



## Research paper

## Associations between TV viewing and depressive symptoms among 60,202 Brazilian adults: The Brazilian national health survey

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## ABSTRACT

**Background:** Our aim was to examine associations between depression and time spent in TV viewing in a representative sample of Brazilian adults.

**Methods:** Data from the Brazilian National Health Survey (Pesquisa Nacional de Saúde – PNS in Portuguese) ( $n = 60,202$ ;  $\geq 18$  years) were used. Time spent TV viewing (h/day) was elicited via interview. Depression was evaluated through the Patient Health Questionnaire-9. Chronological age, educational status, employment status, alcohol use, tobacco smoking and body mass index were covariates. Descriptive statistics (mean and 95% confidence interval) and adjusted logistic regression models were applied.

**Results:** Five or more hours as well as less than 1 h of TV viewing was associated with increased depression (men:  $< 1$  h OR = 1.89, 95%CI = 1.40–2.54;  $\geq 5$  h OR = 2.69, 95%CI = 1.88–3.83; women:  $< 1$  h OR = 1.50, 95%CI = 1.25–1.81;  $\geq 5$  h OR = 1.65, 95%CI = 1.35–2.03) when compared to 2–2.99 h of TV viewing.

**Conclusion:** More than 5 h/day seems to be associated with a higher risk for depression among Brazilian adults (except for older adults). Less than 1 h TV viewing might be a measure-of-proxy for a lower socio-economic status, which is a known risk factor for depression.

## 1. Introduction

Depression is the second leading cause of global disability (Ferrari et al., 2013a). Worldwide, including in Brazil, depressive disorders and associated symptoms such as sadness and suicidal thoughts are pervasive in society, affecting people of all ages, both sexes, across the full range of socioeconomic status (Ferrari et al., 2013a; Silva et al., 2014). A meta-analysis on prevalence rates of depression in Brazil demonstrated that the point prevalence of depressive symptoms was 14% (95% confidence interval [95%CI] 13%–16%), whereas the 1-year prevalence of major depressive disorder was 8% (95%CI 7%–10%), and the lifetime prevalence of major depressive disorder was 17% (95%CI 14%–19%) (Silva et al., 2014). These prevalence estimates of depression in Brazil are higher than the global point prevalence of 4.7% (95%CI: 4.4%–5.0%) and the one-year prevalence of 3.0% (95%CI: 2.4%–3.8%) (Ferrari et al., 2013b).

There is an abundance of research demonstrating that physical

activity is effective for the prevention and management of depression (Mammen and Faulkner, 2013; Schuch et al., 2016a,b). People with depressive symptoms tend to spend less time in physical activity (Schuch et al., 2017; Vancampfort et al., 2017). In past years, there has been growing interest in the relationship between sedentary behavior and depression. Sedentary behavior refers to any waking behavior characterized by an energy expenditure of  $\leq 1.5$  metabolic equivalents (METs), while in a sitting, reclining or lying posture (Tremblay et al., 2017). METs refers to the amount of energy expended by an individual, and is the ratio of the metabolic rate for a specific activity divided by the resting metabolic rate (Ainsworth et al., 2000). A recent meta-analysis, almost exclusively among high-income countries, found that among 110,152 individuals, higher levels of sedentary behavior were associated with depression (relative risk 1.31 (95%CI 1.16–1.48) (Zhai et al., 2015).

Whilst recent advances in the literature have shed light on this neglected issue, a number of biases and gaps exist in the literature

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**Table 1**  
Characteristics of the sample according to sex.

	<i>n</i>	Male % (CI 95%)	<i>n</i>	Female % (CI 95%)
Age				
18–39 (young adults)	12,295	49.3 (48.3–50.4)	16,295	46.3 (45.3–47.2)
40–59 (middle-aged adult)	9070	34.0 (32.9–35.0)	11,365	34.5 (33.6–35.4)
60+ (older adult)	4555	16.7 (15.9–17.5)	6622	19.2 (18.5–20.0)
Educational status				
No academic qualification	4293	15.2 (14.4–15.9)	5806	16.1 (15.4–16.8)
High school	18,090	71.7 (70.8–72.7)	23,417	68.9 (68.0–69.7)
More than high school	3537	13.1 (12.4–13.8)	5059	15.0 (14.3–15.7)
Employment status				
Yes	18,512	71.4 (70.4–72.4)	15,478	45.8 (44.9–46.8)
No	7408	28.6 (27.6–29.6)	18,804	54.2 (53.2–55.1)
Skin color				
White	10,226	46.8 (45.7–47.9)	13,880	48.0 (47.1–49.0)
Other	15,694	53.2 (52.1–54.3)	20,402	52.0 (51.0–53.0)
Feeling of sadness				
No	22,071	85.6 (84.8–86.3)	24,641	72.3 (71.4–73.1)
Yes	3849	14.4 (13.7–15.2)	96,411	27.7 (26.9–28.6)
Suicidal thoughts				
No	25,271	97.5 (97.2–97.8)	32,514	95.1 (94.7–95.5)
Yes	649	2.5 (2.2–2.8)	1768	4.9 (4.5–5.3)
Depression risk				
No	24,652	95.3 (94.8–95.7)	30,499	89.3 (88.7–89.8)
Yes	1268	4.7 (4.3–5.2)	3783	10.7 (10.2–11.3)
Leisure PA				
0	16,654	63.1 (62.0–64.2)	25,652	73.2 (72.3–74.0)
1–149	4403	18.1 (17.2–19.0)	3714	11.7 (11.1–12.3)
150+	4863	18.8 (17.9–19.6)	4916	15.1 (14.4–15.9)
TV viewing				
<1 h	6031	23.8 (22.9–24.8)	7245	21.7 (20.9–22.5)
1–1.99 h	7233	28.0 (27.0–28.9)	8248	23.9 (23.1–24.7)
2–2.99 h	5998	22.7 (21.8–23.5)	7678	22.5 (21.7–23.3)
3–3.99 h	3281	12.9 (12.2–13.6)	5061	14.4 (13.8–15.0)
4–4.99 h	1513	5.9 (5.4–6.4)	2562	7.3 (6.8–7.8)
≥5 h	1864	6.8 (6.3–7.3)	3488	10.2 (9.7–10.8)
Tobacco smoking				
No	20,930	81.1 (80.3–82.0)	30,543	89.0 (88.4–89.6)
Yes	4990	18.9 (18.0–19.7)	3739	11.0 (10.4–11.6)
Alcohol consumption				
No	16,242	60.8 (59.7–61.8)	29,370	84.8 (84.1–85.5)
Moderate	8118	32.5 (31.5–33.5)	4610	14.2 (13.6–14.9)
Heavy	1560	6.7 (6.2–7.3)	302	1.0 (0.8–1.2)
Body mass index				
Eutrophic	11,455	44.4 (43.4–45.5)	13,991	41.8 (40.9–42.8)
Overweight	10,094	38.7 (37.7–39.8)	11,501	33.7 (32.8–34.6)
Obese	4371	16.8 (16.0–17.6)	7990	24.4 (23.6–25.3)

Note. CI, confidence interval; PA, physical activity; TV, television.

exploring the relationship between sedentary behavior and depression to date. First, it remains to be explored in more detail how much time spent sedentary is associated with depression. Second, more research exploring context specific sedentary behavior such as TV viewing is needed, as it may provide important insights into the underlying relationships between sedentary behavior and depression. For example, previous research in a high income setting demonstrated that mainly passive sedentary behavior (TV viewing) is related with adverse mental health, while more cognitive challenging sedentary behavior such as reading, and computer and internet use are to a lesser extent associated with depressive symptoms (Hamer and Stamatakis, 2014). These data however still need to be confirmed. Also, most of the evidence regarding the association between sedentary behavior and depressive symptoms comes from high-income countries (Madhav et al., 2017; Nam et al., 2017).

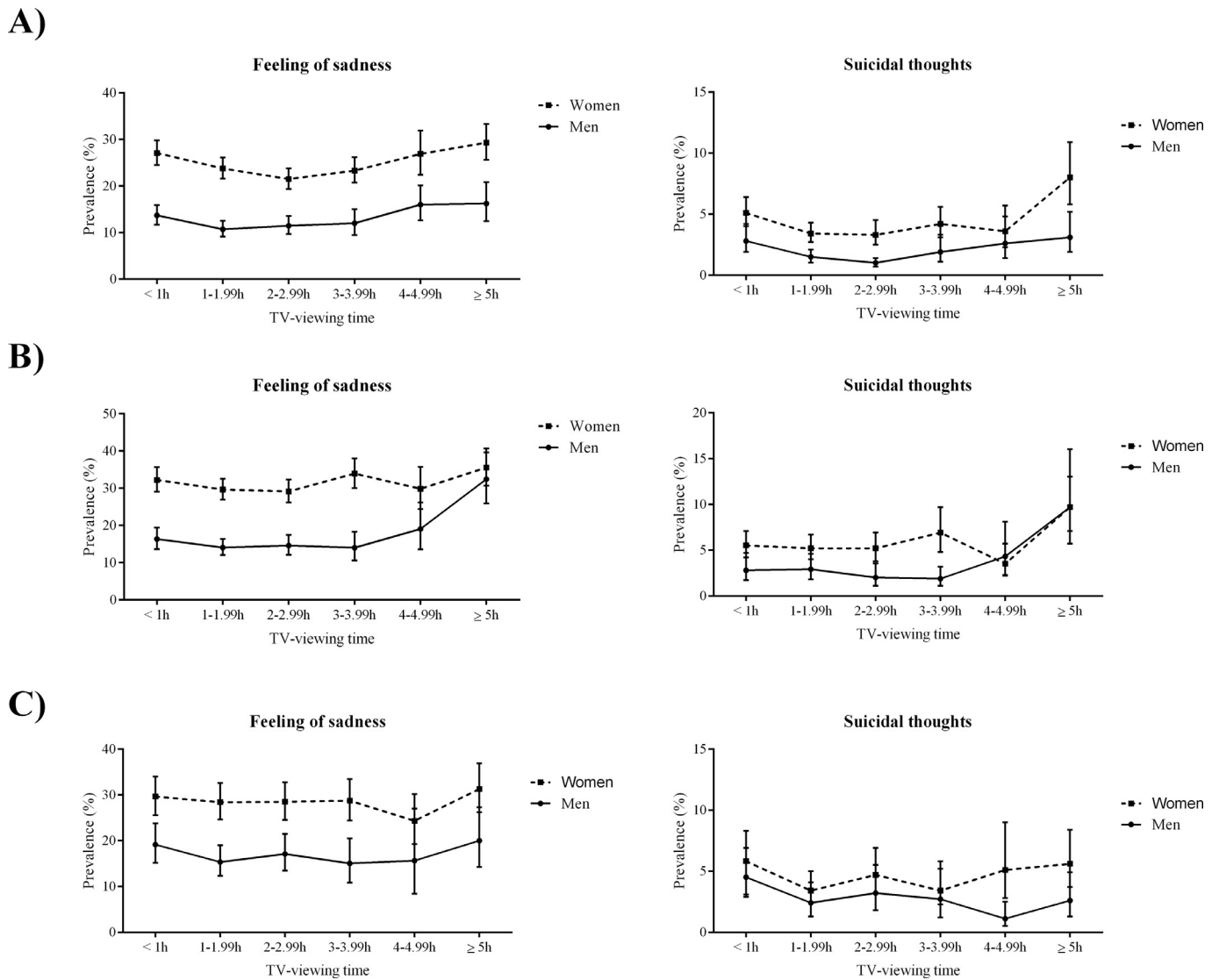
Exploring associations between the presence of depression and/or depressive symptoms and sedentary behavior in low-and middle-income countries, in particular, is important given different socio-cultural structures, methods of transportation, and environmental factors (e.g., safety, climate) compared with high-income countries (Koyanagi et al., 2017). The continuing dearth of studies from this part of the world also highlights the gap between where research is conducted and where the

largest public health impacts of physical inactivity will occur (Sallis et al., 2016). However, given that depression has been highlighted as a growing problem in low-and middle-income countries (Ruscio et al., 2017) and the interaction between factors that result in depression tend to vary according to social and cultural conditions (Munhoz et al., 2016; Silva et al., 2017; Teychenne et al., 2010), further information from national representative samples in low-and middle-income countries is warranted. Brazil is a middle-income country with a continental dimension and large inequalities across its five geographical regions (Brazilian Institute of Geography and Statistics, 2010). Therefore, the present study examined the relationship between symptoms of depression, and time spent TV viewing in a representative sample of Brazilian adults.

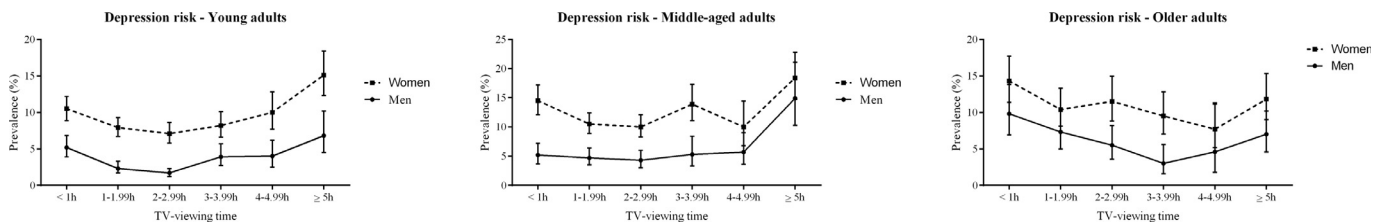
## 2. Methods

### 2.1. Sample

The present study used data from the Brazilian National Health Survey (Pesquisa Nacional de Saúde – PNS in Portuguese) (Brazilian Institute of Geography and Statistics, 2014). The PNS was a cross-sectional epidemiological study, conducted among a national



**Fig. 1.** Relationship between TV-viewing and mental health indicators. Note. Values are presented in prevalence (%). A represents young adults, B represents middle-aged adults and C represents old adults.



**Fig. 2.** Relationship between TV-viewing and depression risk by age group. Note. Values are presented in prevalence (%).

representative sample of adults (18–100 years old) during 2013 in Brazil. The sampling process was conducted in clusters. First, census tracts were randomly selected, next, households were randomly selected; and finally, in the households, one adult was randomly selected. The minimum sample size per federal unit ( $n = 27$ ) was 1800 households, with a total of 64,348 households, where interviews were conducted. For this investigation, the sample included 60,202 adults with complete data for all variables, except for analyses involving body mass index (BMI) that used fewer subjects ( $n = 59,402$ ) due to missing data. Estimates were weighted considering the weight of the household, adjusted for non-response by sex and total population by sex and age, and

counting the number per household. More details of the sample process and weighting have been previously published (Brazilian Institute of Geography and Statistics, 2014). All data were collected through household interviews (participant responding to a verbal prompt from an interviewer). The Brazilian Council of Ethics in Research approved all procedures according to the Helsinki declaration.

### 2.2. Depression risk

The main outcome for this study was positive screening for depression, which was evaluated using the nine items Patient Health

**Table 2**  
Association between TV viewing (collapsed categories) and mental health indicators.

	Depression risk	Feelings	
	OR (95%CI)	Sadness OR (95%CI)	Suicide OR (95%CI)
<b>Men</b>			
All ages			
< 2 h	1	1	1
2–3.99 h	<b>0.71 (0.57–0.89)</b>	0.93 (0.81–1.06)	<b>0.70 (0.51–0.96)</b>
≥ 4 h	<b>1.34 (1.03–1.73)</b>	<b>1.41 (1.18–1.67)</b>	1.39 (0.95–2.02)
Young adults			
< 2 h	1	1	1
2–3.99 h	<b>0.66 (0.47–0.94)</b>	0.91 (0.74–1.12)	0.63 (0.39–1.01)
≥ 4 h	1.41 (0.94–2.12)	<b>1.29 (1.01–1.67)</b>	1.28 (0.75–2.19)
Middle-aged			
< 2 h	1	1	1
2–3.99 h	0.92 (0.63–1.34)	0.93 (0.74–1.17)	0.66 (0.37–1.19)
≥ 4 h	<b>1.92 (1.26–2.93)</b>	<b>1.81 (1.37–2.40)</b>	<b>2.15 (1.16–3.98)</b>
Older adults			
< 2 h	1	1	1
2–3.99 h	<b>0.50 (0.32–0.80)</b>	0.96 (0.72–1.29)	0.88 (0.48–1.60)
≥ 4 h	0.67 (0.40–1.10)	1.11 (0.73–1.69)	0.52 (0.26–1.01)
<b>Women</b>			
All ages			
< 2 h	1	1	1
2–3.99 h	<b>0.83 (0.73–0.95)</b>	<b>0.89 (0.81–0.97)</b>	0.91 (0.75–1.11)
≥ 4 h	1.09 (0.93–1.27)	1.00 (0.89–1.12)	1.17 (0.95–1.44)
Young adults			
< 2 h	1	1	1
2–3.99 h	<b>0.80 (0.65–0.98)</b>	<b>0.79 (0.69–0.91)</b>	0.79 (0.59–1.06)
≥ 4 h	<b>1.45 (1.15–1.83)</b>	1.07 (0.89–1.29)	1.24 (0.90–1.72)
Middle-aged			
< 2 h	1	1	1
2–3.99 h	0.88 (0.70–1.09)	0.96 (0.82–1.13)	1.05 (0.77–1.44)
≥ 4 h	1.03 (0.80–1.34)	0.98 (0.80–1.20)	1.08 (0.77–1.51)
Older adults			
< 2 h	1	1	1
2–3.99 h	0.86 (0.64–1.16)	0.98 (0.80–1.20)	0.93 (0.62–1.40)
≥ 4 h	0.76 (0.56–1.05)	0.98 (0.76–1.25)	1.26 (0.80–2.00)

Note. Adjusted by chronological age, educational status, employment status, alcohol consumption, tobacco smoking, nutritional status and physical activity. OR, odds ratio. CI, confidence interval. TV, television. Bold values represent  $p < 0.05$ .

Questionnaire-9 (PHQ-9) (Kroenke et al., 2001). The PHQ-9 measures the frequency of depressive symptoms (depressed mood or feeling of sadness, anhedonia, trouble sleeping, tiredness or lack of energy, change of appetite or weight, feeling of guilt or uselessness, trouble concentrating, feeling slow or agitated and having recurrent thoughts about death or suicidal ideation) over the two weeks prior to data collection. Responses to each of the nine questions were measured on a Likert-scale: 0 = “Not at all”, 1 = “Several days”, 2 = “More than half the days”, and 3 = “Nearly every day”. The possible score ranges from 0 to 27. The algorithm of the test was used to identify individuals at higher risk of a major depressive episode (MDE), with the sum of the values  $> 9$  adopted as the cut-point for denoting depressive risk (Munhoz et al., 2016); herein referred as depression risk. We also used two specific individual items (feelings of sadness and suicidal thoughts) as outcomes because they are the most common among people with depression in Brazil (Munhoz et al., 2016; Silva et al., 2014; Silva et al., 2017); herein referred as depression symptoms. Symptom was defined as the occurrence of an individual item for at least “several days” (response option of “1” and above). The PHQ-9 instrument has good and acceptable evidence of validity among Brazilian adults (Santos et al., 2013). Moreover, the questionnaire yielded a good (Tavakol and Dennick, 2011) Cronbach's alpha value (0.836) in the present sample.

### 2.3. TV viewing

Television (TV) viewing was estimated through the question: “How many hours a day do you usually spend watching TV?” Responses were: (a)  $< 1$  h; (b) 1 h–1.99 h; (c) 2 h–2.99 h; (d) 3 h–3.99 h (e) 4 h–4.99 h; (f) 5 h–5.99 h; (g)  $> 6$  h; and (h) I do not watch TV. To access a gradual relationship, we classified TV viewing time into 6 categories (1 =  $< 1$  h; 2 = 1 h–1.99 h; 3 = 2 h–2.99 h; 4 = 3 h–3.99 h; 5 = 4 h–4.99 h; and 6 =  $\geq 5$  h). To be consistent with the commonly used cut-point for screen time (Arem et al., 2015; Ratjen et al., 2017), we also collapsed TV viewing time into the 3 categories ( $< 2$  h, 2–3.99 h,  $> 4$  h). Both categorizations (collapsed and non-collapsed categories) of TV viewing were tested separately in the analyses.

### 2.4. Covariates

Chronological age was included as a continuous variable. Based on recent evidence of physical activity and depression in Brazilian adults of different age-groups (de Oliveira et al., 2017), the age variable was also used to group the participants into three categories: young adults (18–39 years), middle-aged adults (40–59 years) and older adults ( $\geq 60$  years). Educational status was collected through the question: “What is your highest academic qualification?” From the responses, three categories (1 = no academic degree; 2 = at least high school; and 3 = at least college) were created and adopted as the covariate. Employment status was assessed through a question asking if the subject had a remunerated job in the last month, with a ‘yes’ or ‘no’ response option adopted as the covariate. Tobacco smoking was evaluated through the question “Do you use any tobacco product?”; answers were “yes, daily”, “yes, but not daily” and “no”. We considered those who answered “yes, daily” and “yes, but not daily” as having exposure and the dichotomous response was used as the covariate. Further, participants were asked on how many days per week they usually consumed alcohol; with the classification of: 1) Non-alcohol consumers; 2) Moderate alcohol consumers (alcohol non-consumption during 1–3 times per week); 3) Heavy alcohol consumers: (alcohol consumption during 4 or more days per week) adopted as the covariate. Also, body mass and stature were collected using a portable digital scale and stadiometer, respectively. After this, body mass index was calculated (as a covariate) and categorized into three categories: eutrophic ( $\leq 24.99$  kg/m<sup>2</sup>), overweight (25 kg/m<sup>2</sup> to 29.9 kg/m<sup>2</sup>) and obese ( $\geq 30$  kg/m<sup>2</sup>) (World Health Organization, 2000).

Leisure-time physical activity was assessed through three subjective questions. First, the subject was asked if they had practiced any sport or physical activity in the previous three months with the question: “Have you practiced any sport and/or activity in the last three months?” The possible answers were: “Yes” and “No”. Next, the frequency of practice was established with the question: “How many days a week do you practice sports or physical exercise?” Finally, the participants were asked a question concerning the length of practice: “In general, on the day that you practice sports and/or physical exercise, how many h/min does it take?” As a covariate, physical activity was classified into three categories, 1 = inactive (0 min/week), 2 = sub-optimally active (1–149 min/week), and 3 = active ( $\geq 150$  min/week) (World Health Organization, 2010). The question on leisure time physical activity, which is the most reliable domain of physical activity in Brazil (Hallal et al., 2010), was derived from the International Physical Activity Questionnaire (IPAQ). All the covariates were used as control variables in the main analyses.

### 2.5. Statistical procedures

For the statistical analyses, we used proportions and confidence intervals of 95% to describe the sample characteristics, prevalence of outcomes (depression risk, feeling of sadness and suicidal thoughts), TV viewing categories and covariates (physical activity, body mass index,

**Table 3**  
Association between TV viewing (non-collapsed categories) and mental health indicators among men.

	Sample size (n)	Depression risk	Feelings	
		OR (95%CI)	Sadness OR (95%CI)	Suicide OR (95%CI)
All ages				
<1 h	6031	<b>1.89 (1.40–2.54)</b>	1.19 (0.99–1.42)	<b>1.81 (1.18–2.78)</b>
1–1.99 h	7233	1.29 (0.95–1.74)	0.95 (0.80–1.13)	1.28 (0.83–1.97)
2–2.99 h	5998	1	1	1
3–3.99 h	3281	1.31 (0.91–1.89)	0.95 (0.76–1.19)	1.18 (0.72–1.92)
4–4.99 h	1513	1.38 (0.92–2.06)	1.26 (0.97–1.65)	1.57 (0.90–2.73)
≥5 h	1864	<b>2.69 (1.88–3.83)</b>	<b>1.68 (1.33–2.14)</b>	<b>2.57 (1.54–4.28)</b>
Young adults				
<1 h	2709	<b>3.29 (2.09–5.17)</b>	1.26 (0.97–1.65)	<b>2.79 (1.59–4.90)</b>
1–1.99 h	3379	1.48 (0.91–2.40)	0.97 (0.74–1.27)	1.50 (0.88–2.58)
2–2.99 h	2902	1	1	1
3–3.99 h	1643	<b>2.40 (1.41–4.06)</b>	1.01 (0.72–1.42)	1.86 (0.94–3.71)
4–4.99 h	780	<b>2.42 (1.34–4.36)</b>	<b>1.46 (1.03–2.06)</b>	<b>2.72 (1.28–5.79)</b>
≥5 h	882	<b>4.13 (2.35–7.25)</b>	1.40 (0.96–2.03)	<b>2.71 (1.39–5.29)</b>
Middle-aged				
<1 h	2168	1.21 (0.72–2.02)	1.15 (0.85–1.56)	1.40 (0.61–3.19)
1–1.99 h	2602	1.15 (0.71–1.87)	0.97 (0.73–1.28)	1.54 (0.71–3.34)
2–2.99 h	2163	1	1	1
3–3.99 h	1074	1.25 (0.68–2.31)	0.93 (0.63–1.37)	0.94 (0.41–2.12)
4–4.99 h	482	1.13 (0.60–2.12)	1.24 (0.79–1.95)	1.84 (0.71–4.79)
≥5 h	581	<b>3.15 (1.81–5.49)</b>	<b>2.48 (1.69–3.63)</b>	<b>4.10 (1.78–9.47)</b>
Older adults				
<1 h	1154	<b>1.87 (1.04–3.36)</b>	1.09 (0.73–1.62)	1.42 (0.69–2.94)
1–1.99 h	1252	1.37 (0.75–2.49)	0.88 (0.60–1.28)	0.74 (0.33–1.65)
2–2.99 h	933	1	1	1
3–3.99 h	564	0.52 (0.24–1.13)	0.84 (0.52–1.33)	0.79 (0.29–2.17)
4–4.99 h	251	0.86 (0.30–2.46)	0.92 (0.42–2.00)	<b>0.32 (0.11–0.90)</b>
≥5 h	401	1.20 (0.64–2.24)	1.20 (0.73–1.98)	0.68 (0.29–1.62)

Note. Adjusted by chronological age, educational status, employment status, alcohol consumption, tobacco smoking, nutritional status and physical activity. OR, odds ratio. CI, confidence interval. TV, television.

**Table 4**  
Association TV viewing (collapsed categories) and mental health indicators among women.

	Sample size (n)	Depression risk	Feelings	
		OR (95%CI)	Sadness OR (95%CI)	Suicide OR (95%CI)
All ages				
<1 h	7245	<b>1.50 (1.25–1.81)</b>	<b>1.26 (1.11–1.43)</b>	1.31 (1.01–1.70)
1–1.99 h	8248	1.05 (0.88–1.26)	1.10 (0.97–1.25)	0.99 (0.77–1.29)
2–2.99 h	7678	1	1	1
3–3.99 h	5061	1.13 (0.92–1.40)	1.11 (0.97–1.28)	1.11 (0.83–1.50)
4–4.99 h	2562	0.99 (0.77–1.28)	1.08 (0.90–1.30)	0.85 (0.59–1.21)
≥5 h	3488	<b>1.65 (1.35–2.03)</b>	<b>1.24 (1.06–1.45)</b>	<b>1.69 (1.27–2.24)</b>
Young adults				
<1 h	3433	<b>1.60 (1.22–2.12)</b>	<b>1.46 (1.20–1.77)</b>	<b>1.66 (1.10–2.48)</b>
1–1.99 h	3855	1.10 (0.83–1.45)	1.20 (0.99–1.44)	1.09 (0.74–1.62)
2–2.99 h	3688	1	1	1
3–3.99 h	2353	1.18 (0.86–1.64)	1.12 (0.91–1.38)	1.21 (0.76–1.91)
4–4.99 h	1252	<b>1.47 (1.02–2.12)</b>	<b>1.40 (1.05–1.86)</b>	1.06 (0.59–1.90)
≥5 h	1714	<b>2.32 (1.67–3.21)</b>	<b>1.42 (1.12–1.81)</b>	<b>2.13 (1.35–3.37)</b>
Middle-aged				
<1 h	2489	<b>1.56 (1.15–2.11)</b>	1.18 (0.95–1.47)	1.08 (0.71–1.65)
1–1.99 h	2957	1.08 (0.82–1.44)	1.05 (0.86–1.29)	1.03 (0.68–1.56)
2–2.99 h	2555	1	1	1
3–3.99 h	1655	1.36 (0.98–1.90)	1.19 (0.94–1.51)	1.27 (0.79–2.06)
4–4.99 h	757	0.88 (0.55–1.41)	0.96 (0.71–1.31)	<b>0.53 (0.31–0.91)</b>
≥5 h	952	<b>1.74 (1.25–2.43)</b>	1.20 (0.92–1.58)	<b>1.65 (1.05–2.58)</b>
Older adults				
<1 h	1323	1.23 (0.84–1.82)	1.06 (0.80–1.42)	1.21 (0.70–2.09)
1–1.99 h	1436	0.89 (0.59–1.35)	1.01 (0.76–1.33)	0.72 (0.42–1.23)
2–2.99 h	1435	1	1	1
3–3.99 h	1053	0.79 (0.51–1.24)	1.02 (0.76–1.37)	0.74 (0.41–1.33)
4–4.99 h	553	0.61 (0.36–1.02)	0.82 (0.57–1.18)	1.12 (0.54–2.34)
≥5 h	822	0.92 (0.60–1.42)	1.13 (0.82–1.56)	1.26 (0.70–2.25)

Note. Adjusted by chronological age, educational status, employment status, alcohol consumption, tobacco smoking, nutritional status and physical activity. OR, odds ratio. CI, confidence interval. TV, television.

education status, employment status, tobacco use and alcohol consumption) by sex. The associations between TV viewing and depression risk, sadness and suicidal thoughts were examined using logistic regression models with odds ratios, adjusted for chronological age, educational status, employment status, alcohol consumption, tobacco smoking, body mass index and physical activity. The logistic regression models were stratified by sex and age-groups (young adults: 18–39 years; middle-aged adults: 40–59 years; older adults:  $\geq 60$  years). All statistical procedures were conducted using sampling weights (svy command) in Stata 14.0 with a significance level of 0.05.

### 3. Results

Characteristics of the sample according to sex are presented in Table 1. In general, the prevalence of depression risk (10.7% vs. 4.7%), feeling of sadness (27.7% vs. 14.4%) and suicidal thoughts (4.9% vs. 2.5%) was higher among women than men. The prevalence of greater levels ( $\geq 5$  h) of TV viewing was higher among women (10.2%) than men (6.8%), but the prevalence of greater levels ( $\geq 150$  min/week) of leisure-time physical activity was higher among men (17.7%) than women (14.4%).

The prevalence of depressive symptoms according to TV viewing patterns by age group is presented in Fig. 1. In both men and women, a U-shape was observed in the association between time spent TV viewing and adverse mental health outcomes. Specifically, a lower prevalence of adverse mental health symptoms was found between 2 and 4 h of TV viewing in the three age categories (except for feeling of sadness in older adult men and women and suicidal thoughts in older adult men). The prevalence of depression risk according to TV viewing patterns by age group is presented in Fig. 2. The pattern was somewhat similar to that of depression symptoms in Fig. 1, given that depression risk has a curvilinear association with TV viewing in all age categories.

The associations of TV viewing with collapsed categories of TV viewing (<2 h, 2 h–3.9 h and  $\geq 4$  h) and adverse mental health indicators are presented in Table 2. In the total sample, depression risk was negatively associated with 2–3.99 h of TV viewing (men: OR = 0.71, 95%CI = 0.57–0.89; women: OR = 0.83, 95%CI = 0.73–0.95) but was positively associated with  $\geq 4$  h of TV viewing in men only (OR = 1.34, 95%CI = 1.03–1.73). This pattern was however not found in middle-aged and older adult women and older adult men. Feeling of sadness was positively associated with  $\geq 4$  h of TV viewing in the total sample of men (OR = 1.41, 95%CI = 1.18–1.67), young adult men (OR = 1.29, 95%CI = 1.01–1.67) and in middle-aged men (OR = 1.81, 95%CI = 1.37–2.40). Conversely, feeling of sadness was negatively associated with 2–3.99 h of TV viewing in the total sample of women (OR = 0.89, 95%CI = 0.81–0.97) and in young adult women (OR = 0.79, 95%CI = 0.69–0.91). Regarding suicidal thoughts, 2–3.99 h of TV viewing (OR = 0.70, 95%CI = 0.51–0.96) and  $\geq 4$  h of TV viewing (OR = 2.15, 95%CI = 1.16–3.98) were associated with respectively lower and higher prevalence of suicidal thoughts in the total sample of men and middle-aged men.

Association between TV viewing (with non-collapsed data) and adverse mental health outcomes (feeling of sadness, suicidal thoughts, and depression risk) are presented in Tables 3 and 4 (separately for men and women, respectively). Adopting the category of lower risk as a reference (2–2.99 h), the extreme groups (<1 h and  $\geq 5$  h) were more likely to present with greater depression risk, sadness and suicidal thoughts in both sexes, especially in the total sample, among young adults and middle-aged adults. Only in older adults were <1 h (except in men for depression risk [OR = 1.87, 95%CI = 1.04–3.36]) and  $\geq 5$  h of TV viewing not consistently associated with adverse mental health outcomes in both sexes.

### 4. Discussion

Our study aimed to evaluate the associations between TV viewing and depression risk, feeling of sadness and suicidal thoughts in a representative sample of adults. The association between TV viewing and depression was curvilinear, with the lowest prevalence of adverse mental health outcomes found in people who viewed TV for 2–3 h/day, and a higher risk of adverse mental health outcomes observed in those who viewed TV <1 h and >5 h/day, especially among young adults and middle-aged adults.

The most consistent evidence is that a higher time in sedentary behavior is associated with more depression, sadness and a higher risk for suicidal thoughts (Hamer et al., 2010; Hamer and Stamatakis, 2014). Accordingly, our findings support previous studies that found a linear association between sedentary behavior (through TV viewing) and worse mental health outcomes (Hamer et al., 2010; Hamer and Stamatakis, 2014), but add that low levels of TV viewing, especially in young adults, might also represent a higher risk of depression in a middle-income country. Less time spent TV viewing might be a measure-of-proxy for a lower socioeconomic status (SES), which is a known risk factor for depression in many countries (O'Donoghue et al., 2016) and in Brazil (Mielke et al., 2015; Munhoz et al., 2016). Higher prevalence of depressive symptoms has been reported among people of lower SES in South Korea (Nam et al., 2017).

Unlike the social pattern of TV viewing in high income countries (Hamer et al., 2010; Hamer and Stamatakis, 2014), in Brazil, individuals with a high SES are more likely to accumulate greater screen time compared to individuals with a low SES (Mielke et al., 2015). Moreover, the hypothesis that <1 h of TV viewing is an indicator for low SES was confirmed by the positive association between TV viewing and depression risk and the higher prevalence of having no academic qualification among individuals with depression risk and lower TV viewing [22%(95%CI:18%–26%)] in our data. This can be explained by the fact that the majority of participants in our study were of low SES and they may have limited access to screen equipment (e.g. TV and screen media devices) compared to people with a higher SES in Brazil (Florindo et al., 2009). However, our findings of associations between >5 h of TV viewing and greater depression (even after adjustment for employment status) could also be a reflection that unemployed (low SES) individuals may have more time for TV viewing and greater depression than higher SES individuals. Thus, strategies to reduce exposure to greater TV viewing time as a means to control depression should target both high and low SES individuals in Brazil.

We found differences in the association between TV viewing and depression among different age groups. Specifically, there was a greater likelihood of an association between TV viewing and adverse mental health outcomes among young and middle-aged adults than among older adults. Although older Brazilian adults watch more TV (Mielke et al., 2015), our finding suggests that the adverse influence of TV viewing on mental health are most pronounced in younger age groups. Practically, this finding reinforces the need for early interventions to prevent any negative mental health consequences of watching too much TV per day. Our study indicates that 5 h of TV viewing per day represents a potential threshold for depression risk. This observation has important practical implications. Broader intervention strategies aiming to reduce time spent watching TV and/or interrupting TV viewing with active breaks are needed. For example, public health messages to regularly (e.g., every 20 min) interrupt time spent sedentary or to reduce TV time to less than 5 h daily may be promising interventions that warrant further investigation in Brazilian adults. Such behavioral activation intervention to decrease time spent TV viewing and increase physical activity has the potential to reduce depressive symptoms (Balán et al., 2016; Pagoto et al., 2008).

The findings of the present study should however be considered with caution. First, we only explored TV viewing as a proxy for sedentary behavior and did not explore differences in associations with

more cognitively active sedentary behaviors such as reading a book, internet use or working at a desk. Therefore, our findings regarding associations between sedentary behavior and depression cannot be generalized to other types of sedentary behavior. Second, the design of this study was cross-sectional, in which causality cannot be inferred. For example, rather than more time spent TV viewing leading to a greater risk for depression, it could be that, due to withdrawal, anhedonia and lack of motivation and energy, depressed people prefer to spend more time watching TV, which is a cognitively passive activity. Third, potential confounders such as actual income, occupational status, social support and family history of depression were not available in our dataset and not controlled for in the analyses. Fourth, although simple and valid (Kroenke et al., 2001), the use of single items to measure symptoms of depression such as feelings of sadness and suicidal thoughts may not be optimal and could undermine the utility of these constructs in our study. On the other hand, we used a valid questionnaire (Santos et al., 2013) and presented data of the association between TV viewing and depression risk from a large national representative sample of adults from a developing country, providing new insight from an understudied population and region.

In conclusion, the current study demonstrates that more than 5 h of TV viewing per day seems to be a threshold for depressive risk among Brazilian adults, especially among young adults and middle-aged adults. These findings can be used to inform effective strategies to reduce or interrupt the time spent watching TV in order to prevent and manage mental health problems among Brazilian adults. Future studies should investigate the timing of TV viewing to determine if for example watching TV late at night versus earlier in the evening and the television show content (e.g., comedic sitcoms versus news shows versus shows with violence) are differently associated with the risk for, and symptoms, of depression.

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### Authorship contribution statement

André O Werneck and Danilo R Silva made statistical procedures, interpretation of data and drafted the first version of the manuscript. Célia L Szwarcwald participated in designing the scope of the study. Adewale L Oyeyemi, and Davy Vancampfort revised the first version and made important intellectual contributions to the manuscript. All authors contributed to the writing of this paper and approved the final version submitted for publication.

### Compliance with ethical standards

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**Conflict of interest:** The authors declare that they have no conflicts of interest.

**Ethics approval:** All procedures performed in the original studies involving human participants were approved by national council of ethics in research (CONEP: 10853812.7.0000.0008) in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

**Informed consent:** Informed consent was obtained from all individual participants included in the study.

### Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.jad.2018.04.083.

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