SSM - Population Health 7 (2019) 100385

Contents lists available at ScienceDirect

SSM - Population Health

journal homepage: www.elsevier.com/locate/ssmph

Article

Relationships between psychological distress and health behaviors among Canadian adults: Differences based on gender, income, education, immigrant status, and ethnicity

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ARTICLE INFO

Keywords:
Psychosocial health
Mental health
Health disparities
Diet
Physical activity
Smoking

ABSTRACT

Objective: Psychosocial health predicts physical health outcomes in both clinical samples and the general population. One mechanism is through relationships with health behaviors. Results might differ based on sociodemographic characteristics such as education, income, ethnicity, and immigrant status. Our objective was to analyze sociodemographic differences in relationships between psychosocial health measures and health behaviors in the general population of Canadian adults.

Methods: We analyzed relationships between non-specific psychological distress, assessed using the Kessler-10 scale, and five key health behaviors: fruit and vegetable intake, screen sedentary behavior, physical activity, alcohol consumption, and cigarette use. Data were collected by Statistics Canada for the Canadian Community Health Survey in 2011–2014. Our sample included 54,789 participants representative of 14,555,346 Canadian adults. We used univariate general linear models on the weighted sample to analyze relationships between distress (predictor) and each health behavior, controlling for age. We entered sex and one of four sociodemographic variable of interest (education, income, ethnicity, immigrant status) into each model to analyze gender and sociodemographic differences in relationships.

Results: Greater distress predicted less fruit and vegetable intake and physical activity, and greater screen sedentary behavior and cigarette use, in the full sample, with small effect sizes (partial η^2 up to 0.013). Differences by gender and sociodemographic characteristics were evident for all health behaviors.

Conclusions: Psychosocial health might contribute to persistent socioeconomic disparities in health in part through relationships with health behaviors, although relationships in the general population are modest. Health behavior interventions incorporating psychosocial health might need to be tailored based on socioeconomic characteristics, and future research on intersections between multiple sociodemographic risk factors remains necessary.

1. Introduction

A growing body of literature highlights a role of psychosocial health in sociodemographic disparities for a variety of physical health outcomes (APA, 2017; WHO, 2013). For example, prevalence of cardiovascular disease and hypertension is higher among some racial minority groups, and psychosocial health is recognized as an important contributor (Mensah & Collins, 2015; Spruill, 2010; Williams & Mohammed, 2009). Similarly, poor psychosocial health is thought to contribute to socioeconomic disparities in diabetes (Kelly & Ismail, 2015), cardiovascular disease (Karlamangla, Merkin, Crimmins, & Seeman, 2010), and mortality and self-rated health (Lantz, House, Mero, & Williams, 2005). Even modest effects of psychosocial health on physical health outcomes might be pertinent from a public health perspective given the severity and persistence of socioeconomic disparities in health.

Multiple pathways underlie these relationships. Stress induces cardiovascular, neuroendocrine, and immune reactions and thereby affects

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https://doi.org/10.1016/j.ssmph.2019.100385
Received 26 June 2018; Received in revised form 9 January 2019; Accepted 12 March 2019

disease risk. Chronic stress can eventually result in dysregulation of these systems, impairing the individual's capacity to react to future social and physical stressors (Beckie, 2012). Furthermore, stress affects cognitive control, or the ability to focus attention, to process information, and to plan and adapt accordingly. This has important implications for mental health and our capacity to react to future stressors. Finally, part of the mechanistic relationship between stress and health disparities reflects associations between stress and health behaviors (APA, 2017; Dimsdale, 2008). Stress might affect our capacity to evaluate and adopt health-promoting behaviors, exacerbate cravings that underlie unhealthy behaviors, and diminish motivation to adopt healthy behaviors. Numerous studies have shown links between psychosocial health and adverse health behaviors among people with psychological disorders (Annamalai, Singh, & O'Malley, 2015; De Hert et al., 2011; Vancampfort et al., 2017). However, relationships are also evident between health behaviors and non-clinical symptoms of anxiety, distress, depression, and stress in the general population. For example, greater symptoms of psychological distress, depression, and anxiety predict greater cigarette use (Ellis, Orom, Giovino, & Kiviniemi, 2015; Kiviniemi, Orom, & Giovino, 2011a) and lower fruit and vegetable consumption (Ellis et al., 2015; Kiviniemi, Orom, & Giovino, 2011b). Similarly, higher stress levels have been linked to high fat diet (Ng & Jeffery, 2003), consumption of fast food and sweets (Laugero, Falcon, & Tucker, 2011; Steptoe, Lipsey, & Wardle, 1998), cigarette use (Cohen, Schwartz, Bromet, & Parkinson, 1991; Ng & Jeffery, 2003; Steptoe, Wardle, Pollard, Canaan, & Davies, 1996), and lower physical activity levels (Laugero et al., 2011; Stetson, Rahn, Dubbert, Wilner, & Mercury, 1997) which, at the population level, could hold widespread health implications.

Patterns between psychosocial health and health behaviors might differ based on sociodemographic characteristics (Ellis et al., 2015; Kiviniemi et al., 2011a, b; Laugero et al., 2011; Pampel, Krueger, & Denney, 2010). In particular, individuals with low income, low education, recent immigrants, and visible minorities or Aboriginal peoples might experience social disadvantages that affect their psychosocial health and their health behaviors (APA, 2017; Kaplan, Madden, Mijanovich, & Purcaro, 2013; Laugero et al., 2011; Mikkonen & Raphael, 2010; Williams, Priest, & Anderson, 2016). Patterns might also vary by gender. The American Psychological Association's Stress in America survey shows that women are more likely to report high levels of stress than men, and are more likely to manage stress via reading, interacting with friends, and eating, specifically overeating and eating unhealthy foods. In contrast, men are more likely to report using sports activities and exercise to manage stress, although both men and women more often manage stress through sedentary activities than through physical activity (APA, 2010). However, few studies of relationships between psychosocial health and health behaviors include large and nationally representative samples required to stratify analyses based on these sociodemographic characteristics.

Our objective was to analyze sociodemographic differences in relationships between psychosocial health and health behaviors among the general population of Canadian adults. We analyzed relationships between global non-specific psychological distress among adults with scores consistent with low risk of mental disorder (Kessler et al., 2002), and five key health behaviors – fruit and vegetable intake, screen sedentary behavior, physical activity, alcohol consumption, and cigarette use – to develop a portrait of broad patterns in the population and differences by sex, education, income, ethnicity, and immigrant status.

2. Methods

This project was reviewed and approved by Statistics Canada.

2.1. Dataset

The Canadian Community Health Survey (CCHS) (Statistics Canada, 2016a) is an initiative of Statistics Canada to collect data on health status, health service utilization, and health determinants among the Canadian population. The sample includes 130,000 respondents age 18 and over and 10,000 respondents age 12–17 every two years. Data are collected using computer and telephone assisted interview software. Individual data are weighted to reflect the number of persons in the population represented by each respondent (Statistics Canada, 2016a).

We analyzed data from the CCHS years 2011–2014. Our analyses included adults age 18 years and older. Because our goal was to analyze general psychosocial health, we excluded participants who reported having anxiety or mood disorders and those with Kessler-10 distress scores ≥ 20 (see below).

2.2. Variables

Distress: The Kessler-10 Distress Scale (Kessler et al., 2002) is a 10-item screening tool for non-specific psychological distress. It encompasses symptoms of anxiety, depression, nervousness, and stress, and is widely used in both clinical and non-clinical samples. Responses to each item are scored from 1 to 5 and summed, yielding a total score of 10–50 (Andrews & Slade, 2001). A score under 20 indicates low risk of mental disorder, 20–24 indicates mild symptoms, and 25–29 indicates moderate symptoms. Scores from 30 to 50 indicate high risk of anxiety or depressive disorder, representing around 2% of the general population (Andrews & Slade, 2001; MHMA, 2005). In the CCHS, scores were coded from 0 to 40 rather than 10–50. We excluded people with scores indicative of high risk of severe mental disorder, corresponding to scores of 20–40, which represented 2.5% of the sample.

Health behaviors: The Fruit and Vegetable Consumption Questionnaire aimed to identify the frequency in a day, week, or month that a person usually consumes fruit juice, fruit, green salad, potatoes, carrots, and other vegetables. Responses were coded to represent total fruit and vegetable servings per day. Screen sedentary behavior was assessed through weekly hours of free time during the last three months on a computer, playing video games, and watching television or videos. Responses were coded into total hours of screen sedentary behavior per week. The module on Physical Activity asked questions on frequency and time spent in leisure and transportation physical activities in the last three months. Responses were coded as monthly frequency of physical activities of 15 min or more. Smoking was assessed through multiple questions on whether the respondent had ever smoked and whether he or she currently smokes daily, occasionally, or not at all. For daily smokers, the number of cigarettes per day was recorded. Occasional smokers reported the number of days in the past month that they smoked and, on days when they smoke, the number of cigarettes they usually smoke. We used these responses to calculate the average number of cigarettes smoked per day in the last month by occasional smokers and created a single variable indicating cigarettes per day including both daily and occasional smokers. People who reported not smoking were excluded from analyses on cigarette use. The module on alcohol asked questions about whether participants drank any alcohol in the last year, and frequency of consumption of beer, wine, spirits, or other liquor in the last week. Responses were coded as the number of alcoholic drinks per day in the last week. People who did not drink alcohol in the last year were excluded from analyses on alcohol.

We analyzed relationships based on four sociodemographic categorizations: highest completed level of education ($<$ secondary, secondary, post-secondary), household income (province-specific quintiles), immigrant status (non-immigrant; ≥ 5 yrs, or long-term immigrant; <5 yrs, or recent immigrant), and ethnicity (majority or not a visible minority, visible minority, Aboriginal/First Nations). Whereas some countries classify Aboriginal peoples as visible minorities, these groups are distinguished in Canada (Statistics Canada, 2018) and are thus analyzed separately. Immigrant refers to an individual who is not a Canadian citizen by birth and who is a permanent resident of Canada.

2.3. Analyses

We used one-way ANOVA to analyze descriptive statistics. Weighting each participant to represent population-wise data, we used univariate general linear models to analyze relationships between distress (predictor) and each health behavior. We first tested associations between distress and each health behavior in the full sample, including age as a covariate. We then analyzed associations between distress and each health behavior within each subgroup, including age as a covariate and sex as a fixed factor, as well as one of the sociodemographic categorizations of interest (education, income, ethnicity, immigrant status), with a distress*sex*sociodemographic interaction term. Unstandardized coefficients (B) for independent variables and interaction terms were used to compute coefficients for distress for men and women in each sociodemographic categorization. This analysis was completed separately for each of the four sociodemographic categorizations of interest, for each of the 5 health behaviors. The Bonferroni correction was used to correct for multiple testing (4 sociodemographic categorizations) within each health behavior by multiplying p-values by 4. Bonferroni-adjusted p-values < 0.05 were considered statistically significant, which corresponds to an initial, unadjusted p-value $<$ 0.00125. We report effect sizes using partial eta squared (partial η^2), reflecting the proportion of the total variance in each health behavior explained by distress in the full sample, controlling for other variables. Figures reflect estimated values for each health behavior at low (0) and high (10) levels of distress, calculated from unstandardized coefficients (B) for each group. Analyses were conducted using SPSS version 22.0 (IBM Corp., Armonk NY).

3. Results

3.1. Descriptive statistics

The sample included 54,789 participants representative of 14,555,346 Canadian adults. Sample characteristics are shown in Table 1. Means and standard deviations for distress and health behavior variables by sex and sociodemographic categorizations are provided in Table 2.

Data from Statistics Canada on ethnicity and immigration help to illustrate population-wide trends. In 2011, 19.1% of Canada's total population identified as an ethnic minority; 30.9% of these were born in Canada (Statistics Canada, 2018). Similarly, in 2011, 20.6% of the

Table 1
Sample characteristics.

	Men	Women	Total
Age			
Mean (SD)	46.2 (17.2)	47.4 (18.0)	46.8 (17.6)
Median	46	47	47
Sample size, n (%)	24835 (45.3)	29954 (54.7)	54789
Education, n (%)			
Post-secondary	14436 (58.9)	17501 (59.1)	31937 (59.0)
Secondary	5797 (23.6)	7045 (23.8)	12842 (23.7)
< Secondary	4286 (17.5)	5045 (17.0)	9331 (17.2)
Income, n (%)			
Quintile 5 (high)	6385 (25.5)	5781 (19.3)	12166 (22.2)
Quintile 4	5666 (22.6)	5880 (19.6)	11546 (21.1)
Quintile 3	5095 (20.4)	6200 (20.7)	11295 (20.6)
Quintile 2	4661 (18.6)	6388 (21.3)	10849 (19.8)
Quintile 1 (low)	3228 (12.9)	5705 (19.0)	8933 (16.3)
Ethnicity, n (%)			
Majority	21665 (88.1)	26231 (88.4)	47896 (88.3)
Visible minority	2137 (8.7)	2538 (8.6)	4675 (8.6)
Aboriginal	778 (3.2)	908 (3.1)	4686 (3.1)
Immigrant status, n (%)			
Non-immigrant	20795 (84.4)	25050 (84.2)	45845 (84.3)
Immigrant > 5 years	3442 (14.0)	4187 (14.1)	7629 (14.0)
Recent immigrant	401 (1.6)	501 (1.7)	902 (1.7)

Table 2
Means and standard deviations for distress and health behaviors, by sex and sociodemographic patterns.

	Distress (K10 score)		Fruit & Veg. (servings/day)		Screen sedentary behavior (hrs/wk)		Physical activity (freq./mo)		Alcohol (units/day)		Cigarette use (cig./day)	
	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women
Education												
Post-secondary	3.3 (3.5)	3.8 (3.7)	4.5 (2.4)	5.4 (2.6)	21.2 (14.0)	18.7 (12.8)	28.1 (25.2)	27.6 (23.5)	0.8 (1.2)	0.4 (0.7)	11.1 (9.4)	8.9 (7.6)
Secondary	3.6 (3.9)	4.1 (3.9)	4.2 (2.5)	4.8 (2.5)	23.9 (16.3)	22.3 (15.2)	28.2 (27.5)	26.3 (24.2)	0.8 (1.3)	0.4 (0.7)	12.6 (9.7)	10.0 (8.0)
< Secondary	3.5 (4.2)	3.9 (4.1)	4.0 (2.6)	4.7 (2.5)	22.7 (16.3)	22.9 (16.0)	22.1 (24.6)	18.5 (21.2)	0.8 (1.4)	0.3 (0.7)	16.3 (11.3)	12.5 (8.7)
Income												
Quintile 5 (high)	3.1 (3.2)	3.6 (3.5)	4.6 (2.5)	5.6 (2.6)	19.6 (12.5)	17.8 (12.1)	31.4 (26.4)	31.4 (24.0)	1.0 (1.2)	0.5 (0.8)	12.0 (10.2)	9.2 (7.7)
Quintile 3	3.3 (3.7)	3.8 (3.7)	4.3 (2.5)	5.2 (2.5)	22.4 (14.8)	20.3 (13.9)	26.2 (25.1)	26.7 (23.5)	0.8 (1.2)	0.4 (0.7)	12.5 (9.9)	9.6 (7.9)
Quintile 1 (low)	4.1 (4.3)	4.4 (4.4)	4.1 (2.5)	4.8 (2.6)	25.4 (18.2)	21.9 (16.1)	24.7 (26.6)	21.7 (22.9)	0.6 (1.3)	0.3 (0.8)	12.8 (10.5)	10.7 (8.6)
Ethnicity												
Majority	3.3 (3.6)	3.9 (3.8)	4.4 (2.5)	5.3 (2.6)	21.7 (14.6)	19.9 (13.7)	27.8 (25.3)	27.3 (23.7)	0.9 (1.3)	0.4 (0.7)	13.5 (10.1)	10.4 (8.1)
Visible minority	3.5 (3.8)	3.9 (4.1)	4.3 (2.4)	4.9 (2.4)	23.0 (16.0)	20.6 (15.0)	24.9 (26.3)	21.6 (22.3)	0.4 (0.9)	0.2 (0.5)	7.0 (6.6)	4.6 (5.2)
Aboriginal	4.4 (4.0)	4.6 (4.0)	4.2 (3.0)	4.6 (2.7)	24.8 (16.8)	21.8 (15.9)	29.8 (29.3)	26.8 (24.7)	0.9 (1.7)	0.4 (0.9)	12.8 (11.1)	9.5 (7.4)
Immigrant status												
Non-immigrant	3.5 (3.7)	4.0 (3.8)	4.4 (2.6)	5.2 (2.6)	22.2 (15.0)	20.3 (14.0)	28.4 (25.9)	27.4 (23.7)	0.9 (1.3)	0.4 (0.8)	13.5 (10.2)	10.3 (8.0)
Immigrant > 5 years	3.1 (3.7)	3.6 (3.9)	4.4 (2.3)	5.1 (2.4)	21.5 (14.9)	18.9 (13.4)	24.9 (25.3)	23.4 (23.1)	0.5 (0.9)	0.2 (0.5)	9.4 (8.5)	7.6 (7.7)
Recent immigrant	3.1 (3.2)	4.6 (4.4)	4.4 (2.4)	4.7 (2.5)	22.4 (14.7)	22.2 (16.5)	21.3 (23.0)	19.7 (21.8)	0.4 (0.8)	0.2 (0.5)	6.0 (5.6)	4.3 (5.0)

Table 3
Unstandardized coefficients for distress, by sex and sociodemographic categorization, for each health behavior. Coefficients were computed from unstandardized coefficients for independent variables and interaction terms in the full model (controlling for age) for each health behavior.

	Fruit & Veg. (servings/day)		Screen sedentary behavior (hrs/wk)		Physical activity (freq./mo)		Alcohol (units/day)		Cigarette use (cig./day)	
	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women
Education										
Post-secondary	−0.02	−0.05*	0.57*	0.32*	−0.46*	−0.48*	0.01*	0.01*	−0.03	0.12*
Secondary	−0.06*	−0.05*	0.69*	0.60*	−0.05	−0.23*	0.00	0.00	−0.06	0.30*
< Secondary	−0.01	−0.01	0.42*	0.43*	−0.36*	−0.23	0.01	0.01*	0.46*	0.27*
Income										
Quintile 5 (high)	−0.02*	−0.03*	0.36*	0.11	−0.48*	−0.38*	0.03*	0.01*	−0.06	−0.06
Quintile 3	−0.03*	−0.02	0.49*	0.36*	0.01	−0.19	0.01	0.01*	0.03	0.06
Quintile 1 (low)	−0.01	−0.03*	0.74*	0.50*	−0.10	−0.20*	0.02*	0.01	0.30*	0.33*
Ethnicity										
Majority	−0.04*	−0.05*	0.57*	0.37*	−0.48*	−0.47*	0.01*	0.01*	0.11*	0.23*
Visible minority	−0.02*	−0.04*	0.65*	0.53*	0.02	−0.18	0.01	0.00	0.08	0.07
Aboriginal	0.13*	−0.09*	0.75*	0.49*	−0.74*	−0.84*	0.02	0.01	0.48	−0.08
Immigrant status										
Non-immigrant	−0.03*	−0.05*	0.61*	0.43*	−0.44*	−0.37*	0.01*	0.01*	0.13*	0.14*
Immigrant > 5 years	−0.04*	−0.05*	0.57*	0.25*	−0.39*	−0.62*	0.00	0.00	0.05	0.77*
Recent immigrant	0.05	−0.05	0.76*	1.20*	0.34	0.02	−0.05*	0.01	−0.42*	−0.33*

*Adjusted p-value < 0.05.

Canadian population was foreign born. Most immigrants (59.3%) came from Asia (primarily the Philippines, China, and India), followed by Africa (13.6%; primarily Morocco, Egypt, and Algeria), Europe (11.9%, primarily France and the United Kingdom), North and Central America (5.9%; primarily the United States and Mexico), the Caribbean and Bermuda (4.9%), South America (4.3%, primarily Colombia), and Oceania (1.0%) (Statistics Canada, 2016b).

3.2. Relationships between distress and health behaviors

Table 3 shows unstandardized coefficients for distress, by sex and sociodemographic categorization, for each health behavior.

3.2.1. Fruit & vegetable consumption (FVC) (Fig. 1)

Distress had little effect on fruit and vegetable intake in the full sample (B = −0.03, partial η^2 = 0.002).

Education: Relationships between distress and FVC were not significant among adults with less than secondary education and were significant but modest among men with post-secondary education (B = −0.02). Stronger negative relationships were observed for the other groups (B = −0.05 to −0.06): for women with post-secondary or secondary education, and men with secondary education, low compared to high distress corresponded to a difference of around one serving per day (Fig. 1a).

Income: Relationships between distress and FVC were not significant among men with low income and women with average income. There were modest negative relationships between distress and FVC in other groups (B = −0.02 to −0.03), corresponding to differences of up to 0.6 servings per day (Fig. 1b).

Ethnicity: We observed negative relationships between distress and FVC among women regardless of ethnicity (B = −0.04 to −0.09). Differences were most marked among Aboriginal women, among whom low compared to high distress corresponded to a difference of around 1.6 servings per day. Relationships were similar among majority (B = −0.04) and visible minority (B = −0.02) men. However, among Aboriginal men, we observed positive relationships between distress and FVC (B = 0.13) (Fig. 1c).

Immigration: Negative relationships between distress and FVC were observed for non-immigrant and long-term immigrant men (B = −0.03 to −0.04) and women (B = −0.05). In contrast, relationships were not significant among recent immigrants (Fig. 1d).

3.2.2. Screen sedentary behaviors (Fig. 2)

We observed positive relationships between distress and screen sedentary behavior in the full sample (B = 0.47) with a small effect size (partial η^2 = 0.013).

Education: Low versus high distress corresponded to a difference of around 6–12 h of screen sedentary behavior per week, with the strongest relationships among men with post-secondary (B = 0.57) or secondary (B = 0.69) and women with secondary education (B = 0.60), and the weakest relationships among women with post-secondary education (B = 0.32) (Fig. 2a).

Income: Hours of screen sedentary behavior was highest for men with low income, who also showed the most marked relationships between distress and sedentarity (B = 0.74): low versus high distress corresponded to a difference of more than 13 h per week, compared to a difference of 6–9 h for other men (B = 0.36–0.49). Relationships between distress and sedentarity were not significant among women with the highest income, who had the lowest levels of sedentary behavior overall (Fig. 2b).

Ethnicity: At low levels of distress, hours of screen sedentary behavior were largely similar among ethnic groups for men and women. With increasing distress levels, differences by sex and ethnicity became more marked, with greater levels of sedentarity among men and Aboriginal adults, and lower levels among women and majority adults. The strongest relationships between distress and sedentary corresponded to a difference of more than 14 h between low and high distress levels among Aboriginal men (B = 0.75) (Fig. 2c).

Immigrant status: Among men, low versus high distress corresponded to differences in screen sedentary behavior of around 10 h for non-immigrants (B = 0.61) and long-term immigrants (B = 0.57), compared to 13 h among recent immigrants (B = 0.76). Differences by immigrant status were more marked among women (B = 0.25–1.20). Relationships between distress and sedentarity were highest among recent immigrant women (B = 1.20), among whom low versus high distress corresponded to a difference of more than 20 h (Fig. 2d).

3.2.3. Physical activity (Fig. 3)

We observed negative relationships between distress and physical activity in the full sample (B = −0.36) with a very small effect size (partial η^2 = 0.003). Relationships differed based on education, income, ethnicity, and immigrant status.

Education: Physical activity showed negative relationships with distress (B = −0.05 to −0.48), with the strongest relationships among adults with greater education (B = −0.46 to −0.48). Low versus high

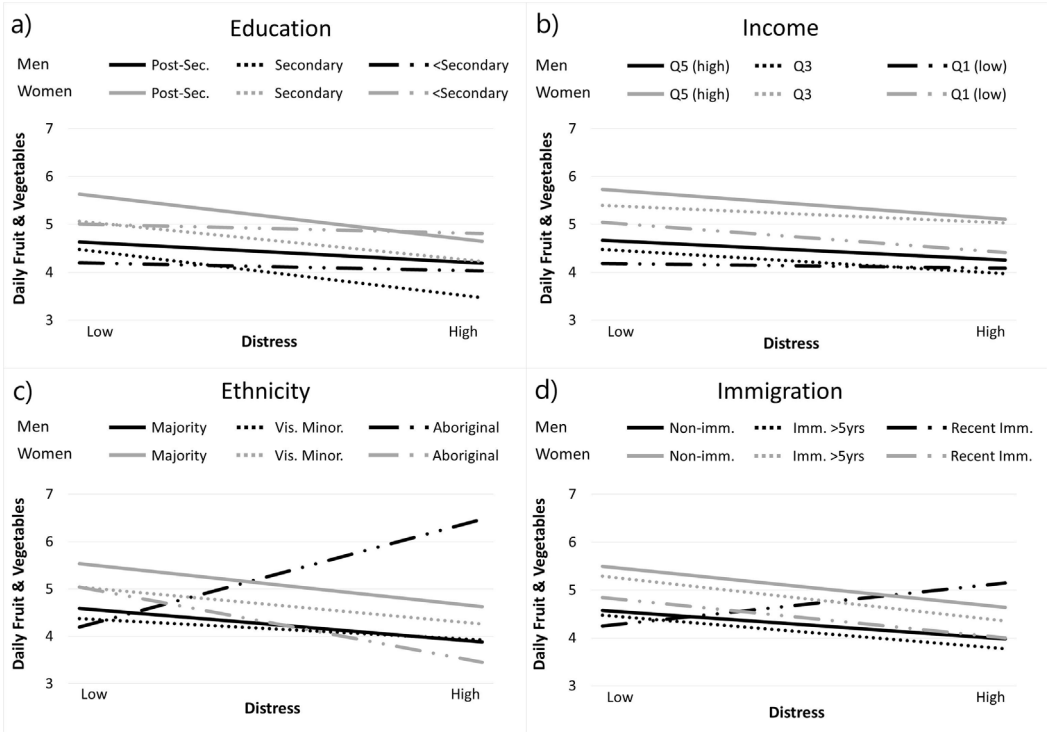

Fig. 1. Relationships between distress and daily servings of fruit and vegetables. Distress = K10 Score, ranging from 0 (low) to 10 (high).

distress corresponded to a difference of around 4–6 sessions per week for women with less than secondary or secondary education and men with less than secondary education, but 8–9 sessions per week for adults with post-secondary education (Fig. 3a).

Income: Physical activity was highest for adults with the highest income, but these groups also showed the strongest negative relationships with distress. Low versus high distress corresponded to a difference of 7–9 sessions for adults in quintile 5 (B = −0.38 to −0.48) but only 3 sessions for women in quintile 1 (B = −0.20). Relationships were not significant among other groups (Fig. 3b).

Ethnicity: With increasing distress levels, physical activity decreased among majority men (B = −0.48) and women (B = −0.47), with a difference of around 8 sessions between low and high distress, and particularly markedly among Aboriginal men (B = −0.74) and women

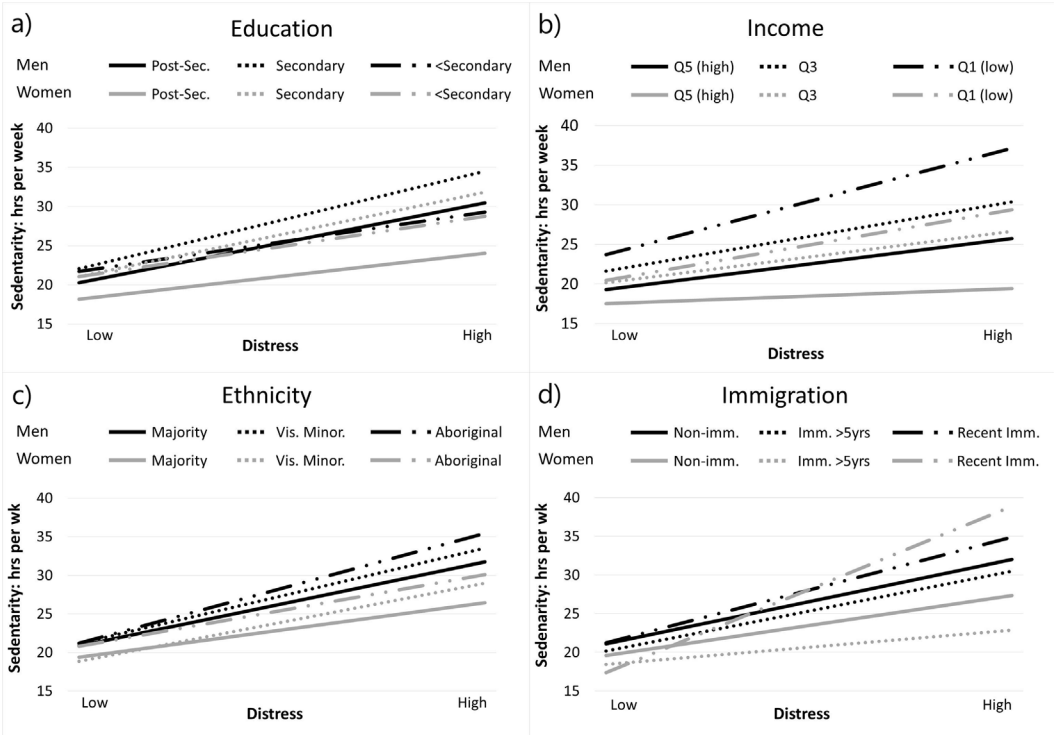

Fig. 2. Relationships between distress and hours per week of leisure-time screen sedentary behavior. Distress = K10 Score, ranging from 0 (low) to 10 (high).

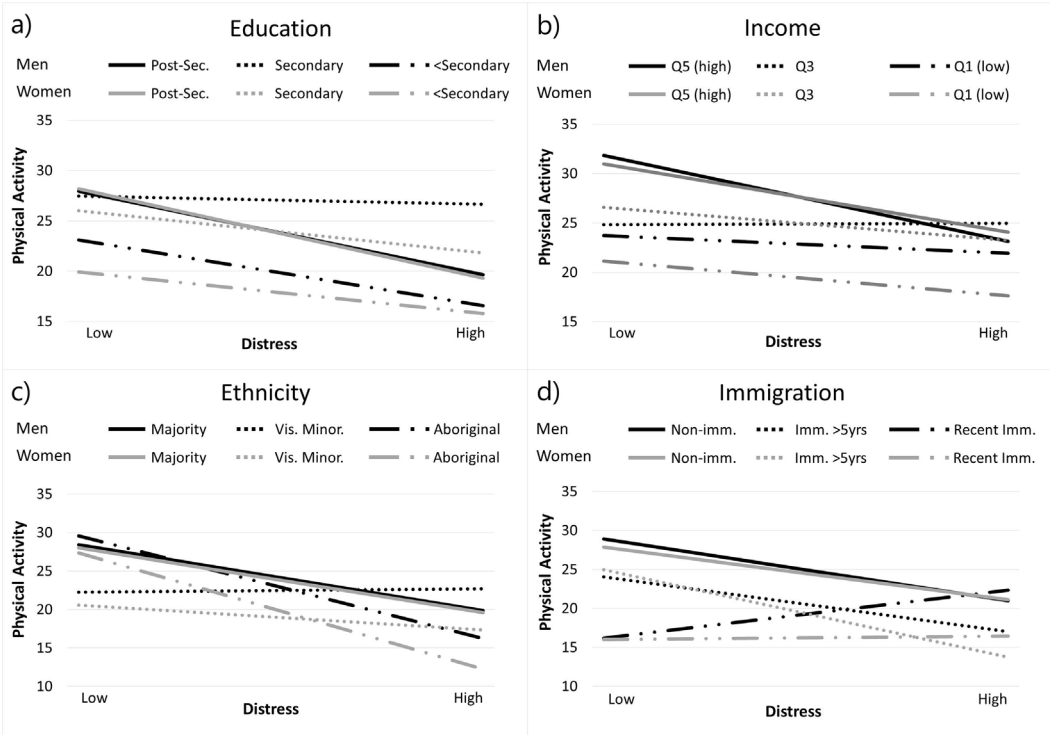

Fig. 3. Relationships between distress and weekly frequency of physical activities > 15 min. Distress = K10 Score, ranging from 0 (low) to 10 (high).

(B = −0.84), with a difference of 13–15 sessions between low and high distress levels. Relationships were not significant among visible minorities (Fig. 3c).

Immigrant status: With increasing distress levels, physical activity decreased among non-immigrant men (B = −0.44) and women (B = −0.37) and long-term immigrant men (B = −0.39), corresponding to differences of 6–8 sessions between low and high distress. Patterns were more marked among long-term immigrant women (B = −0.62), corresponding to differences of more than 11 sessions. In contrast, distress did not predict physical activity among recent immigrants (Fig. 3d).

3.2.4. Alcohol consumption (Fig. 4)

Distress had no appreciable effect on alcohol intake in the full sample (B = 0.01, partial $\eta^2 < 0.001$).

Education: Among adults with high education, alcohol consumption increased only modestly with increasing distress levels (B = 0.01–0.02), corresponding to differences of up to 0.3 units per day between low and high distress. Relationships were not significant among adults with secondary education or men with less than secondary education (Fig. 4a).

Income: Alcohol consumption increased only modestly with increasing distress levels among most groups (B = 0.01–0.02), corresponding to differences of up to 0.3 units per day between low and high distress. Relationships were slightly more marked among men with high income (B = 0.03), among whom low versus high distress corresponded to a difference of more than 0.5 units per day (Fig. 4b).

Ethnicity: Alcohol consumption increased modestly with distress among majority men and women (B = 0.01), corresponding to differences of up to 0.3 units per day between low and high distress. Relationships were not significant among other groups (Fig. 4c).

Immigrant Status: We observed only modest relationships between distress and alcohol consumption among non-immigrant men and women (B = 0.01), corresponding to differences of up to 0.2 units per day between low and high distress. There was no significant relationship among long-term immigrants or recent immigrant women. In contrast to other groups, recent immigrant men showed negative relationships between distress and alcohol consumption (B = −0.05) (Fig. 4d).

3.2.5. Cigarette use (Fig. 5)

We observed positive relationships between distress and cigarette use in the full sample (B = 0.10) with a very small effect size (partial $\eta^2 = 0.002$).

Education: Distress and cigarette use were positively related among women (B = 0.12–0.30), especially those with secondary or less than secondary education, corresponding to a difference of around 5 cigarettes per day between low and high distress. Among men, relationships were significant only for those with less than secondary education (B = 0.46), corresponding to a difference of around 8 cigarettes per day between low and high distress (Fig. 5a).

Income: Cigarette use was relatively similar among groups at low levels of distress, and was not associated with distress among adults with high or average income. However, cigarette use and distress were positively related among men and women with the lowest income (B = 0.30–0.33), corresponding to a difference of more than 5 cigarettes per day between low and high distress (Fig. 5b).

Ethnicity: There were no significant relationships between distress and cigarette use for visible minority or Aboriginal adults. However, increasing distress was associated with increased cigarette use among majority men (B = 0.11) and particularly women (B = 0.23), corresponding to a difference of around 4 cigarettes per day between low and high distress for ethnic majority women (Fig. 5c).

Immigrant Status: We observed only modest associations between cigarette use and distress among non-immigrant men (B = 0.13) and women (B = 0.14), and no significant relationship among long-term immigrant men. Relationships were more marked among long-term immigrant women (B = 0.77), corresponding to a difference of around 13 cigarettes per day between low and high distress. In contrast to other groups, recent immigrants showed negative relationships between distress and cigarette use (B = −0.42 to −0.33) (Fig. 5d).

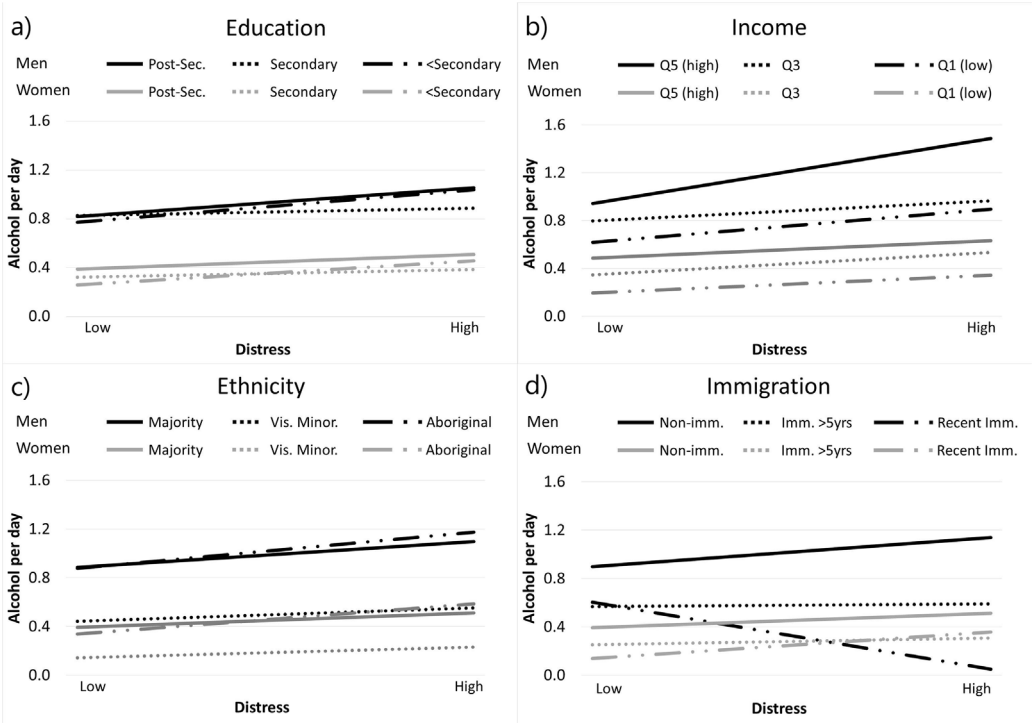

Fig. 4. Relationships between distress and daily consumption of alcohol. Distress = K10 Score, ranging from 0 (low) to 10 (high).

4. Discussion

4.1. Strengths and limitations

To our knowledge, this is the first study that provides population-wide analyses of relationships between distress and fruit and vegetable consumption, sedentary behaviors, physical activity, alcohol consumption, and cigarette use among Canadian adults. Study strengths include the large diverse sample, which allowed us to analyze differences based on sex and sociocultural characteristics, and the ability to generalize to the population level.

The study is limited by the self-reported data collection. In particular, individuals are likely to over-report healthy behaviors and to under-report those perceived as unhealthy. If the tendency to over- or under-report varies by distress level or sociodemographic characteristics, this could introduce systematic bias into the analyses.

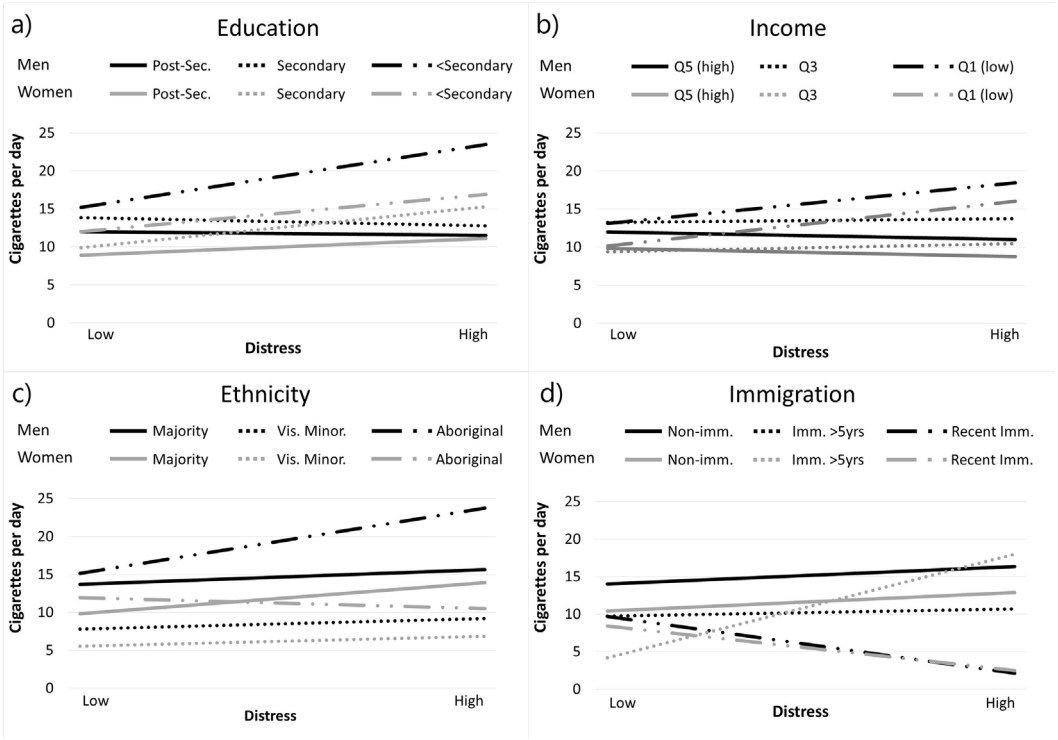

Fig. 5. Relationships between distress and cigarettes per day. Distress = K10 Score, ranging from 0 (low) to 10 (high).

Furthermore, we have analyzed data on only five key health behaviors and one distress measure. Results might differ for other health behaviors, or for other measures of psychosocial health such as symptoms of anxiety or depression. Finally, our cross-sectional analyses do not allow us to identify causal relationships.

We chose the K-10 scale as our predictor variable because it is validated and widely used in both clinical and non-clinical samples to measure non-specific psychological distress (Kessler et al., 2002). Some psychiatric conditions are characterized by high distress levels, especially when distress co-occurs with other symptoms. However, in the absence of psychiatric conditions and at lower levels, distress can be viewed as a normal emotional reaction to stressors and life events that affects everyone to different degrees (Avison, Ali, & Walters, 2007; Drapeau et al., 2012). Thus, we discuss our results in comparison to past research on psychological distress, but also related symptoms such as psychosocial stress and non-clinical anxiety and depressive symptoms.

4.2. Distress and health behaviors: contextualization of results

Results in our study mirror those of others showing relationships between psychosocial health measures and unhealthy behaviors, but highlight variations based on sex and sociodemographic characteristics.

4.3. Fruit and vegetable consumption (FVC)

FVC was higher among women than men, and was slightly higher among adults with higher income and greater education, consistent with other analyses from the CCHS (Azagba & Sharaf, 2011). Other studies have shown similar sex and sociodemographic differences in FVC (Lindstrom, Hanson, Wirfalt, & Ostergren, 2001; Seiluri, Lahelma, Rahkonen, & Lallukka, 2011).

We observed modest negative relationships between distress and FVC. Few studies have specifically analyzed relationships between psychosocial health measures in the general population and FVC. Greater perceived stress predicted lower FVC among adolescents in the UK (Cartwright et al., 2003), and studies of Puerto Rican adults living in the U.S. showed non-linear relationships between perceived stress and fruit and vegetable intake, with significantly greater intake among individuals with the lowest stress levels (Laugero et al., 2011). Other nationally representative surveys of adults in the U.S. showed that relationships between symptoms of depression, anxiety (Ellis et al., 2015), and psychological distress (Kiviniemi et al., 2011b) and FVC differed based on ethnicity. Symptoms of psychological distress (Kiviniemi et al., 2011b) and depression (Ellis et al., 2015) predicted lower FVC among white and Hispanic, but not black, adults (Kiviniemi et al., 2011b), with similar (but non-significant) interactions observed for anxiety (Ellis et al., 2015). Relationships were modest, as in our study.

The survey in the U.S. did not include Indigenous peoples, but results might help to contextualize the positive relationships between distress and FVC among Aboriginal men in our study, in contrast to other groups. Most individuals increase food intake during periods of psychological stress, but of highly palatable foods or those associated with positive affect specifically – for example, foods high in fat and sugar – with subsequent reductions in fruit and vegetable intake (Adam & Epel, 2007; Kiviniemi et al., 2011b; Moore & Cunningham, 2012). However, the foods associated with mood and positive affect would be expected to exhibit cultural differences. This might underlie the lack of association between FVC and distress, anxiety, and depressive symptoms among black and Hispanic Americans (Ellis et al., 2015; Kiviniemi et al., 2011b). We would expect similar cultural differences based on ethnicity in our study. The use of food as a coping mechanism and the foods associated with positive affect are likely different for Aboriginal men than for others in the sample. Sex differences in dietary patterns in response to distress are also often observed. For example, one study showed that men increased red meat consumption during high stress periods, whereas intake did not change among women (Steptoe et al., 1998). It is possible that intake of all foods increases during distress for Aboriginal men, including fruits and vegetables.

Results might also reflect an example of reverse causality in which the dietary patterns observed represent a source of distress. Food insecurity is high among Aboriginal families (Willows, Veugelers, Raine, & Kuhle, 2009), and many Aboriginal families report that they would prefer to eat more traditional foods but have difficulty accessing them (Elliott & Jayatilaka, 2011). Fish, meat, and animal fat are prioritized in many traditional Aboriginal diets, with vegetables holding lower priority or even viewed disfavorably (INSPQ, 2015). If greater FVC is accompanied by a lack of access to preferred foods among men, this might represent a source of distress. Without data on broader food patterns, these relationships remain speculative and highlight an area for more detailed investigations.

4.4. Sedentarity

Screen sedentary behavior tended to be highest among people with lower income and was slightly higher among men, Aboriginal adults, and adults with less than post-secondary education, similar to other studies of Canadian adults (Anderson, Currie & Copeland, 2016; Anderson, Currie, Copeland, & Metz, 2016; Herman & Saunders, 2016).

We observed positive relationships between distress and screen sedentary behavior among all groups except women with high income. Few studies have analyzed distress and sedentary behaviors specifically. Studies among U.S. Latino adults showed that chronic and lifetime stressors predicted both self-reported and objectively measured sedentary behavior (Vasquez et al., 2016). Adjustment for socioeconomic variables attenuated but did not negate these effects. Longitudinal analyses among Australian women in socioeconomically disadvantaged neighborhoods showed that psychological stress predicted increased television viewing (Mouchacca, Abbott, & Ball, 2013). Studies from the Boston Puerto Rican Health Study showed that time spent watching television was greatest among adults in the highest two perceived stress quartiles (Laugero et al., 2011). Finally, studies of 4344 Belgian adults showed that symptoms of psychological distress, anxiety, and depression each predicted greater sitting time, with few variations by gender, age, or education (Asztalos et al., 2015). Our results suggest that these relationships might be particularly important among Canadian men with greater education, Aboriginal men, and recent immigrant men, and in particular among recent immigrant women.

4.5. Physical activity

Leisure and transportation-related physical activity levels were lower among adults with less education and lower income, consistent with other studies (Gilmour, 2007; Halton Region Public Health, 2016). We observed lower physical activity levels among recent immigrants and visible minorities, consistent with other studies among recent immigrant (Tremblay, Bryan, Pérez, Ardern, & Katzmarzyk, 2006) and ethnic minority (Bryan, Tremblay, Pérez, Ardern, & Katzmarzyk, 2006) groups.

In general, we observed modest negative relationships between distress and physical activity. Other studies have shown similar negative relationships, although results are not always consistent (Stults-Kolehmainen & Sinha, 2014). For example, studies among U.S. working adults showed that perceived stress predicted less leisure time physical activity among men and women (Ng & Jeffery, 2003). Analyses among Australian women in disadvantaged neighborhoods showed that psychological stress was associated with decreased likelihood of participating in medium or high levels of leisure time physical activity (Mouchacca et al., 2013). Similarly, studies from the Boston Puerto Rican Health Study showed that physical activity scores were lower among adults in the highest perceived stress quartile (Laugero et al., 2011). Finally, studies of 4344 Belgian adults showed that moderate to

vigorous physical activity (MVPA) moderated relationships between symptoms of psychological distress, anxiety, and depression, and sitting time: poorer mental health scores predicted greater sitting time among people who reported less than 30 min of MVPA per day, but not those with greater levels of MVPA (Asztalos et al., 2015).

Relationships in our study differed based on education, income, ethnicity, and immigrant status. For example, although adults with higher education and income tended to have higher physical activity levels, they also showed more marked decreases with increasing distress. Interventions incorporating psychosocial health might be important to help these individuals maintain their high levels of physical activity. Similarly, Aboriginal men and especially women, and long-term immigrant women, showed marked decreases in physical activity with increasing distress.

4.6. Alcohol

Alcohol consumption was higher among men than women, individuals with higher income, and non-immigrants, and was similar among majority and Aboriginal adults but lower among visible minorities. Similar studies have shown greater alcohol intake among Canadian men than women and adults with higher socioeconomic status (PHAC, 2015), and lower intake among immigrants compared to non-immigrants (Agic et al., 2016) and Aboriginal compared to non-Aboriginal adults (PHAC, 2015).

We observed no appreciable relationships between distress and alcohol consumption in the full sample. Relationships in other studies are mixed, and a focus specifically on heavy or problem drinking in many studies complicates comparison with patterns among the general population. Cross-sectional analyses of Japanese rural workers showed that those with low job control, which can be a source of higher stress, had greater alcohol consumption (Tsutsumi et al., 2003). In contrast, studies among U.S. working adults showed no relationships between perceived stress and frequency of alcohol intake among men or women (Ng & Jeffery, 2003). The lack of consistent conclusions from past studies is not surprising based on our results, which show only modest relationships. The most notable positive relationship between distress and alcohol intake was among men with high income, who already had the highest intake and might be more likely to increase intake with distress. However, intake was still well within recommended limits, and the modest relationship might not be pertinent at the population level. Rather, the focus on heavy or problem drinking in past studies might merit further research.

In contrast to other groups, recent immigrant men showed negative relationships between distress and alcohol consumption. The explanation for these patterns is not clear. Results might reflect reverse causality: if low alcohol intake among recent immigrant men is due to lack of access because of cost or other barriers, this might reflect a broader stressful environment. It is also possible that some recent immigrant men drink very little because of cultural or religious proscriptions, and that these groups have high distress. Finally, whereas alcohol is a stress coping mechanism for many adults, recent immigrant men might employ other coping mechanisms that take the place of alcohol.

4.7. Cigarette smoking

Cigarette use was higher among men, adults with less education, and non-immigrants, and was lower among visible minorities compared to majority or Aboriginal adults. Similar studies of Canadian adults have shown greater smoking among men than women (Janz, 2015; Jones, Gulbis, & Baker, 2010) and among native-born Canadians and people with greater education, and lower smoking among ethnic minorities (Jones et al., 2010).

Relationships between distress and cigarette use were modest and varied by education, ethnicity, and immigrant status. Greater distress was associated with greater cigarette use among adults with less education and lower income, ethnic majority adults, non-immigrants, and long-term immigrant women. Apparent strong positive relationships between distress and cigarette use among Aboriginal men were not significant, likely reflecting high variability that underlies this pattern.

Results in other studies are mixed. Studies among U.S. working adults showed that perceived stress was not associated with number of cigarettes per day, but predicted increased smoking in the last year, greater difficulty to quit smoking, and less control to not smoke when stressed (Ng & Jeffery, 2003). Similar studies showed that greater psychosocial stress predicted greater odds of continued smoking from baseline to follow-up 9–10 years later, adjusting for income and education (Slopen et al., 2013). Finally, nationally representative surveys of adults in the U.S. showed that symptoms of depression, anxiety (Ellis et al., 2015), and psychological distress (Kiviniemi et al., 2011a) predicted greater odds of smoking, but patterns differed based on ethnicity. Psychological distress predicted greater odds of smoking and a greater number of cigarettes per day among white, but not black or Hispanic, adults (Kiviniemi et al., 2011a). Similarly, depressive symptoms predicted greater odds of smoking for white and Hispanic adults, but not black adults (Ellis et al., 2015). Differences in relationships between anxiety and odds of smoking were not significant, but general patterns mirrored those of depression (Ellis et al., 2015).

The most striking differences in the current sample were based on immigrant status: although relationships between distress and cigarette use were modest overall, they were stronger among long-term immigrant women than most other groups, and were negative among recent immigrants. Possible reasons underlying the negative relationships between distress and smoking among recent immigrants might mirror those for alcohol, including lack of access or cultural proscriptions against smoking that are also associated with distress, or the use of different coping mechanisms that take the place of cigarettes. On the other hand, we observed particularly strong relationships between distress and smoking among long-term immigrant women. Past studies show that acculturation is associated with greater smoking, with variations by ethnicity (An, Cochran, Mays, & McCarthy, 2008; Kondo, Rossi, Schwartz, Zamboanga & Scalf, 2016), and these relationships may be stronger among women than men (An et al., 2008; Li, Kwon, Weerasinghe, Rey, & Trinh-Shevrin, 2013). Gender differences in the social acceptability of smoking might underlie part of this relationship. Studies among Asian Americans highlight greater smoking among more acculturated women, which researchers suggest might reflect gender differences in the social acceptability of smoking. Smoking is perhaps more acceptable for men than women in many countries of origin, whereas there are fewer gender differences in acceptability in the USA (or Canada) (An et al., 2008). Past research suggests that women are more likely than men to smoke in response to stress (Allen, Oncken, & Hatsukami, 2014; Verplaetse, Smith, Pittman, Mazure, & McKee, 2016), and our results suggest that long-term immigrant women might be particularly susceptible. Others have emphasized the importance of culturally-appropriate and gender-specific smoking prevention or intervention programs for ethnic minority and immigrant communities (An et al., 2008; Li et al., 2013). Incorporating distress into these programs might be particularly important for immigrant women.

4.8. Distress and health behaviors: broader implications

Given the difficulty of developing effective interventions to address unhealthy behaviors, incorporating psychosocial health into interventions targeting some health behaviors might be beneficial (Dagogo-Jack, Egbuonu, & Edeoga, 2010; Kaar, Luberto, Campbell, & Huffman, 2017). For example, stress reduction programs improve not only the stress response, but also eating patterns (Daubenmier et al., 2011). Thus, efforts to reduce distress in at-risk groups might hold benefits on both psychosocial health and health behaviors. These relationships are reciprocal: risky behaviors might themselves be a source of stress, and

improving health behaviors can thus improve psychosocial health outcomes. For example, combined diet and exercise interventions can improve psychosocial health, with effects greater than those from either intervention (exercise or diet) alone (Imayama et al., 2011). Measuring psychosocial health outcomes in health behavior studies could provide another important outcome measure. Even interventions that do not succeed in changing health behaviors might still have important implications if they help to improve psychosocial health.

Such relationships might be pertinent for the overall population, or might be specific to at-risk groups. For example, nearly all groups showed positive relationships between distress and sedentary behaviors. Given the persistent high levels of sedentarity among Canadian adults (Herman & Saunders, 2016), broad sensitization to the relationship between distress and sedentarity might be prioritized, and incorporating psychosocial health into public health messages about sedentary behavior might have widespread public health implications. On the other hand, relationships between distress and cigarette smoking were more marked among adults with low income and education, who might benefit from more targeted combined interventions.

Analyses can also highlight unexpected risk for adverse health behaviors that might otherwise be overlooked. For example, whereas long-term immigrant women have lower cigarette use than many other groups overall, the particularly strong positive relationships between distress and cigarette use might put them at higher risk during periods of distress. Interventions combining distress and health behaviors might need to be tailored to the health outcomes most likely to be related to distress in each group, and analyses might need to consider sex, ethnicity, and sociocultural context to show measurable results. Relationships might be particularly strong among people with multiple risk factors, such as ethnic minority immigrant women or those with low income or education. Analyzing intersections between multiple sociodemographic characteristics could be a particularly important strategy to identify at-risk groups and to identify the most pressing challenges to and pathways for intervention (Bowleg, 2012). Ultimately, both distress and the health behaviors analyzed here are strongly reflective of broader social determinants of health (Government of Canada, 2018). In Canada and globally, persistent health disparities are observed based on gender, education, income, ethnic and cultural background, and place of residence (PHAC, 2018). Stress represents one underlying source of these disparities (APA, 2017; WHO, 2013). Part of this relationship is through health behaviors. For example, individuals with low income have increased risk of sedentary behavior, which could increase risk of cardiovascular diseases, and this disparity becomes even greater as distress increases. On the other hand, the small effect sizes in our study might suggest that the role of distress in persistent socioeconomic health disparities is largely through mechanisms other than health behaviors. Thus, widespread improvement in distress and health behaviors also requires broader environmental change. For example, low education and income represent risk factors for both low fruit and vegetable consumption and for psychosocial stress, and both might be exacerbated by environmental barriers such as proximity to supermarkets or cultural barriers such as lack of familiarity with available and affordable foods. Action from the education, justice, and employment sectors that improve the physical, social, and economic environment is required to enact broad and sustainable change, highlighting the importance of interventions even outside the healthcare sector (Williams, Costa, Odunlami, & Mohammed, 2008) and the potential for collaborations between multiple sectors (Andermann, 2016).

5. Conclusion

In addition to direct relationships with physical health and quality of life, distress might also affect health through its relationships with health behaviors. Effects at the population level are modest, but might still be pertinent from a public health perspective given the persistence of socioeconomic disparities in health and health behaviors, and the demonstrated success of programs incorporating psychosocial health into health behavior interventions. Analyses of differences by sex and sociodemographic characteristics, and more nuanced analyses using an intersectionality framework to evaluate relationships between multiple risk characteristics, can help to highlight promising targets for such interventions. Action from multiple sectors targeting broader social determinants of health could have the dual benefit of improving both psychosocial health and health behaviors, highlighting the importance of targeted individual interventions but also broad population-wide initiatives, and the incorporation of psychosocial health in evaluations.

Disclosures

The analyses presented in this paper were conducted at the Québec Inter-University Centre for Social Statistics at UQAM, a part of the Canadian Research Data Centre Network (CRDCN). The CRDCN is supported by funds from the Social Sciences and Humanities Research Council (SSHRC), the Canadian Institute for Health Research (CIHR), the Canadian Foundation for Innovation (CFI), and Statistics Canada. Although the research and analysis are based on data from Statistics Canada, the opinions expressed do not represent the views of Statistics Canada.

Ethical approval

This project was reviewed and approved by Statistics Canada. This project analyzes data already collected by Statistics Canada, for which further human subjects review is not required.

Funding

Myriane St-Pierre was supported by fellowships from the Quebec Inter-University Centre for Social Statistics (QICSS) and an award from the Faculty of Sciences of the Université du Québec à Montréal while working on this study. Kelsey Dancause and Paquito Bernard are supported by salary awards from the Fonds de recherche du Québec - Santé. Paquito Bernard is supported by the Institut Universitaire de Santé Mentale de Montréal.

Acknowledgments

We are deeply indebted to Frédéric Broussau of the Quebec Inter-University Centre for Social Statistics (QICSS) for his assistance.

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