, universities), workplaces, community organizations, and faith-based organizations could be leveraged to promote alternatives to sedentary TV viewing, including physical activity for young adults. Structural interventions to provide safe green spaces and outdoor recreation areas, particularly in low-income neighborhoods, could also provide alternatives to TV viewing.[34]

CONCLUSIONS

Overall, higher TV viewing in young adulthood and subsequent increases in middle age are associated with incident CVD risk factors, including hypertension, diabetes, and high triglycerides. Young adulthood represents an important time when individuals establish lifestyle behaviors such as TV and screen viewing for the rest of their life course. Specific guidance and interventions aimed at limiting excess TV viewing in young adulthood and optimizing screen use are important areas of future research. Future longitudinal studies can expand on this study to include additional screen modalities and CVD event outcomes (e.g., myocardial infarction, stroke) in later life.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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REFERENCES

1. U.S. Department of Health and Human Services. Physical Activity Guidelines for Americans, 2nd Edition. Department of Health and Human Services; 2018. https://health.gov/sites/default/files/2019-09/Physical_Activity_Guidelines_2nd_edition.pdf. Accessed November 27, 2023.
2. U.S. Department of Health and Human Services. 2018 Physical Activity Guidelines Advisory Committee scientific report. https://health.gov/sites/default/files/2019-09/PAG_Advisory_Committee_Report.pdf. Accessed November 27, 2023.
3. MacDonell N, Hancox RJ. Childhood and adolescent television viewing and metabolic syndrome in mid-adulthood. Pediatrics. 2023;152 (2):e2022060768. 10.1542/peds.2022-060768. [PubMed: 37483126]
4. Maher CA, Mire E, Harrington DM, Staiano AE, Katzmarzyk PT. The independent and combined associations of physical activity and sedentary behavior with obesity in adults: NHANES 2003-06. Obesity (Silver Spring). 2013;21(12):E730–E737. 10.1002/oby.20430. [PubMed: 23512825]
5. Saunders TJ, Chaput JP, Tremblay MS. Sedentary behaviour as an emerging risk factor for cardiometabolic diseases in children and youth. Can J Diabetes. 2014;38(1):53–61. 10.1016/J.JCJD.2013.08.266. [PubMed: 24485214]
6. Nagata JM, Lee CM, Lin F, et al. Screen time from adolescence to adulthood and cardiometabolic disease: a prospective cohort study. J Gen Intern Med. 2023;38(8):1821–1827. 10.1007/s11606-022-07984-6. [PubMed: 36627526]
7. Krantz-Kent R. Television, Capturing America's Attention at Prime Time and Beyond. https://www.bls.gov/opub/btn/volume-7/televisioncapturing-americas-attention.htm. Accessed October 7, 2022, 11; 2018.
8. Sidney S, Sternfeld B, Haskell WL, Jacobs DR, Chesney MA, Hulley SB. Television viewing and cardiovascular risk factors in young adults: the CARDIA study. Ann Epidemiol. 1996;6(2):154–159. 10.1016/1047-2797(95)00135-2. [PubMed: 8775596]
9. Oh M, Jacobs DR, Gabriel KP, et al. Ten-year changes in television viewing and physical activity are associated with concurrent 10-year change in pericardial adiposity: the Coronary artery Risk Development in Young Adults Study. J Phys Act Health. 2022;19(8):531–539. 10.1123/jpah.2021-0726. [PubMed: 35894964]
10. Kwon S, Janz KF, Letuchy EM, Burns TL, Levy SM. Developmental trajectories of physical activity, sports, and television viewing during childhood to young adulthood: Iowa bone development study. JAMA Pediatr. 2015;169 (7):666–672. 10.1001/jamapediatrics.2015.0327. [PubMed: 25984811]

11. Friedman GD, Cutter GR, Donahue RP, et al. Cardia: study design, recruitment, and some characteristics of the examined subjects. J Clin Epidemiol. 1988;41(11):1105–1116. 10.1016/0895-4356(88)90080-7. [PubMed: 3204420]
12. Pereira MA, FitzerGerald SJ, Gregg EW, et al. A collection of physical activity questionnaires for health-related research. Med Sci Sports Exerc. 1997;29(6 suppl):S1–205. [PubMed: 9243481]
13. Yano Y, Reis JP, Levine DA, et al. Visit-to-visit blood pressure variability in young adulthood and hippocampal volume and integrity at middle age: the CARDIA study (Coronary artery Risk Development in Young Adults). Hypertension. 2017;70(6):1091–1098. 10.1161/HYPERTENSIONAHA.117.10144. [PubMed: 28993449]
14. Coronary Artery Risk Development in Young Adults Study. Year 20 Manual of Operations - Blood Pressure and Pulse. https://www.cardia.dopm.uab.edu/images/more/pdf/mooy20/Y20%20Blood%20Pressure.pdf. Accessed November 27, 2023.
15. Whelton PK, Carey RM, Aronow WS, et al. 2017 ACC/AHA/AAPA/ ABC/ACPM/AGS/APhA/ASH/ASPC/NMA/PCNA Guideline for the Prevention, Detection, Evaluation, and Management of High Blood Pressure in Adults: a Report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines. Hypertension. 2018;71(6):e13–115. 10.1161/HYP.0000000000000065. [PubMed: 29133356]
16. Laddu DR, Rana JS, Murillo R, et al. 25-year physical activity trajectories and development of subclinical coronary artery disease as measured by coronary artery calcium: the Coronary artery Risk Development in Young Adults (CARDIA) study. Mayo Clin Proc. 2017;92(11):1660–1670. 10.1016/j.mayocp.2017.07.016. [PubMed: 29050797]
17. Friedewald WT, Levy RI, Fredrickson DS. Estimation of the concentration of low-density lipoprotein cholesterol in plasma, without use of the preparative ultracentrifuge. Clin Chem. 1972;18(6):499–502. 10.1093/clinchem/18.6.499. [PubMed: 4337382]
18. Nagata JM, Vittinghoff E, Gabriel KP, et al. Moderate-to-vigorous intensity physical activity from young adulthood to middle age and metabolic disease: a 30-year population-based cohort study. Br J Sports Med. 2022;56(15):847–853. 10.1136/BJSPORTS2021-104231. [PubMed: 34521685]
19. Nagata JM, Vittinghoff E, Pettee Gabriel K, et al. Physical activity and hypertension from young adulthood to middle age. Am J Prev Med. 2021;60(6):757–765. 10.1016/j.amepre.2020.12.018. [PubMed: 33867211]
20. Thorp AA, Healy GN, Owen N, et al. Deleterious associations of sitting time and television viewing time with cardiometabolic risk biomarkers: Australian Diabetes, Obesity and Lifestyle (AusDiab) study 2004-2005. Diabetes Care. 2010;33(2):327–334. 10.2337/dc09-0493. [PubMed: 19918003]
21. Healy GN, Dunstan DW, Salmon J, Shaw JE, Zimmet PZ, Owen N. Television time and continuous metabolic risk in physically active adults. Med Sci Sports Exerc. 2008;40(4):639–645. 10.1249/MSS.0b013e3181607421. [PubMed: 18317383]
22. Grøntved A, Hu FB. Television viewing and risk of type 2 diabetes, cardiovascular disease, and all-cause mortality: a meta-analysis. JAMA. 2011;305(23):2448–2455. 10.1001/jama.2011.812. [PubMed: 21673296]
23. Nagata JM, Vittinghoff E, Gabriel KP, et al. Physical activity from young adulthood to middle age and premature cardiovascular disease events: a 30-year population-based cohort study. Int J Behav Nutr Phys Act. 2022;19(1):123. 10.1186/s12966-022-01357-2. [PubMed: 36127703]
24. Wijndaele K, Brage S, Besson H, et al. Television viewing and incident cardiovascular disease: prospective associations and mediation analysis in the EPIC Norfolk Study. PLoS One. 2011;6(5):e20058. 10.1371/journal.pone.0020058. [PubMed: 21647437]
25. Alblas MC, Mollen S, Wennekers AM, Fransen ML, van den Putte B. Consuming media, consuming food: investigating concurrent TV viewing and eating using a 7-d time use diary survey. Public Health Nutr. 2021;26(4):1–10. 10.1017/S1368980021002858. [PubMed: 34284844]
26. Nagata JM, Iyer P, Chu J, et al. Contemporary screen time modalities among children 9-10 years old and binge-eating disorder at one-year follow-up: a prospective cohort study. Int J Eat Disord. 2021;54 (5):887–892. 10.1002/eat.23489. [PubMed: 33646623]

27. Fiechtner L, Fonte ML, Castro I, et al. Determinants of binge eating symptoms in children with overweight/obesity. Child Obes. 2018;14 (8):510–517. 10.1089/chi.2017.0311. [PubMed: 30153037]

28. Jensen ML, Dillman Carpentier FR, Corvalan C, et al. Television viewing and using screens while eating: associations with dietary intake in children and adolescents. Appetite. 2022;168:105670. 10.1016/j.appet.2021.105670. [PubMed: 34478756]

29. Huffman FG, Vaccaro JA, Exebio JC, Zarini GG, Katz T, Dixon Z. Television watching, diet quality, and physical activity and diabetes among three ethnicities in the United States. J Environ Public Health. 2012;2012:191465. 10.1155/2012/191465. [PubMed: 22851980]

30. Shuval K, Gabriel KP, Leonard T. TV viewing and BMI by race/ethnicity and socio-economic status. PLoS One. 2013;8(5):e63579. 10.1371/journal.pone.0063579. [PubMed: 23691070]

31. Rideout V, Robb M. The Common Sense Census: media use by tweens and teens. Common Sense Media. 2019:1–104. Published online. https://www.commonsensemedia.org/sites/default/files/research/report/2019-census-8-to-18-full-report-updated.pdf. Accessed November 27, 2023.

32. Twenge JM, Campbell WK. Associations between screen time and lower psychological well-being among children and adolescents: evidence from a population-based study. Prev Med Rep. 2018;12:271–283. 10.1016/J.PMEDR.2018.10.003. [PubMed: 30406005]

3. Reid Chassiakos YL, Radesky J, Christakis D, Moreno MA, Cross C, COUNCIL ON COMMUNICATIONS AND MEDIA. Children and adolescents and digital media. Pediatrics. 2016;138(5):e20162593. 10.1542/peds.2016-2593. [PubMed: 27940795]

34. Nagata JM, Cortez CA, Dooley EE, Iyer P, Ganson KT, Pettee Gabriel K. Moderate-to-vigorous intensity physical activity among adolescents in the USA during the COVID-19 pandemic. Prev Med Rep. 2022;25:101685. 10.1016/J.PMEDR.2021.101685. [PubMed: 35004134]

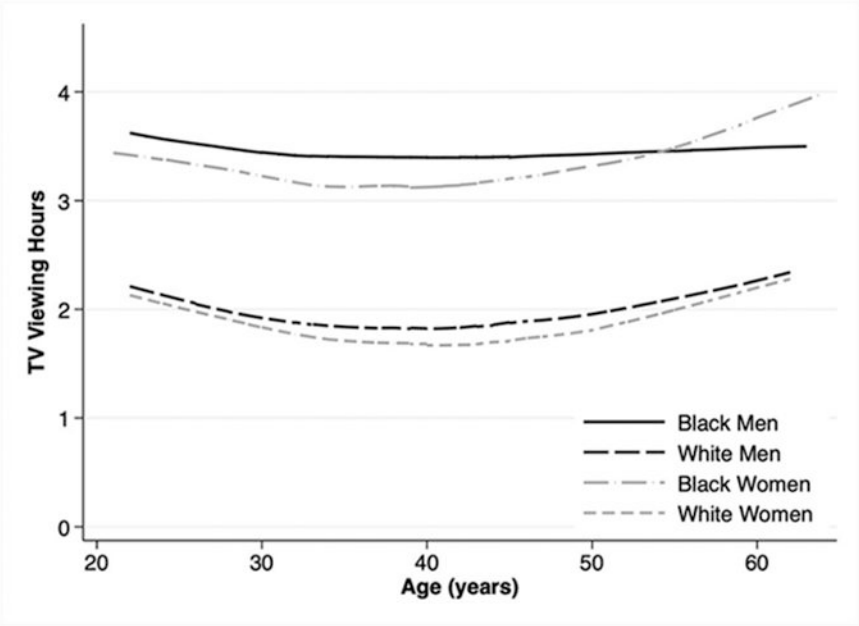

Figure 1.
Average TV viewing trajectories (hours per day), by race and sex.

Table 1.

Demographic and Health Characteristics of Participants in the CARDIA Study

Sociodemographic and health characteristics	Median (IQR)/*n*(%)
N	4,318
Age, years	30.0 (27.0–33.0)
Race and sex	
White women	1,165 (27.0%)
Black women	1,205 (27.9%)
White men	1,046 (24.2%)
Black men	902 (20.9%)
Highest grade of school completed	14.0 (12.0–16.0)
Family history of cardiovascular disease	861 (19.9%)
BMI	24.9 (22.2–28.6)
<25 kg/m^2	2,221 (51.4%)
≥25 and <30 kg/m^2	1,253 (29.0%)
≥30 kg/m^2	844 (19.5%)
Smoking status	
Never	2,468 (57.2%)
Former	610 (14.1%)
Current	1,240 (28.7%)
Alcohol (milliliter of alcohol consumed per day)	2.4 (0.0–14.3)
Total physical activity score (EU)[a]	311.0 (161.0–532.0)
TV viewing	
Total TV viewing at Year 5 examination (hours per day)	2.0 (1.0–3.0)
Estimated total TV viewing at the age of 23 years (hours per day)	2.9 (2.3–3.8)
Annual increase in TV viewing (hours per day)	0.2 (−0.2 to 0.5)
Cardiovascular disease risk factors	
Hypertension	871 (20.2%)
Diabetes	38 (0.9%)
High LDL cholesterol	283 (6.6%)
LDL cholesterol (mg/dL)	106.0 (86.0–127.5)
Low HDL cholesterol	647 (15.0%)
HDL cholesterol (mg/dL)	52.0 (43.0–62.0)
High triglycerides	153 (3.5%)
Triglycerides (mg/dL)	64.0 (46.0–93.0)
Dyslipidemia[b]	831 (19.3%)
Obesity	844 (19.5%)

[a] A total physical activity score of 300 EUs approximates the HHS recommendations of approximately 150 minutes of moderate-intensity activity per week.

[b] *Dyslipidemia* defined as triglycerides ≥150 mg/dL or HDL<35 mg/dL for males or HDL <45 mg/dL for females.

Table 2.

Associations Between TV Viewing Trajectories and Cardiovascular Disease Risk Factors in the CARDIA Study

Outcomes	Estimated TV viewing (hours per day) at the age of 23 years		Annual increase in TV viewing (hours per day)	
	OR (95% CI)	*p*-value	OR (95% CI)	*p*-value
Hypertension				
Model 1 (adjusted for age, sex, race)[a]	**1.20 (1.15, 1.25)**	**<0.001**	**1.28 (1.18, 1.39)**	**<0.001**
Model 2 (fully adjusted)[b]	**1.16 (1.11, 1.22)**	**<0.001**	**1.26 (1.16, 1.37)**	**<0.001**
Diabetes				
Model 1 (adjusted for age, sex, race)[a]	**1.20 (1.13, 1.28)**	**<0.001**	**1.16 (1.00, 1.33)**	**0.048**
Model 2 (fully adjusted)[b]	**1.19 (1.11, 1.28)**	**<0.001**	1.10 (0.95, 1.28)	0.21
High LDL cholesterol				
Model 1 (adjusted for age, sex, race)[a]	1.03 (0.96, 1.11)	0.36	1.07 (0.94, 1.23)	0.32
Model 2 (fully adjusted)[b]	1.02 (0.94, 1.11)	0.67	1.03 (0.90, 1.19)	0.65
Low HDL cholesterol				
Model 1 (adjusted for age, sex, race)[a]	**1.13 (1.07, 1.20)**	**<0.001**	**1.21 (1.08, 1.35)**	**<0.001**
Model 2 (fully adjusted)[b]	1.06 (0.99, 1.14)	0.07	**1.15 (1.03, 1.30)**	**0.018**
High triglycerides				
Model 1 (adjusted for age, sex, race)[a]	**1.25 (1.17, 1.33)**	**<0.001**	**1.42 (1.25, 1.62)**	**<0.001**
Model 2 (fully adjusted)[b]	**1.17 (1.08, 1.26)**	**<0.001**	**1.32 (1.15, 1.51)**	**<0.001**
Dyslipidemia[c]				
Model 1 (adjusted for age, sex, race)[a]	**1.18 (1.12, 1.24)**	**<0.001**	**1.31 (1.20, 1.43)**	**<0.001**
Model 2 (fully adjusted)[b]	**1.10 (1.03, 1.16)**	**0.002**	**1.22 (1.11, 1.34)**	**<0.001**
Obesity				
Model 1 (adjusted for age, sex, race)[a]	**1.11 (1.06, 1.16)**	**<0.001**	**1.15 (1.05, 1.25)**	**0.002**
Model 2 (fully adjusted)[b]	**1.12 (1.06, 1.17)**	**<0.001**	**1.17 (1.07, 1.27)**	**<0.001**

Note: Boldface indicates statistical significance ($p<0.05$).

[a]Model 1 includes estimated TV viewing level at the age of 23 years, annual increase in TV viewing, age, sex, and race.

[b] Model 2 includes estimated TV viewing level at the age of 23 years, annual increase in TV viewing, age, race, sex, education, physical activity, smoking, alcohol, family history of cardiovascular disease, and BMI (except for obesity outcome).

[c] *Dyslipidemia* defined as triglycerides ≥150 mg/dL or HDL <35 mg/dL for males or HDL <45 mg/dL for females.

CARDIA, Coronary Artery Risk Development in Young Adults; HDL, high-density lipoprotein.