Behaviour Research and Therapy 115 (2019) 12–18

Contents lists available at ScienceDirect

Behaviour Research and Therapy

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

Longer duration of smoking abstinence is associated with waning cessation fatigue

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ARTICLE INFO

Keywords:
Quitting
Cessation
Nicotine dependence
Cessation fatigue

ABSTRACT

Background: Cessation fatigue, a construct theorized to reflect exhaustion of coping resources due to quitting smoking, has been found to predict relapse. This study examines the association between cessation fatigue and duration of abstinence among 1397 adult former smokers who participated in the 2016 International Tobacco Control (ITC) Four Country Smoking and Vaping Wave 1 Survey (4CV). We hypothesized lower levels of cessation fatigue will be correlated with longer duration of abstinence.

Method: Data for this cross-sectional study were collected in a web-based survey which recruited national samples from Australia, Canada, England, and United States. Former smokers were abstinent up to five years.

Results: Lower cessation fatigue was associated with longer duration of smoking abstinence. Cessation fatigue was highest in former smokers that had been quit for up to six months, with lower cessation fatigue found in those quit for at least seven months and another drop-off in fatigue observed for those quit for at least two years.

Conclusions: Cessation fatigue is highest soon after quitting smoking but declines over time for those who remain abstinent. Understanding the mechanisms by which cessation fatigue is related to abstinence could potentially offer insights into ways to help individuals sustain quitting.

1. Introduction

Cigarette addiction, like other drug addiction, is a chronic relapsing disorder (USDHSS, 2014). The majority of smokers who make a quit attempt end up relapsing back to smoking regardless of treatment method (Cahill, Stevens, Perera, & Lancaster, 2013). Well-established relapse risk factors (e.g., withdrawal symptoms) typically dissipate within 2–4 weeks of abstinence (Hughes, 2007), which suggests the need to delineate additional relapse risk factors that occur later in a quit attempt. Identifying novel processes that undermine smoking cessation will offer unique therapeutic targets to optimize treatment development (Baker et al., 2016).

Cessation fatigue, or tiredness of trying to quit smoking, is one promising individual difference characteristic that has received limited empirical attention to date (Piper, 2015). Cessation fatigue was first conceptualized as a latent construct comprising loss of motivation to quit, loss of hope in cessation success, reduced coping skills utilization, decreased self-efficacy, and exhaustion of self-control resources (Piasecki, Fiore, McCarthy, & Baker, 2002). Drawing from the large body of self-control literature (Muraven & Baumeister, 2000), cessation fatigue was posited to increase over the course of a quit attempt as the cumulative toll of remaining abstinent depletes an individual's coping resources. It was theorized to increase vulnerability to relapse, particularly in the weeks or months after a quit attempt, once acute withdrawal symptoms had abated. Indeed, higher cessation fatigue has been shown to predict shorter delay to lapse/relapse and lower likelihood of abstinence at two and six month follow-ups (Heckman et al., 2018; Liu, Li, Lanza, Vasilenko, & Piper, 2013). Despite strong theoretical rationale and these initial findings, the time course for how cessation fatigue unfolds has not been well studied.

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https://doi.org/10.1016/j.brat.2018.11.011
Received 19 September 2018; Received in revised form 20 November 2018; Accepted 20 November 2018
Available online 23 November 2018
0005-7967/

To date, four studies have prospectively examined cessation fatigue among smokers undergoing a quit attempt. Three studies examined a single-item measure of cessation fatigue, "I am tired of trying to quit smoking," within a large clinical trial. In one study, smokers who had a history of anxiety disorders, relative to those who did not, had greater increases in cessation fatigue during the week leading up to and following a quit attempt (Piper, Cook, Schlam, Jorenby, & Baker, 2011). A second investigation found that cessation fatigue increased over the first two weeks of a quit attempt, but this could be dampened by using stop smoking medications (Liu et al., 2013). A third study simulated cessation fatigue trajectories over two months, and estimated which medications were most effective for mitigating fatigue (Bekiroglu, Russell, Lagoa, Lanza, & Piper, 2017). Nicotine patch produced the fastest initial rate of change, whereas combination nicotine replacement therapy (patch + lozenge) produced the greatest long-term reductions in cessation fatigue. These studies strongly suggest that task difficulty is a cause of fatigue, as might be expected. Finally, an observational study used a multi-item Cessation Fatigue Scale (Mathew, Heckman, Meier, & Carpenter, 2017) to examine how fatigue unfolds naturalistically over three months (Heckman et al., 2018). Peak fatigue values were observed at around six weeks at which point they plateaued and remained stable through three months.

These findings are consistent with the initial conceptualization of cessation fatigue (Piasecki et al., 2002), and a recently proposed workload-capacity model of health behaviors (Heckman, Mathew, & Carpenter, 2015; Mathew et al., 2017). The latter predicts cessation fatigue will emerge as workload (i.e., demands from quitting and general life demands) increases or capacity (i.e., coping resources) decreases. Conversely, the workload-capacity model suggests cessation fatigue may decrease over time as living smoke-free becomes more routine (i.e., less demanding), thereby mirroring evidence that relapse risk diminishes as abstinence is maintained (Hughes, Keely, & Naud, 2004; Kirshenbaum, Olsen, & Bickel, 2009). There is a need to study how cessation fatigue changes in relationship to duration of abstinence from smoking over a longer timeframe than previously examined to identify when cessation fatigue may begin to attenuate and help elucidate possible mechanisms for how fatigue relates to relapse risk.

Additionally, further efforts are needed to delineate how cessation fatigue is influenced by smoker characteristics. Although prior cessation fatigue studies have found several predictors of cessation fatigue, these findings are limited because most of the samples studied were treatment seekers enrolled in research studies who may not necessarily be representative of the broader population of smokers making quit attempts. Thus, population-based studies that have a more diverse and representative sample of smokers would help to determine if the early studies of cessation fatigue can generalize to smokers more generally.

The purpose of the current study was to help fill these research gaps by examining the relationship between cessation fatigue and quit duration among adult former smokers that have been quit for up to five years. This is the first study to examine this relationship in a sample that has been quit more than three months. We hypothesized that cessation fatigue will be associated with quit duration, with lower cessation fatigue ratings seen among those with longer quit duration. Additionally, this study explores how sociodemographic and smoking-related variables correlate with cessation fatigue ratings. A major strength of the current study is that we used data from an international cohort study [Australia (AU), Canada (CA), England (EN), and the United States (US)] to provide the most representative sample to date in which predictors of fatigue have been examined.

2. Method

2.1. Participants

Participants in this study include 1397 adult former smokers (≥18 years) who reported quitting smoking within the past five years. Data were drawn from a parent study, the 2016 International Tobacco Control (ITC) Four Country Smoking and Vaping Wave 1 Survey (ITC 4CV1). Methodological details for each country are available via the ITC website (http://www.itcproject.org/methods). In brief, the ITC 4CV1 sample comprised the following cohorts (see Thompson et al., under review): (1) re-contact smokers and quitters who participated in the previous wave of the ITC 4C Survey, regardless of e-cigarette use, (2) newly recruited current smokers and recent quitters (quit smoking in the past 24 months) from country-specific panels, regardless of e-cigarette use, and (3) newly recruited current e-cigarette users (use at least weekly) from country-specific panels. The sample in each country was designed to be as representative as possible of smokers and used either probability-based sampling frames or non-probability quota samples. Respondents for the ITC 4CV1 survey were recruited via random-digit-dialing (RDD) sampling frames, or web-based or address-based panels, or a combination of these frames, as an expansion of the previous ITC 4C Survey. All former smokers that participated in the parent study completed the online survey measures described below.

2.2. Procedures and measures

Participants completed the online survey after informed consent was obtained. All procedures were cleared for ethics by Institutional Review Board, Medical University of South Carolina; Research Ethics Office, King's College London, UK; Office of Research Ethics, University of Waterloo, Canada; and Human Research Ethics, Cancer Council Victoria, Australia.

Cessation Fatigue. Cessation fatigue was measured using a single question: "*to what extent are you tired of trying to stay quit*?", which has predictive validity for smoking cessation (Liu et al., 2013). Responses options ranged from 1 (*not at all tired*) to 5 (*extremely tired*) such that higher scores indicate greater fatigue.

Quit Duration. Quit duration was assessed by asking former smokers "*how long ago did you quit smoking*?" Four response options with small sample sizes [less than 1 week ago (n = 19; 1.3%), 1–2 weeks ago (n = 22; 1.6%), 3–4 weeks ago (n = 29; 2.0%), and 1–3 months ago (n = 111; 8.0%)] were combined into one quit duration group of Up to Three Months Abstinent to improve power and because this represents a meaningful cutoff for our research question. Cessation fatigue values have been found to peak and stabilize by three months abstinent (Heckman et al., 2018), and the current study is the first to test whether fatigue levels begin to decline in quitters that have maintained abstinence for longer than three months. The remaining quit duration groups were based on the remaining survey response options: 4–6 months, 7–12 months, 1–2 years, 2–3 years, and 3–5 years.

Covariates. Demographic and smoking history information was collected. Country of residence had four levels (CA, US, EN, and AU). Age, gender, ethnicity, income, and education were categorized in a manner consistent with prior ITC studies. Ethnicity was coded as the majority (CA/US/EN = White; AU = English speaking) or minority. Monthly household income and education were categorized into three levels (low, moderate, and high), with the tertiles roughly comparable across the four countries.

Average cigarettes per day, based on the months before quitting, served as a proxy for nicotine dependence. Use of stop smoking medications was coded dichotomously based on use of any of the following methods during their current quit attempt: any type of nicotine replacement therapy (e.g., patch, gum, mouth spray), Varenicline/Chantix/Champix, or Bupropion/Zyban/Wellbutrin. Use of non-pharmacological quit aids was coded dichotomously based on use of any of the following methods during their current quit attempt: telephone/quitline service, in person services (CA/US: clinic/individual or group counselling/stop smoking course/behavior therapy; UK: local stop smoking service/clinics/specialists; AU: face-to-face specialized stop smoking program), face-to-face advice from a doctor or other health care professional (e.g., dentist, pharmacist), apps or automated

services on a mobile phone/tablet, the internet (i.e., website about quitting smoking), or pamphlets/brochures on how to quit. Use of electronic cigarettes as a quit method was coded dichotomously based on use during their current quit attempt. A single item was used to assess quit difficulty: "*how easy or hard has it been to stay quit*?" Responses options ranged from 1 (*very easy*) to 5 (*very hard*) such that higher scores indicate greater difficulty.

2.3. Analytic strategy

Analyses were conducted via SPSS v25, with traditional significance levels set at $p < .05$ (two-tailed). Rescaled cross-sectional sampling weights, calibrated on gender, age, geographic region, ethnicity, education, use of electronic cigarettes, and quit duration, were used to ensure estimates were as representative as possible of quitters in each country (see Thompson et al., under review).

Univariate descriptive statistics and frequency distributions were calculated for the primary predictor (quit duration), outcome (cessation fatigue), and covariates. ANOVA/ANCOVA was used to examine quit duration as a predictor of cessation fatigue. We tested an unadjusted model and an adjusted model that included all covariates (country of residence, age, gender, ethnicity, income, education, pre-quit cigarettes per day, quit difficulty, use of stop smoking medications, use of non-pharmacological quit aids, and use of electronic cigarettes as quit aids). Effect sizes, indexed as Cohen's d (Cohen, 1988), were calculated for between-group comparisons based on quit duration. Values of 0.2, 0.5, and 0.8 can be considered small, medium, and large, respectively.

3. Results

3.1. Participant characteristics

Table 1 displays the sample characteristics. Participants were balanced across most sociodemographic variables. Participants smoked an average of 13.7 ($SD = 10.8$) cigarettes per day prior to quitting and reported moderate levels of difficulty quitting ($M = 2.7$, $SD = 1.3$; possible range = 1–5). The majority of participants did not use medications, nonpharmacological aids, or electronic cigarettes during their current quit attempt.

Table 1
Participant characteristics.

	% $N = 1397$
Sex	
Female	45.4%
Male	54.6%
Age	
18-24	10.3%
25-39	35.7%
40-54	28.2%
55 and up	25.8%
Ethnicity	
Majority	86.6%
Minority	12.3%
DK Ethnicity	1.1%
Country of Residence	
Canada	32.0%
United States	26.4%
England	30.1%
Australia	11.5%
Income	
Low	20.7%
Moderate	26.3%
High	45.6%
DK Income	7.4%
Education	
Low	28.1%
Moderate	48.1%
High	22.8%
DK Education	1.0%
Quit Duration	
up to 3 months ago	12.9%
4–6 months ago	9.5%
7–12 months ago	14.0%
1–2 years ago	41.5%
2–3 years ago	11.6%
3–5 years ago	10.5%
Quit Method Used	
Medication	30.6%
Nonpharmacological aid	21.6%
Electronic cigarette	27.0%

Note. DK = answered don't know or refused to answer.

3.2. Predictors of cessation fatigue

Quit Duration. Unadjusted analyses showed a main effect of quit duration on cessation fatigue [$F(5, 1372) = 11.52$, $p < .001$). Fig. 1 (Panel A) and Table 2 shows that increased quit duration was associated with lower cessation fatigue (up to three months: $M = 1.83$; $SE = 0.07$; 4–6 months: $M = 1.66$; $SE = 0.08$; 7–12 months: $M = 1.48$; $SE = 0.06$; 1–2 years: $M = 1.49$; $SE = 0.04$; 2–3 years: $M = 1.26$; $SE = 0.07$; 3–5 years: $M = 1.23$; $SE = 0.07$). Generally, we observed nonsignificant differences and small effect sizes ($ds < 0.28$; see Table 3) between adjacent groups: up to three months vs. 4–6 months ($p = .09$), 4–6 months vs. 7–12 months ($p = .06$), 7–12 months vs. 1–2 years ($p = .06$), and 2–3 years vs. 3–5 years ($p = .75$). Quitters who had been abstinent for up to three months reported greater fatigue than those abstinent 7–12 months (*mean difference* = 0.35; $p < .001$; $CI = 0.18$ to 0.53), 1–2 years (*mean difference* = 0.34; $p < .001$; $CI = 0.19$ to 0.48), 2–3 years (*mean difference* = 0.57; $p < .001$; $CI = 0.39$ to 0.76), and 3–5 years (*mean difference* = 0.60; $p < .001$; $CI = 0.41$ to 0.79), with the magnitude of effect sizes increasing from small to medium based on longer quit duration ($ds = 0.18$ to 0.66). Quitters abstinent 4–6 months (*mean difference* = 0.44; $p < .001$; $CI = 0.23$ to 0.64), 7–12 months (*mean difference* = 0.25; $p = .009$; $CI = 0.06$ to 0.44), and 1–2 years (*mean difference* = 0.27; $p < .001$; $CI = 0.11$ to 0.42) reported greater fatigue relative to those quit for 3–5 years. The remaining comparisons were also statistically significant: 4–6 months vs. 1–2 years (*mean difference* = 0.17; $p = .04$; $CI = 0.01$ to 0.34), 4–6 months vs. 2–3 years (*mean difference* = 0.40; $p < .001$; $CI = 0.20$ to 0.61), and 7–12 months vs. 2–3 years (*mean difference* = 0.22; $p = .02$; $CI = 0.04$ to 0.40).

We observed a similar pattern of Results from the adjusted analyses, which accounted for sociodemographics and smoking-related variables. There was a main effect of quit duration on cessation fatigue [$F(5, 1191) = 3.01$, $p = .01$). Fig. 1 (Panel B) shows that increased quit duration was associated with lower cessation fatigue (up to three months: $M = 1.83$; $SE = 0.08$; 4–6 months: $M = 1.75$; $SE = 0.09$; 7–12 months: $M = 1.65$; $SE = 0.07$; 1–2 years: $M = 1.63$; $SE = 0.05$; 2–3 years: $M = 1.60$; $SE = 0.08$; 3–5 years: $M = 1.45$; $SE = 0.09$), even after controlling for sociodemographics and smoking-related variables (see also Table 2). Quitters who had been abstinent for up to three months reported greater fatigue than those abstinent 7–12 months (*mean difference* = 0.18; $p = .04$; $CI = 0.01$ to 0.36), 1–2 years (*mean difference* = 0.20; $p = .009$; $CI = 0.05$ to 0.35), 2–3 years (*mean difference* = 0.23; $p = .03$; $CI = 0.03$ to 0.44), and 3–5 years (*mean difference* = 0.38; $p < .001$; $CI = 0.18$ to 0.58), but were not significantly different from those quit for 4–6 months (*mean difference* = 0.08; $p = .42$; $CI = -0.11$ to 0.27). Quitters abstinent 4–6 months (*mean difference* = 0.30; $p = .006$; $CI = 0.09$ to 0.51), 7–12 months (*mean difference* = 0.20; $p = .049$; $CI = 0.001$ to 0.39), and 1–2 years (*mean difference* = 0.18; $p = .03$; $CI = 0.02$ to 0.34) reported greater fatigue relative to those quit for 3–5 years. We observed nonsignificant differences between 4 and 6 months, 7–12 months, 1–2 years, and 2–3 years ($ps > .15$).

Covariates. There were main effects for quit difficulty [$F(1,$

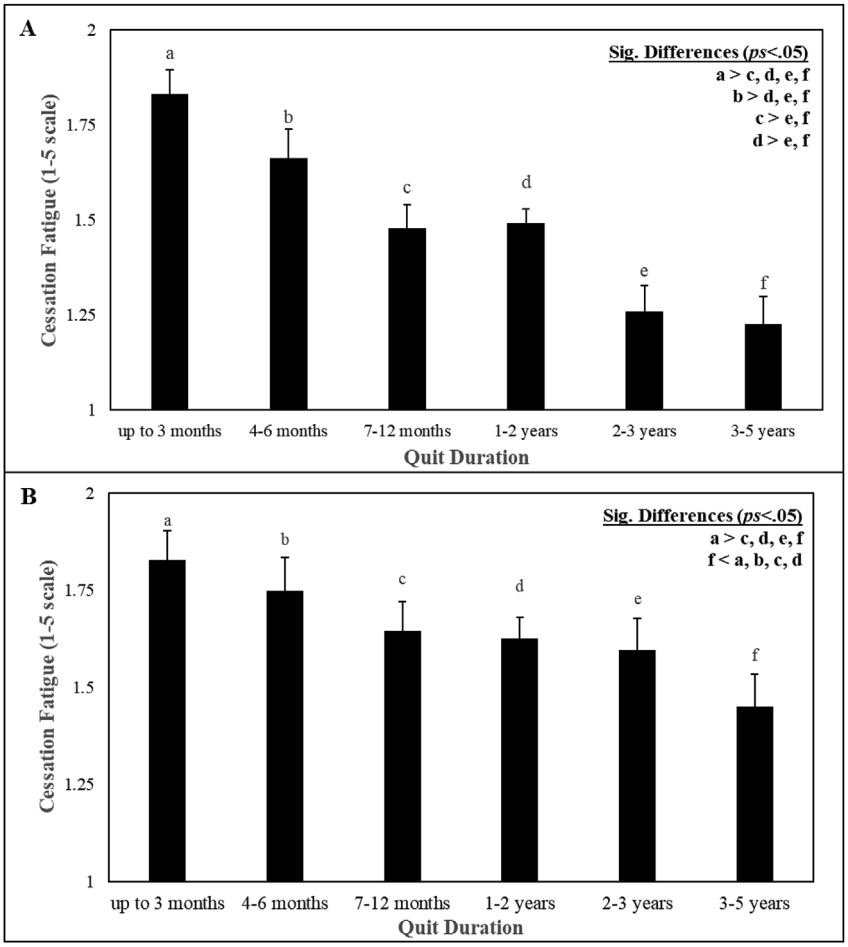

Fig. 1. Cessation fatigue (means and standard errors) as a function of quit duration, based on unadjusted (Panel A) and adjusted (Panel B) analyses.

1191) = 227.22, $p < .004$), gender [$F(1, 1191) = 11.89$, $p = .001$), use of medications [$F(1, 1191) = 6.46$, $p = .01$), education [$F(2, 1191) = 5.43$, $p = .004$), use of nonpharmacological quit aids [$F(1, 1191) = 4.37$, $p = .04$), and age [$F(3, 1191) = 2.85$, $p = .04$), whereas income [$F(2, 1191) = 0.02$, $p = .98$), ethnicity [$F(1, 1191) = 0.15$, $p = .70$), country of residence [$F(3, 1191) = 1.13$, $p = .34$), pre-quit cigarettes per day [$F(1, 1191) = 0.33$, $p = .56$), and use of electronic cigarettes as quit aids [$F(1, 1191) = 0.82$, $p = .36$) were not significant predictors of cessation fatigue. Table 2 shows greater fatigue was reported by those who reported greater difficulty quitting, were female, used medications, were more highly educated, used nonpharmacological aids, and were younger.

4. Discussion

The current study provides novel data to delineate how cessation fatigue unfolds over time among former smokers by testing for the first time whether fatigue levels begin to decline after three months of abstinence. Prior studies have examined cessation trajectories during the first three months of abstinence, where cessation fatigue was found to increase over the first six weeks of a quit attempt and then plateau and remain stable through three months (Heckman et al., 2018). Based on a large, representative, sample that had been abstinent for up to five years, we empirically tested the association between cessation fatigue and quit duration. Cessation fatigue was highest in former smokers that had been quit for up to six months. Lower cessation fatigue was found in former smokers that had been quit for at least seven months and another drop-off in fatigue was observed for those abstinent for at least two years. These Results suggest quitting may become less tiresome the longer abstinence is maintained. This finding, along with evidence that cessation fatigue prospectively predicts important smoking-cessation milestones (Heckman et al., 2018; Liu et al., 2013), may help explain why relapse risk decreases as abstinence is maintained (Hughes et al., 2004; Kirshenbaum et al., 2009).

This study also provides insights about factors associated with cessation fatigue which may provide clues about how cessation fatigue influences risk of relapse. In general, the findings from this population-based study on correlates of cessation fatigue correspond to those from studies based on convenience samples of smokers and those recruited for treatment studies (Bekiroglu et al., 2017; Heckman et al., 2018; Liu et al., 2013; Mathew et al., 2017; Piper et al., 2011). In this study, we found several sociodemographic variables that predicted cessation fatigue. Younger quitters reported higher cessation fatigue, consistent with findings from two prior studies (Heckman et al., 2018; Mathew et al., 2017). Higher education was associated with higher fatigue. Future studies could explore whether different stressors/life demands or social/environmental factors experienced by older adults or those from lower socioeconomic status lead to diminished relative impact of quitting. Females reported greater fatigue, consistent with Results from another study (Liu et al., 2013). Future research should test to what extent these gender differences help explain why female smokers have greater difficulty maintaining long-term smoking abstinence (Smith, Bessette, Weinberger, Sheffer, & McKee, 2016).

Higher ratings of cessation fatigue were reported in those who used stop smoking medications and nonpharmacological methods to aid their quit attempt. These Results are similar to those from another cross-sectional survey study (Mathew et al., 2017), but opposite to those from a clinical trial in which smokers randomized to receive

Table 2
Parameter estimates for predictors of cessation fatigue.

	Unadjusted Model			Adjusted Model		
	B	*SE*	*p-value*	*B*	*SE*	*p-value*
Intercept				0.84	.17	< .001
Quit Duration						
up to 3 months ago	0.60	.10	< .001	0.38	.10	< .001
4–6 months ago	0.44	.10	< .001	0.30	.11	.006
7–12 months ago	0.25	.10	.009	0.20	.10	.049
1–2 years ago	0.27	.08	< .001	0.18	.08	.03
2–3 years ago	0.03	.10	.75	0.15	.10	.15
3–5 years ago	ref			ref		
Quit Method: Medication						
No				−0.14	.05	.01
Yes				ref		
Quit Method: Nonpharmacological Aid						
No				−0.13	.06	.04
Yes				ref		
Quit Method: Electronic cigarette						
No				−0.05	.05	.36
Yes				ref		
Gender						
Female				0.16	.05	.001
Male				ref		
Income						
Low				0.01	.06	.89
Moderate				0.01	.06	.85
High				ref		
Education						
Low				−0.17	.07	.01
Moderate				−0.19	.06	.001
High				ref		
Ethnicity						
Majority				−0.03	.07	.70
Minority				ref		
Country						
Canada				−0.02	.08	.84
United States				0.10	.09	.27
England				0.01	.08	.90
Australia				ref		
Age						
18-24				0.19	.09	.046
25-39				−0.05	.07	.49
40-54				0.05	.07	.42
55 and up				ref		
Difficulty quitting				0.28	.02	< .001
Cigarettes per day				−0.001	.002	.56

active medications had lower fatigue relative to the placebo condition (Liu et al., 2013). This discrepancy may be due to selection bias, as smokers who use these treatments are typically more nicotine dependent and experience more severe nicotine withdrawal (Shiffman, Di Marino, & Sweeney, 2005). Post hoc analyses revealed greater difficulty quitting was reported by those who used stop smoking medications ($M = 3.1$, $SD = 1.4$) compared to those who did not ($M = 2.6$, $SD = 1.3$); $t(1382) = 7.5$, $p < .001$. A similar pattern was found for those who used nonpharmacological methods ($M = 3.1$, $SD = 1.3$) relative to those who did not ($M = 2.6$, $SD = 1.3$); $t(1382) = 6.2$, $p < .001$. However, controlling for quit difficulty and smoking rate did not eliminate these differences. Alternatively, results could potentially be explained by the workload-capacity model of health behaviors (Heckman, Mathew, et al., 2015) in that the workload associated with the process of quitting, such as treatment engagement, may have increased cessation fatigue. Future research should determine the degree to which evidence-based treatments impact fatigue and need for interventions specific to cessation fatigue. Finally, the current study found difficulty quitting was positively associated with fatigue, again consistent with the workload-capacity model in that efforts to maintain abstinence will lead to greater fatigue. Future research should examine other factors that may moderate susceptibility to cessation fatigue, such as personality (e.g., negative emotionality; Leventhal et al., 2012) and transdiagnostic psychopathology (e.g., anhedonia, anxiety sensitivity, distress tolerance; Leventhal & Zvolensky, 2015).

4.1. Clinical implications

Elevated cessation fatigue may signal limited self-control resources that if not addressed will undermine long-term abstinence (Heckman et al., 2017, 2018). As proposed by a workload-capacity model of health behaviors (Heckman, Mathew, et al., 2015), there are several pathways to buffer against cessation fatigue. Reducing the workload associated with general life demands and the process of quitting should attenuate cessation fatigue. For example, effective stress management is paramount (Baker, Piper, McCarthy, Majeskie, & Fiore, 2004) as stressors reliably increase motivation to smoke (Heckman, Carpenter, et al., 2015; Heckman et al., 2013). Thus, in future work it will be important to try to measure total demand, not just from the focal behavior change (smoking), but from other life demands. Technology could be leveraged to overcome burden associated with treatment adherence. For example, mobile health (mHealth) interventionists are working towards automatic yet personalized treatment delivery. Context sensing interventions can reduce the amount of effort typically needed to monitor and

Table 3
Effect Sizes (Cohen's d) for Between-group Comparisons based on Quit Duration.

	Quit Duration (unadjusted)					
	≤3 months	4–6 months	7–12 months	1–2 years	2–3 years	3–5 years
≤3 months	–					
4–6 months	0.18	–				
7–12 months	0.37	0.19	–			
1–2 years	0.40	0.20	−0.02	–		
2–3 years	0.63	0.45	0.23	0.28	–	
3–5 years	0.66	0.47	0.26	0.32	0.04	–
	Quit Duration (adjusted)					
	≤3 months	4–6 months	7–12 months	1–2 years	2–3 years	3–5 years
≤3 months	–					
4–6 months	0.08	–				
7–12 months	0.17	0.10	–			
1–2 years	0.20	0.12	0.02	–		
2–3 years	0.24	0.16	0.05	0.03	–	
3–5 years	0.38	0.30	0.19	0.17	0.15	–

cope with high-risk situations and have shown potential for relapse prevention (Gustafson et al., 2014). Additionally, capacity can be increased by improving general coping resources. Many promising approaches focused on increasing resilience may be relevant for cessation fatigue, including: self-control strength training interventions (Muraven, 2010), positive psychotherapy (Kahler et al., 2015), distress tolerance (Brown et al., 2013), and acceptance and commitment therapy (Bricker, Wyszynski, Comstock, & Heffner, 2013).

4.2. Limitations

Several limitations are noteworthy. Though these initial findings suggest that cessation fatigue may decrease after six months of abstinence, stronger evidence from longitudinal studies is needed to support this interpretation. It is possible that those with high persistent fatigue tend to relapse, while those with low fatigue throughout are the ones who persist. Second, findings are limited by reliance on a single-item measure. A multi-item cessation fatigue scale would be less susceptible to random measurement error, allow for computation of internal consistency reliability, and take into account other cognitive and emotional factors that may comprise cessation fatigue. Third, quit duration was limited to retrospective self-report only, which is susceptible to recall bias. Although this approach conforms with recommendations for observational studies (SRNT, 2002), future studies could incorporate remote bioverification of smoking status to overcome this limitation (McClure & Gray, 2013). Finally, quit duration was assessed by categorical response options. Given that quit processes can change rapidly (Hughes et al., 2014), future research should capture the temporal dynamics of fatigue with greater precision (e.g., ecological momentary assessment).

5. Conclusions

This is the first study to examine the relationship between cessation fatigue and quit duration in a sample that has been quit more than three months. Cessation fatigue appears to decline after six months of smoking abstinence. Assessing cessation fatigue may index the sustainability of behavioral change by capturing the cumulative toll associated with efforts to maintain abstinence and associated relapse risk. That fatigue has been found to impede long-term abstinence suggests the need for ongoing efforts to monitor and reduce fatigue. Innovations in technology-based interventions (e.g., mHealth) are well positioned to meet these needs.

Funding

The ITC Four Country Smoking and Vaping Project in the US, Canada, and England was supported by the US National Cancer Institute (P01 CA200512), and the Canadian Institutes of Health Research (FDN-148477). The ITC Australia Project was supported by the National Health and Medical Research Council of Australia (APP1106451). BWH, JD, and JJKS were supported by the US National Institute on Drug Abuse (K23 DA041616, K23 DA045766, R25 DA020537). GTF was supported by a Senior Investigator Grant from the Ontario Institute for Cancer Research. The sponsors had no role in the design and conduct of the study; collection, management, analysis, and interpretation of the data; preparation, review, or approval of the manuscript; and decision to submit for publication.

Conflict of interest declaration

KMC and MJC have received consulting funds from Pfizer. KMC also receives funding as an expert witness in litigation filed against the tobacco industry.

Acknowledgements

Dr. Heckman was overall responsible for conduct of the current study, including data analyses and manuscript preparation. Drs. Borland, Cummings, and Fong were overall responsible for conduct of the parent study, including scientific input on study design, study coordination, and manuscript preparation. Remaining authors contributed scientific input on study design and assisted with manuscript preparation.

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