Development, implementation and evaluation of fitness training and psychosocial education interventions in wildland firefighting

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I declare that this thesis is my own work and has not been submitted for the award of a higher degree elsewhere.

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Abstract

Interventions are the critical mechanism through which research can be translated into practice for the improvement of employee health and well-being. The Job Demands-Resources (JD-R) Theory has emerged as a popular theory of occupational stress, with inherent flexibility, organization and structure for detecting and understanding both positive and negative antecedents of employee well-being and strain. Wildland fires are an increasing concern to both public safety and critical to their effective management is the safe work of highly trained wildland firefighters (WFFs) who routinely face extreme physical and psychological demands. The present research leverages the JD-R Theory and employs the RE-AIM Framework to implement and evaluate two resource-building intervention programs through an iterative participatory approach across a wildland fire season.

Two hundred and thirty WFFs were randomly assigned by their work location to one of four experimental conditions: 1- control group; 2- fitness training intervention; 3- psychosocial education intervention; and 4- both interventions. Pre- and post-season assessments of job demands and resources, personal resources including physical fitness and psychological capital, work engagement and job stress allowed for a comprehensive documentation of WFFs baseline measurements, change over a fire season, and evaluation of intervention effectiveness.

Results affirm WFFs' high levels of job and personal resources and work engagement at the outset of a wildland fire season. The psychosocial education intervention was effective at buffering the impact of a wildland fire season on appraisals of psychosocial risk associated with job demands and resources, while the fitness training intervention demonstrated limited success at mitigating psychosocial factors. The combined intervention group reported significantly lower incidence rate of injury. Aspects of intervention reach, adoption, implementation and maintenance provide additional contextual information to strengthen interpretation of intervention effectiveness. Implications for theory, research and practice are discussed.

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AB	Attack Base, one type of location where wildland firefighters are located within the partnering organization
CROSH	Centre for Research in Occupational Safety and Health, research centre where the author was employed at the time of project completion
FMH	Fire Management Headquarters, term for the base, or locations participating in the current study
GM@W	Guarding Minds at Work, resource and survey instrument for addressing and assessing 13 psychosocial risk factors
JD-R Theory	Job Demands-Resources Theory, as proposed by Bakker and Demerouti (2017)
MNRF-AFFES	Ministry of Natural Resources and Forestry's Aviation Forest Fire and Emergency Services, partnering organization for the current study and responsible for all wildland firefighting activities within Ontario, Canada
NER	North East Region, one of two wildland firefighting regions in Ontario consisting of all fire management headquarters and attack bases in the north east region
NWR	North West Region, one of two wildland firefighting regions in Ontario, consisting of all fire management headquarters and attach bases in the north west region
PAR-Q	Physical Activity Readiness Questionnaire, screening instrument used for clearing participants to engage in fitness testing
PsyCap	Psychological Capital, as defined and measured by Luthans et al. (2007)
QATSDD	Quality Assessment Tool for Studies with Diverse Designs, a comprehensive gradient of indicators of good quality research from Sirriyeh et al. (2012) .
Standard	CSA-Z1003-13, National Standard of Canada, Psychological health and safety in the workplace e- prevention, promotion, and guidance to staged implementation

RMG	Regional Management Group, meeting held twice annually between management groups from all fire management headquarters and attack bases within each region
WFF	Wildland Firefighter, also known as FireRangers in Ontario and hired seasonally to engage in wildland fire suppression and management activities from April 1 to October 31
WFX-FIT	Canadian Physical Performance Exchange Standard for Type 1 Wildland Firefighters, fitness test that all individuals must achieve in order to work as a wildland firefighter across Canada

CHAPTER 1. Introduction

1.1 Introduction

Intervention programs designed, delivered and evaluated by and within organizations are a critical component in the promotion of employee health and well-being and prevention of occupational injury (Cartwright & Cooper, 2009; Cooper, 2013b, 2017; Karanika-Murray & Biron, 2015b; Rivara & Thompson, 2000; Van Eerd et al., 2015). Central to the success of intervention programs is the ability to translate theory into practice, overcoming the primary challenge of integrating themselves in meaningful ways into the context of an organization and with the appropriate intensity to yield the desired outcomes (Goldenhar & Schulte, 1994, 1996; Karanika-Murray & Biron, 2015b). Recent efforts to enhance methodological rigour in organizational intervention research sacrifice the ability to shed greater light on the understanding of context and process, and limit the ability to learn from poorly designed or inadequately implemented interventions (Karanika-Murray & Biron, 2015a; Nielsen & Miraglia, 2017). Moreover, research on the design and implementation of interventions designed to foster employee well-being have focussed traditionally on healthcare and education and have yet to be synthesized for a wide range of working groups, including those in high-demand and unpredictable occupations (Havermans et al., 2016).

Wildland firefighting in Canada is a physically and psychologically demanding seasonal occupation, and presents unique and dynamic challenges for both the promotion of health and well-being and the prevention of injury (Aisbett, Phillips, Sargeant, Gilbert, & Nichols, 2007; Aisbett, Wolkow, Sprajcer, & Ferguson, 2012; Bakker, 2011; Carballo-Leyenda, Villa, López-Satué, & Rodríguez-Marroyo, 2019; Cuddy & Ruby, 2011; Cuddy, Sol, Hailes, & Ruby, 2015; Gordon & Lariviere, 2014;

Lui, Cuddy, Hailes, & Ruby, 2014; Palmer, 2005). To date, there remains no published literature evaluating the effectiveness of interventions designed to improve the physical and psychological well-being of wildland firefighters. Critical for transference of findings across complex occupational settings is clearly articulated development processes, a reliance on and evaluation of underlying theoretical foundations and the inclusion of relevant outcomes emerging out of participatory action processes (Giga, Cooper, & Faragher, 2003; Goldenhar & Schulte, 1994; Karanika-Murray & Biron, 2015b; Nielsen & Miraglia, 2017). It is therefore essential to begin with the selection and critical review of a theoretical framework to inform the development, implementation and evaluation of a comprehensive program targeting physical and psychological health and well-being of wildland firefighters (Goldenhar & Schulte, 1994, 1996; Karanika-Murray & Biron, 2015b).

Over nearly a century, a number of theories have been posited to enhance our understanding of the experiences and impact of stress within the context of work (Cannon, 1932; Cartwright & Cooper, 2009; Cooper, 2013a; Ganster & Perrewé, 2011; Ganster & Rosen, 2013; Ganster & Schaubroeck, 1991). Initially, Selye's General Adaptation Syndrome (Selye, 1951, 1955, 1957) and Lazarus' Transactional Model of Stress (Lazarus, 1966) were key in challenging researchers to focus on both the features and appraisal of environment factors and demands and evaluating the associated influence on individual's responses. Since that time, several other theories have emerged to help explain stress in the context of work, including the Job Demands-Control model (Karasek, 1979), the Conservation of Resources (COR) theory (Hobfoll, 1989) and the Effort-Reward Imbalance (ERI) model (Siegrist, 2002, 2017). The Job Demands-Control model demonstrated efficacy heuristically; however, it is limited by

the prominence of control over other workplace resources that can positively influence demands and subsequently experiences of strain. Expanding on this notion, COR theory proposed a broad definition of resources and identified 74 specific resources that could be compartmentalized into one of four categories influencing an individual's response to work and work conditions (Hobfoll, 1989). A primary challenge with proposing such a broad and inclusive definition of resources at work is that renders the theory so generic that it becomes unable to discriminate across contexts (Thompson & Cooper, 2001). Finally, the ERI model framed negative experiences of stress as emerging from imbalances between effort on the part of an employee relative to the benefit or reward received (Siegrist, 1996, 2017). Despite considerable uptake in stress literature particularly as it relates to physiological health outcomes, several underlying assumptions of the ERI model remain unsubstantiated or scantly investigated (Eddy, Wertheim, Hale, & Wright, 2018; Eddy, Wertheim, Kingsley, & Wright, 2017; Van Vegchel, De Jonge, Bosma, & Schaufeli, 2005).

1.2 Job Demands-Resources (JD-R) Theory

The Job Demands-Resources (JD-R) model was initially proposed as a framework for understanding occupational stress, suggesting strain is a response to the imbalance between demands placed on an individual and the resources at their disposal to meet the demands (Demerouti, Bakker, Nachreiner, & Schaufeli, 2001). In part, the development of the JD-R model was in response to the restrictions of other contemporary models and approaches to employee health and well-being. Specifically, as previously elucidated, the Demand-Control model (Karasek, 1979) and Effort-Reward Imbalance model (Siegrist, 1996) lacked the flexibility to include all relevant predictors across a range of occupation types (Bakker & Demerouti, 2017). Further, the JD-R model also sought to

incorporate both positive and negative antecedents of employee strain and well-being within a single model (Bakker & Demerouti, 2007; Demerouti et al., 2001). Since initially posited, the JD-R model has been applied in a vast amount of empirical research and utilized across a diverse range of organizations around the world (Bakker & Demerouti, 2007, 2017; Schaufeli & Taris, 2014), evolving into a mature theory expounding on the relationships between job characteristics and employee well-being (see Figure 1) (Bakker & Demerouti, 2017; Bakker, Demerouti, & Sanz-Vergel, 2014; Crawford, Lepine, & Rich, 2010; Lesener, Gusy, & Wolter, 2019; Nahrgang, Morgeson, & Hofmann, 2011). Central to the JD-R Theory's widespread acceptance is an inherent flexibility when applied to various occupational settings and the structure it lends to detecting and understanding antecedents of employee well-being (Schaufeli & Taris, 2014). Notwithstanding existing challenges, the JD-R Theory has served as foundational for a burgeoning field of intervention research targeting individual components within it while also contributing to the evaluation of the theory as a whole (Bakker & Demerouti, 2017; Knight, Patterson, & Dawson, 2019; Schaufeli, 2017; Schaufeli & Taris, 2014). The present research aims to leverage the organization and structure of the JD-R Theory by developing and implementing two resource building intervention programs designed to foster work engagement and improve employee well-being while mitigating the impact of job demands on psychological strain and negative outcomes (e.g., injury). An overview of the JD-R Theory, including definitions of each component and the relationships therein, in addition to a summary of the meta-analytic and review evidence for JD-R Theory can be found in Appendix 1.

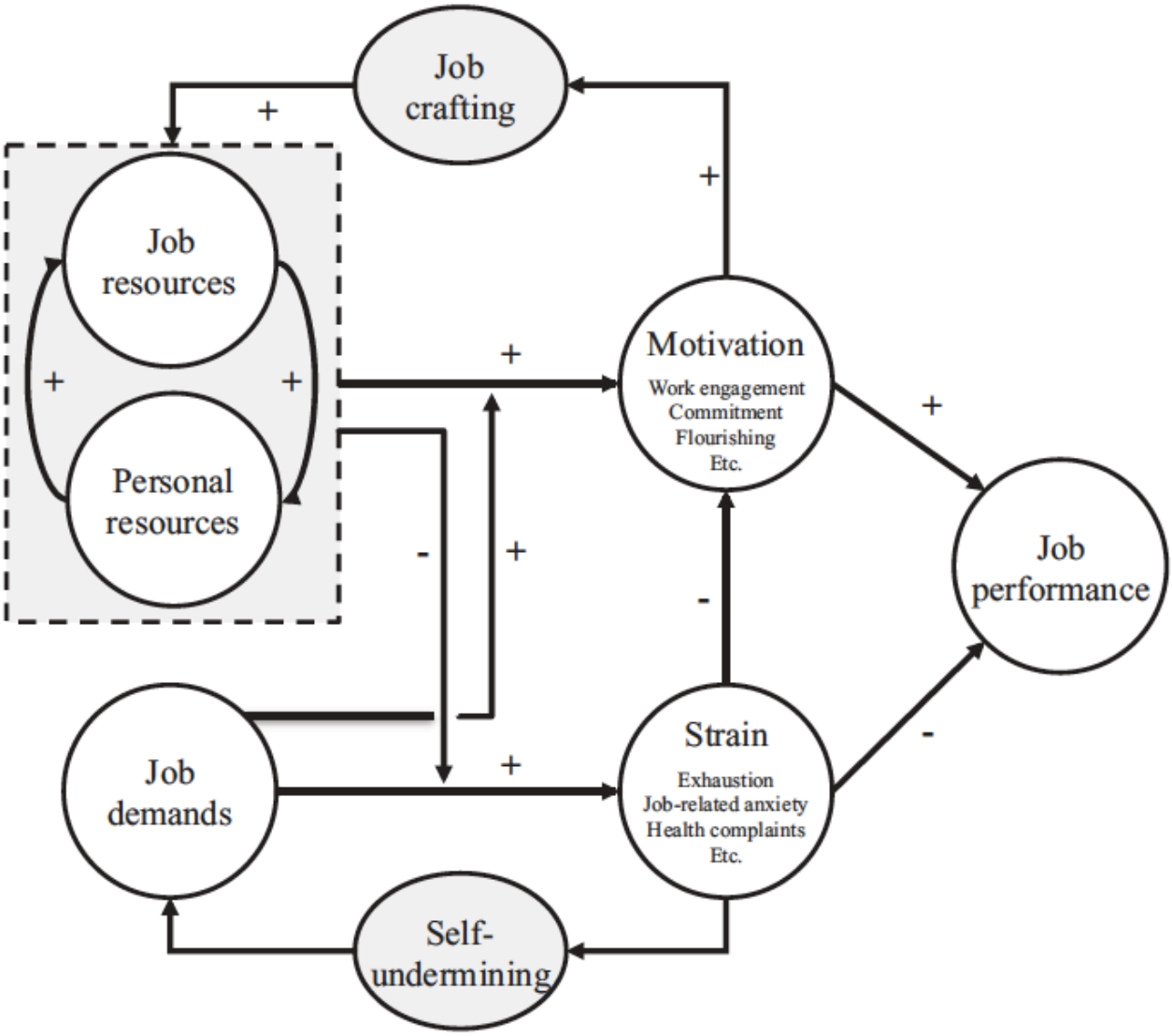

Figure 1. Job Demands-Resources (JD-R) Theory as proposed by Bakker & Demerouti, 2017

1.2.1 Reviewing Intervention Research on JD-R Theory Components

Over the past decade efforts have accelerated towards designing, implementing and evaluating interventions targeting individual constructs within JD-R Theory. To that end, recent reviews have begun to summarize the evidence of intervention research, frequently partitioning studies by JD-R construct, namely work engagement (Knight, Patterson, & Dawson, 2017; Knight et al., 2019), and personal resources (Gilbert, E., Foulk, & Bono, 2018).

In a narrative systematic review and meta-analysis, Knight, Patterson, and Dawson (2017) reviewed the effectiveness of work engagement interventions. In total, 20 studies were included, revealing a small, reliable and positive overall effect of interventions on work engagement. No effect was noted across types of interventions by mechanism through which work engagement was influenced: personal resource building (n=5), job resource building (n=3), leadership training (n=6) or health promotion (n=6). However, a medium to large effect was found for group-based interventions (n=13) as compared to individual (n=4) or both group and individual (n=3), affirming previous literature advocating for group approaches to occupational health interventions (Egan et al., 2007; Knight, Patterson, & Dawson, 2017). One of the challenges with evaluating the effects of intervention effectiveness stems from the large heterogeneity found in the analyses, resulting in the inability to differentiate between the indirect or mediating relationships between other JD-R constructs across the included studies (e.g., personal resources impacting job resources, or well-being). Further limitations of the review include small sample sizes (both overall response rate and attrition across included studies) and an inability to control for variance in participation in the intervention at the individual level and in the adherence and implementation at the organizational level (Knight, Patterson, & Dawson, 2017).

Reflective of the rapid growth in work engagement intervention literature, Knight et al. (2019) updated and expanded their systematic review including twice as many studies (n=40). Of the included studies, 19 focused on resource building (job resources = 12; personal resources = 5 and job and personal resources = 2), while 18 focused on health promotion, and 3 on leadership development. Half of the 40 studies noted a positive impact of their intervention on work engagement, while 18 demonstrated no effect and

only 2 of 40 observed a negative effect. Affirming previous organizational intervention research was the discovery of employee participation and consideration of job crafting as influential moderators of intervention impact on work engagement (Knight et al., 2019; Nielsen, 2013; Nielsen & Randall, 2012). Common challenges with the intervention research reviewed included difficulty implementing programming resulting from poor response and attrition rates and unpredictable organizational factors such as restructuring (Knight et al., 2019). In concluding their review, Knight et al. (2019), renewed calls for evaluating underlying theories of interventions, and more specifically adding to our understanding to how, why and when interventions work, affirming the call from Nielsen and Miraglia (2017) to employ a more realist evaluation of interventions, and testing context-mechanism-outcome configurations.

E. Gilbert and colleagues (2018) completed an integrative review of workplace interventions intending to enhance three aspects of personal resources: psychological, cognitive and physiological. Six types of interventions were reviewed: expressive writing, social sharing or capitalization, work breaks, positive psychology, mindfulness, and nature exposure (Gilbert, E. et al., 2018). Reported effect sizes ranged from very small to medium for all intervention types at improving personal resources which should not be overlooked, given the minimal manipulations reported by the majority of interventions (Gilbert, E. et al., 2018; Prentice & Miller, 1992). Key considerations with respect to future workplace interventions to improve personal resources include understanding the context in which it is delivered, documenting and evaluating potential moderators to success, and targeting resources specific to the demands of the occupation (Gilbert, E. et al., 2018). A limitation of the review is inherent in its integrative approach, lacking a systematic process for study inclusion and a limited reproducibility

allowing for selection bias. Also lacking from the review was the application of any theoretical framework, which hinders the ability of the findings to be interpreted or understood more broadly or across contexts. Given the centrality of personal resources within the JD-R Theory, it would be anticipated that had the review considered this component, more poignant recommendations on implementation and usefulness of findings could have been posited.

1.2.2 Recommendations for JD-R Theory Intervention Research

As the evidence base has been firmly established for the efficacy of the JD-R Theory as an accessible, valid and flexible framework for understanding the influence of work characteristics on health and well-being, recommendations for the design and implementation of intervention work have emerged (Bakker & Demerouti, 2017; Gilbert, E. et al., 2018; Knight et al., 2019; Nielsen et al., 2017; Schaufeli, 2017; Schaufeli & Taris, 2014).

In Nielsen and colleagues' (2017) review and meta-analysis of workplace resources influence on employee well-being and performance, it was suggested interventions may be effective targeting employees via the individual, group, leader or organizational levels. Moreover, targeting multiple levels is preferred and where contextually appropriate (Nielsen et al., 2017). Further, calls were made to evaluate interventions designed to support resources that promote job crafting, social support and cohesion between leaders and employees (Nielsen et al., 2017).

Recommendations emerging from Gilbert, E. et al. (2018)'s integrative review of personal resource interventions relate to delivery context, intervention fit and the

monitoring of the evolving impact over time. Future research is challenged with considering both the organizational context in which the interventions occur, but also the relationships and social constructs in which interventions are delivered and exert influence. Similar to previous calls for evaluation of how and why interventions work (Knight et al., 2019), Gilbert, E. et al. (2018) calls for greater understanding of individual and organizational differences which moderate the influence of intervention efforts. From an applied perspective, Gilbert, E. et al. (2018) recommends "deploying programs that target resources specific to task demands" (p.10), and leveraging existing wellness programs and initiatives where possible. Elsewhere, and also from the applied perspective, research attempting to evaluate intervention effectiveness were advised to ensure adequate managerial support for employee participation, thereby alleviating additional confounding demands on participants (Knight et al., 2019; Nielsen & Randall, 2013).

Emerging from consecutive reviews of work engagement intervention literature was a call for greater evaluation of how and why interventions may or may not achieve the desired outcomes (Knight, Patterson, & Dawson, 2017; Knight et al., 2019). This call is not unique, and affirms the necessity of testing underlying theories, such as the JD-R Theory for building knowledge around intervention effectiveness (Knight et al., 2019). It is worth noting that across the reviews, the settings for the intervention research were either not mentioned (Gilbert, E. et al., 2018) or focused primarily on healthcare, education, finance and manufacturing outcomes (Knight, Patterson, & Dawson, 2017; Knight et al., 2019). Therefore, the current project will seek to expand the application of the JD-R Theory for intervention development into a new unique occupational context, wildland firefighting.

1.3 Development and Evaluation Considerations

Central to developing and implementing effective interventions in the context of work is a participative approach wherein the end-user's involvement is continually sought through phases of planning, implementation and evaluation (Giga et al., 2003; Nielsen, 2013; Nielsen & Randall, 2012). As such, the design, implementation and evaluation processes of the current intervention research was led by the author and undertaken collaboratively in an iterative process with on-going facilitated communication and feedback between members of the research team and multiple levels of stakeholders within the partnering organization. Throughout all, the final decisions regarding project methodology, evaluation and analyses were those of the author for the purposes of fulfilling the requirements of the current dissertation. Additional clarity with regard to the author's role while completing the current dissertation is offered in Section 1.5, with the practical implications for ethical approval is discussed in Section 3.5.3.4. Throughout the development and across all aspects of the research project, extensive consideration was given to the context in which the interventions would be received and implemented. Two additional models of training and intervention programs strongly influenced the development and implementation of the current intervention research, both of which are discussed in greater detail in Chapter 3 (Karanika-Murray & Biron, 2015b; Robson et al., 2012).

1.3.1 RE-AIM Framework

With regard to intervention evaluation, the current project sought to utilize the RE-AIM Framework to extend consideration beyond effectiveness and respond to calls to enhance our understanding of how and why interventions may be effective (Glasgow et al., 2019; Knight, Patterson, & Dawson, 2017; Knight et al., 2019). Conceptualized over

two decades ago, the RE-AIM Framework provides an effective evaluative framework for intervention research to help contextualize findings and identify barriers and facilitators for translating intervention research into future practice (Glasgow et al., 2019; Glasgow, Vogt, & Boles, 1999). The RE-AIM Framework distributes 34 potential criteria to be evaluated across five dimensions: reach, effectiveness, adoption, implementation and maintenance (Glasgow et al., 2019). Drawing from recent examples of applications within workplace interventions, the present study will utilize the RE-AIM Framework to provide meaningful evaluation, addressing 19 criteria and at least one criteria from each of the framework's five dimensions (Glasgow et al., 2019; Harden et al., 2015; Harden et al., 2018; Kwan et al., 2019).

1.4 Research Context

1.4.1 Wildland Fire: A Global Concern

Wildland fires are a global concern as global temperatures rise (Fox et al., 2015). Fire severity and season length, ignition rates, and land area consumed are reaching unprecedented levels (Chas-Amil, Touza, & García-Martínez, 2013; Flannigan et al., 2013; Vanderwerf et al., 2006). Paramount to effective wildland fire management is the safe work of a highly trained and specialized group of wildland firefighters (WFFs). WFFs are exposed to extreme physical and psychological challenges across a wildland fire season, including: rough terrain, heavy equipment, long working hours, personal risk, poor sleep, and unpredictable environmental factors including variations in heat all while attempting to contain and suppress fires raging across hectares of densely forested regions (Aisbett et al., 2007; Aisbett et al., 2012; Bakker, 2011; Carballo-Leyenda et al., 2019; Cuddy & Ruby, 2011; Cuddy et al., 2015; Gordon & Lariviere, 2014; Lui et al., 2014; Palmer, 2005). Notwithstanding the aforementioned challenges,

WFFs are expected to maintain a high level of physical fitness and mental acuity through it all, ensuring their ability to competently complete the task of wildland firefighting. Ensuring the safe work of WFFs is essential, and as a result, interventions designed to promote their health and well-being in addition to preventing injury are crucial (Cartwright & Cooper, 2009; Cooper, 2013b, 2017; Karanika-Murray & Biron, 2015b; Rivara & Thompson, 2000; Van Eerd et al., 2015).

1.4.2 Wildland Firefighting in Canada

In the Canadian province of Ontario, WFFs are employed by the Ministry of Natural Resources and Forestry's Aviation, Forest Fire, and Emergency Services (MNRF-AFFES) division. Wildland fire seasons run from April 1 to October 31 in Ontario, each posing unique challenges with an average of approximately 700 wildland fires annually within the province's jurisdiction of over 1,000,000KM^2 (O.M.N.R.F., 2017). Ontario's 760 WFFs are stationed in crews of four at one of the 14 Fire Management Headquarters (FMHs) or three Attack Bases (ABs) divided into Northwestern (NWR) and Northeastern (NER) Regions (see Figure 2) (O.M.N.R.F., 2014b). While all FMHs and ABs work under the umbrella and ultimate authority of the MNRF-AFFES, each location operates independently as their own organization, managing their district and territory with their own resources, personnel and management. Further, the distances between FMHs and ABs can be hundreds if not thousands of kilometers away, as depicted in Figure 2. When deployed on large wildland fires, crews can be stationed up to hundreds of kilometers away from their FMH in remote areas of burning forest for up to 14 consecutive days, with shift lengths lasting up to 16 hours daily before taking a mandatory, two-day reprieve. During their deployment, WFFs can be solely

responsible for establishing their base camp, cooking their own meals, and sleeping in a tent a safe distance from the fire in the forest.

Figure 2. Map of the Province of Ontario depicting fire regions and FMH locations

1.4.3 Physical Job Demands in Wildland Fire

Wildland firefighting viewed through the lens of the JD-R Theory allows for greater understanding of both the demands and resources associated with the profession. An extreme occupation, wildland firefighting presents employees with arduous physical and psychological demands, including rough terrain, heavy equipment, long working hours, personal risk, poor sleep and a variety of unpredictable environmental factors (e.g., weather, heat, wildlife) all while attempting to contain and suppress wildland fires raging across hectares of densely forested regions in extreme heat (Aisbett et al., 2007; Aisbett et al., 2012; Bulmer, Aisbett, Wolkow, & Main, 2017; Carballo-Leyenda et al., 2019; Cuddy & Ruby, 2011; Cuddy et al., 2015; Gordon & Lariviere, 2014). Research over the past 15 years has consistently estimated the daily energy demands whilst fighting wildland fires to exceed 4500kcal, a result of navigating rough terrain while carrying or pulling heavy equipment such as pumps and hoses (Cuddy et al., 2015; Heil, 2002; Robertson et al., 2017; Ruby et al., 2002). Additional research has found that a WFF's average heart rate over the course of a shift ranged from 110 to 160 beats per minute, reflective of the variation in intensity required by various duties through the day (Budd, 2001; Cuddy et al., 2015). In terms of metabolic equivalent (METs), wildland firefighting has been shown to average 6.5 METs over the course of a day, with an upper threshold of 9 METs during peak exertion (Gaskill et al., 2003). Meeting these demands requires above average fitness levels (Domitrovich, 2011), with many additional factors to consider including: hydration (Raines, Snow, Nichols, & Aisbett, 2015; Raines et al., 2012, 2013), nutrition (Robertson et al., 2015; Ruby et al., 2002) and thermoregulation across variable thermal environments (Budd, 2001; Carballo-Leyenda et al., 2019; Lui et al., 2014).

Much research has been conducted to identify and document the physical characteristics and demands of the tasks associated with wildland firefighting (Lord et al., 2012; Netto et al., 2013; Petersen et al., 2010; Phillips et al., 2011; Phillips et al., 2012). This work has informed pre-season fitness requirements and fit-for-duty test development processes in addition to guiding the implementation of regional and national fitness standards, which are a pre-requisite for employment (Gumieniak, Gledhill, & Jamnik, 2018a, 2018b; Gumieniak, Shaw, Gledhill, & Jamnik, 2018; Jamnik, Gumienak, & Gledhill, 2013; Lord et al., 2012). In order to be employed as a wildland firefighter in Canada, individuals must successfully complete the Canadian Physical Performance Exchange Standard for Type 1 Wildland Firefighters, also known as the WFX-FIT (C.I.F.F.C., 2012). The WFX-FIT was implemented in 2012 as a "valid job-related physical performance standard used to determine whether an individual possesses the physical capabilities necessary to meet the rigorous demands encountered while fighting wildland fires" (C.I.F.F.C., 2012, p. 2). Successful completion of the WFX-FIT test is valid for a period of 90 days that immediately precedes the beginning of each wildland fire season. However, once the fire season begins, limited research has evaluated the physical fitness levels of WFFs as there are currently no minimum fitness standards or requirements that they must maintain throughout the fire season. Moreover, there remains no validated in-season fitness training program to support WFFs capacity to physically meet the demands of their occupation.

Limited in-season assessments of WFF fitness have been completed to date, creating a gap in our understanding with regard to the change in their physical capabilities across a wildland fire season. Gaskill et al. (2003) evaluated the aerobic capacity of WFFs and found a slight decrease from pre-season to mid- and post-season measures, positing that

individuals adapted to the specific demands of the occupation and particular fire season. These findings are consistent with the principle of detraining, where significant reductions in fitness can begin to occur after a few weeks of reduced training (Bickel, Cross, & Bamman, 2011). To date, research has yet to be conducted to comprehensively evaluate the fitness (or the physical personal resources) of WFFs and the impact of in-season training activity on fitness levels over the course of a fire season.

The lack of continuous fitness monitoring is troublesome as injury rates are high among WFFs, with fitness levels and physical fatigue often identified as contributing factors (Britton, Lynch, Ramirez, et al., 2013; Gordon & Lariviere, 2014; Palmer, 2005). In the context of this research, the lost-time injury rates among WFFs in the Ontario, Canada are triple the provincial average of all workers over the past 10 years (4.6 vs. 1.4/100 workers), with slips, trips, and falls and exertion and exhaustion being cited as the primary mechanisms of injury over the five-year period that immediately preceded this research project (Leduc, C., Tsimiklis, & Dorman, 2018, In Press; W.S.I.B., 2015). Most commonly, the nature of the resulting injury was sprains and strains (45.8%) followed by contusions and wounds (25.5%) (Leduc, C. et al., In Press). These findings are consistent with recent analyses of injury patterns reported by WFFs across the United States (Britton, Lynch, Ramirez, et al., 2013; Britton, Lynch, Torner, & Peek-Asa, 2013; Moody, Purchio, & Palmer, 2019). A recent survey of 284 WFFs in the United States found that nearly all had suffered at least one injury over the five-year period preceding the survey (89.4%) with over half of them classified as musculoskeletal injuries and 20% reported to have been thought to be preventable (Moody et al., 2019). Moreover, the MNRF-AFFES has identified both the frequency and severity of lost-time claims as a result of musculoskeletal injuries as an area of

concern, necessitating a more proactive, preventative intervention approach to maintaining task-specific fitness across the duration of a wildland fire season (Young, 2016).

1.4.4 Psychological Job Demands in Wildland Fire

Despite exposure to the perpetual uncertainty of fighting wildland fires resulting in significant occupational and environmental stressors, limited research has evaluated the psychological demands and subsequent psychological well-being of WFFs (Barton, Sutcliffe, Vogus, & Dewitt, 2015). Gordon and Larivière (2014) found that nearly half of surveyed WFFs in Ontario self-reported high levels of job stress over the course of a fire season. A subsequent study of a smaller sample of WFFs in Ontario found that experiences of overall job stress increased from mid- to post-season though scores remained within limits indicating perceived work stress as comparable to the average range in normative data for workers employed in the skilled-maintenance sector (Mcgillis et al., 2017; Mcgillis et al., 2015; Spielberger & Vagg, 1994). More specifically, perceived level of organizational support was identified as the primary driver of overall job stress and increased significantly over the course of the fire season (Mcgillis et al., 2015). To this point, no comprehensive evaluation of psychosocial risk factors has been completed in the context of wildland fire, nor does the organization possess complete data on the impact of its psychosocial climate on organization-level outcomes or lost-time claims within their workforce.

Given the lack of comprehensive evaluation of occupational stress and psychological job demands associated with wildland fire, there is opportunity to learn from other positions within wildland fire (Palmer, 2014; Palmer, Miller, Gaskill, & Domitrovich,

2009; Sharkey, Miller, & Palmer, 2008). For example, members of Incident Management Teams (IMT) in the United States participated over a four-year period in a study evaluating their physical health and stress levels (Palmer, Miller, & Gaskill, nd.; Palmer et al., 2009). Over 30% of the IMT members noted above average to severe levels of stress resulting from their work. Years of experience and team cohesion and unity mitigated the impact of job stress, while organizational constraint was cited as a confounding variable (Palmer et al., nd.). Elsewhere, a qualitative study of wildland firefighting dispatch workers revealed three broad categories of occupational stressors: work-life balance, job-related demands and issues relating to control (Palmer, 2014). With regard to coping strategies, it was noted that exercise, time off to recover, receiving support from others and placing an emphasis on the service they provide all served as instrumental for the dispatch workers (Palmer, 2014). In the United States, it has been noted that team leaders often face intense whilst making operational decisions on active fire lines and faced with great uncertainty (Barton et al., 2015; Useem, Cook, & Sutton, 2005). Given the common practice of promoting to positions of leadership from within wildland fire crews despite little to no additional training, there have been calls for formalized leadership training in the wake of major critical incidences of compromised decision making while under high levels of stress (Useem et al., 2005). Efforts in this regard have sought to identify compatible traits (e.g., mindfulness and compassion) within the context of wildland fire through the validation of several scale measures from both the perspective of the crew leader and member (Waldron & Ebbeck, 2015; Waldron & Schary, 2019; Waldron, Schary, & Cardinal, 2015).

Recently, an emphasis on developing applied mental health initiatives and support resources within wildland firefighting has been in response to a number of suicides

among WFFs (Degrosky, 2018; Gabbert, 2017; Keller, 2017; Stanley, Hom, Gai, & Joiner, 2018). While the exact statistics surrounding WFF suicide remains elusive, current estimates approximate 25-30 deaths annually in the United States (Degrosky, 2018). Recently, Stanley and colleagues (2018) extracted data from two national studies in the United States into all firefighters mental health to examine the levels of suicide within wildland firefighting and found an increased level of risk relative to other firefighters (e.g., structural or volunteer firefighters). Alarmingly, 55% of wildland firefighters reported clinically significant suicidal symptoms with thwarted belongingness explaining the statistically significant elevation as compared to other firefighters (Stanley et al., 2018). Calls to expand supports for wildland firefighters outside of their regular service hours have begun to be answered through provision of peer support and counselling access, however, neither psychosocial education nor risk mitigation intervention programming has yet to be investigated (Stanley et al., 2018).

1.4.5 Resources in Wildland Fire

Following the introduction of the WFX-FIT as a fitness requirement in 2012, several resources have been developed to support Canadian WFFs both in their preparation for meeting the standard and supporting training throughout the fire season. The Canadian Interagency Forest Fire Centre (CIFFC) developed a preparation guide and supplementary training program to prepare WFFs for the WFX-FIT test and the physical demands of a wildland fire season (C.I.F.F.C., 2012; Tobias, 2012).

With regard to in-season resources available for WFFs, Ontario's MNRF-AFFES developed a 'Commit to be Fit' task team in 2013 to guide the development of a fitness program. From 2013 to 2015, several iterations of the fitness program were developed,

piloted and evaluated internally based on feedback from all levels of staff and management across the organization (O.M.N.R.F., 2014a). The goal of the MNRF-AFFES' Commit to be Fit program is to "build and maintain strength, flexibility and endurance and maintain mental alertness" (O.M.N.R.F., 2014a, p. 1), recognizing WFFs as 'occupational athletes', and permitting them to engage in physical activity for a period of up to one hour within the first two hours of work and at base. The program also sought to identify a 'fitness lead' at each location to advocate for participation and assist in establishing a culture of fitness and well-being. Resources were made available to the fitness leads and WFFs at each location including an exercise library and support for purchasing training equipment (O.M.N.R.F., 2014a; Young, 2016). While the program has been well received among WFFs, several challenges remain including participation, availability of equipment, timing and management support, and training structure (Young, 2016). To date, no formal evaluation of program participation, or evaluation of efficacy via established fitness tests have been completed.

With regard to the psychological safety and well-being of WFFs over the course of a wildland fire season several reactionary supports exist. On a province-wide level, as public service employees, WFFs have access to an Employee Assistance Program and a comprehensive Workplace Discrimination and Harassment Program. On a ministerial level, as employees of the MNRF, WFFs can access a peer support program if experiencing psychological distress, particularly in response to critical incidents. Finally, and internal to their organization, the RESPECT Program at MNRF-AFFES leads holistic wellness initiatives at a local level across all work locations. However, evaluation of program effectiveness and documentation of participation in the aforementioned programs remains elusive. Further, no proactive program designed to

educate WFFs on workplace issues impacting their psychological safety and well-being exists. As such, given the potential for extremely high physical and psychological job demands, wildland firefighting presents a unique occupation for evaluating the efficacy of proactive resource-based intervention programs. To date, no comprehensive, resource-based interventions targeting physical fitness or psychological health and well-being have been conducted in the context of wildland fire.

1.4.6 Connecting Physical and Psychological Demands, Resources and Well-being

The connection between physical fitness and psychological well-being is well established (Biddle, 2016; Penedo & Dahn, 2005; Plante & Rodin, 1990). Workplaces have been identified as the priority setting for promoting both physical and psychological health and well-being through interventions, proving efficacious for both improvements in well-being and work performance alike (Commissaris et al., 2016; Ford, Cerasoli, Higgins, & Decesare, 2011; Malik, Blake, & Suggs, 2014). To that end, and in the context of work, numerous studies have expanded on the relationship between physical fitness and activity and positive psychological benefits including improved mental health, diminished risk of burnout and exhaustion and increased ability to deal with occupational stress (Abdin, Welch, Byron-Daniel, & Meyrick, 2018; Gerber et al., 2019; Naczenski, Vries, Hooff, & Kompier, 2017; Puig-Ribera et al., 2015; Schmidt, Beck, Rivkin, & Diestel, 2016; White et al., 2016).

The relationship between physical and psychological well-being in the context of work is reciprocal, with experiences of occupational stress linked with poor physical health outcomes, including burnout, exhaustion, somatic concerns including gastrointestinal problems and sleep disturbances (Gerber et al., 2019; Nixon, Mazzola, Bauer, Krueger,

& Spector, 2011; Peterson et al., 2008). However, repeated challenges to physical fitness and health promoting interventions includes a lack of theoretical grounding to connect and link findings across contexts or organizations and poor methodological rigour (Abdin et al., 2018; Conn, Hafdahl, Cooper, Brown, & Lusk, 2009; Ford et al., 2011). Moreover, research addressing job demands or resources has often focused on documenting, developing or understanding a single aspect of either physical or psychological well-being rather than attempting to influence and measure both simultaneously.

1.5 Personal Reflection

The current research builds upon nearly a decade of collaborative research between the organization and the research centre where the researcher is located. Research over the 2011 wildland fire season sought to document understanding of Ontario WFFs personality, physical fitness and job stress, and in particular, their contributions to the likelihood of injury incidence (Gordon & Lariviere, 2014; Gordon, Lariviere, Eger, Gauthier, & Leduc, 2012). In 2014, research collaboration efforts strengthened understanding of the physiological demands, nutritional requirements, sleep patterns and psychological demands associated with wildland firefighting (Mcgillis et al., 2017; Robertson et al., 2017). Participation in the aforementioned projects was formative in providing context for the author of this dissertation, who provided support across a number of capacities, as both Research Associate and Technologist supporting data collection, analysis and manuscript preparation.

Beginning in 2015, the author initiated dialogue between the doctoral supervision committee at Lancaster University, members of the research centre at Laurentian

University and the partnering organization, MNRF-AFFES with regard to the feasibility of conducting an intervention program over the subsequent fire season to fulfill the dissertation requirements for the author's doctoral program. It was agreed that the author would have the autonomy and responsibility to lead the development, implementation and evaluation of the interventions for his doctoral dissertation, under the supervision of his committee at Lancaster University. Funding for the project would be allocated and procured through the established collaborative research agreement between the research centre at Laurentian University and the partnering organization. As a research associate at the research centre working across several other unrelated projects, the author was allocated the time to complete data collection and intervention implementation activities of the dissertation project. The author remained the sole responsible agent for overseeing all activities pertaining to the current dissertation. Implications with regard to gaining ethical approval for conducting research to fulfill dissertation requirements at Lancaster University whilst being employed and receiving funding through Laurentian University are further discussed in Section 3.5.3.4.

Several actors within the research centre supported the researcher at various stages of project completion, including administrative and leadership support from the centre's Director, intervention development feedback, and data collection assistance by way of research assistants all under the direct supervision of the researcher. Likewise, as the design, implementation and evaluation of both interventions in the current study were undertaken using a participatory approach, several key stakeholders and champions within the partnering organization were instrumental in informing the project and facilitating completion. Members of local and senior management provided leadership and guidance throughout the process and championed participation across the

organization. The organization's Health and Wellness Specialist provided critical input to intervention material development, implementation and evaluation processes in addition to supporting, scheduling and facilitating data collection procedures. The current dissertation research is the intellectual property of the researcher, solely responsible for project conceptualization and all aspects of intervention development, implementation and evaluation, including data collection, entry, analysis and dissemination.

1.6 Aims and Objectives

Applying the JD-R Theory to the context of wildland fire, the aim of the current research project is to utilize a cluster-randomised control trial methodology to evaluate the effectiveness of two resource building intervention programs that were developed out of an iterative participatory approach: a fitness training intervention and a psychosocial education intervention program. Second, the current project seeks to contextualize effectiveness findings with aspects of intervention reach, adoption, implementation and maintenance. As no previous evaluation of JD-R Theory components has been completed in the context of wildland fire, a thorough documentation at baseline and across the fire season is necessary and must precede any form of intervention evaluation. Both intervention programs were designed to maintain task-specific personal resources, mitigate job demands, foster work engagement and psychological capital, and decrease job stress and incidence of injury. Each of the intervention programs were implemented independently across unique work locations and in conjunction with one another at separate, additional work locations. The fitness training intervention program was designed to align strategically with the organization's existing Commit to be Fit program to address its limitations: a lack of structure,

provision of tailored feedback, offer in-season training support and evaluate participation. The psychosocial education intervention was a new initiative within the organization to educate wildland firefighters on the influence of both demand and resource psychosocial factors across a wildland fire season and the impact on both their physical and psychological well-being.

CHAPTER 2. Systematic Review of JD-R Theory Intervention Literature

2.1 Introduction

As introduced, a central framework for understanding the relationship between job characteristics and employee well-being over the past 20 years is the Job Demands-Resources (JD-R) Theory (Bakker & Demerouti, 2014). Widely accepted due to its inherent flexibility in classifying work characteristics as either a demand or resource, the JD-R Theory sought to incorporate both positive and negative antecedents of employee strain and well-being within a single model (Bakker & Demerouti, 2007; Demerouti et al., 2001; Schaufeli & Taris, 2014). As a result, and since its inception, the JD-R Theory has been applied in a vast amount of empirical research and utilized across a diverse range of organizations around the world (Bakker & Demerouti, 2017; Schaufeli & Taris, 2014), evolving into a mature theory expounding on the relationships between job characteristics and employee well-being (Bakker & Demerouti, 2017; Bakker et al., 2014; Crawford et al., 2010; Lesener et al., 2019; Nahrgang et al., 2011). Explaining the relationship between demands and resources through two independent processes influencing psychological state and subsequently employee well-being, the JD-R Theory can also be used to understand a diverse range of organizational outcomes (Bakker & Demerouti, 2014, 2017). Moreover, and more recently, unified calls have persisted for the JD-R Theory to guide the development, implementation and evaluation of applied intervention research in the workplace (Bakker & Demerouti, 2017; Schaufeli, 2017; Schaufeli & Taris, 2014).

Whereas much of previous literature and subsequent reviews have focused primarily on individual components of the JD-R Theory (e.g., work engagement, personal resources), no review has systematically appraised research seeking to simultaneously

evaluate both the efficacy of an intervention program and the JD-R Theory as a whole. Further, many of the previous reviews have employed a number of other theoretical perspectives in addition to the JD-R Theory when connecting its components. For example, aspects of the Conservation of Resources Theory (Hobfoll, 2002) and Job Demand-Control model (Karasek, 1979) are commonly used to explain the psychological processes that are present within the JD-R Theory (Schaufeli & Taris, 2014). Notwithstanding this challenge, calls persist for the development, implementation and evaluation of intervention research based on the JD-R Theory (Bakker & Demerouti, 2014, 2017; Knight et al., 2019; Schaufeli, 2017).

2.2 Review Questions

In an effort to inform the current intervention research, the objective of the present review is to systematically and critically appraise organizational interventions explicitly utilizing and evaluating the efficacy of the JD-R Theory to enhance outcomes and address recommendations from existing cross-sectional research. Specifically, the current review aims to address the following questions:

1. What is the efficacy of the JD-R Theory as foundational to organizational interventions to enhance or influence outcomes?
2. What is the overall methodological quality of the JD-R Theory intervention literature?
3. What opportunities and challenges exist for utilizing the JD-R Theory for future applied intervention research?

2.3 Review Methodology

2.3.1 Protocol and Search Strategy

The systematic literature search was conducted between January 2018 and October 2018. EBSCO was utilized as the online reference system to search four major databases, including: Academic Search Ultimate, Business Source Complete, CINAHL Complete and PsycINFO. In order to capture the full range of journal articles, MESH/APA terms were reviewed, and utilized within searches using free-text words appearing in the title or abstract. The search was originally completed October 13, 2018 and updated October 6, 2019. Table 1 depicts the search strategy.

Table 1. Search strategy with results (originally searched October 13, 2018, updated October 6, 2019)

Concept 1: Intervention Research
Search #1 Free-text words in Title/Abstract: intervention or training or program [2,714,210 hits]
Concept 2: Workplace Context
Search #2 Free-text words in Title/Abstract: work* or employ* or job [4,283,649 hits]
Combine #1 AND #2 = #3 [610,743 hits]
Concept 3: Addressing aspect of JD-R Theory
Search #4 Free-text words in Title/Abstract: resource* or demand* or craft* or strain or engagement or motivation or exhaustion or performance [4,418,180 hits]
Combine #3 AND #4 = #5 [155,863 hits]
Concept 4: Explicit mention of JD-R Theory
Search #6 Free-text words anywhere: “Job Demands Resources” [1389]
Combine #6 AND #5 = #7 [233 hits]
Limit #7 by English language only [226 hits]
Remove duplicates (indexed in multiple databases) [134 hits]

Papers were screened using the following inclusion criteria: (1) having conducted an intervention in the context of an organization or workplace, (2) having explicitly utilized the JD-R Theory as formative to intervention development or evaluation; (3)

possess outcome measures evaluating the intervention via components identified within the JD-R Theory both pre- and post-intervention.

Following removal of duplicate articles, the initial database search yielded 134 titles and abstracts for review, and references were exported to EndNote X8 citation manager software. Titles and abstracts were then screened, and full text articles were retrieved for 49 papers. Following full text review, 40 papers were rejected as they either lacked a pre- and post-intervention evaluation or conducted only cross-sectional or observational research, leaving nine articles for inclusion (Ângelo & Chambel, 2013; Biggs, Brough, & Barbour, 2014; Gordon et al., 2018; Knight, Patterson, Dawson, & Brown, 2017; Van Steenbergen, Van Der Ven, Peeters, & Taris, 2018; Wingerden, Bakker, & Derks, 2016, 2017a, 2017b; Wingerden, Derks, & Bakker, 2017). In reviewing the full text and citations of the nine remaining articles, two additional papers

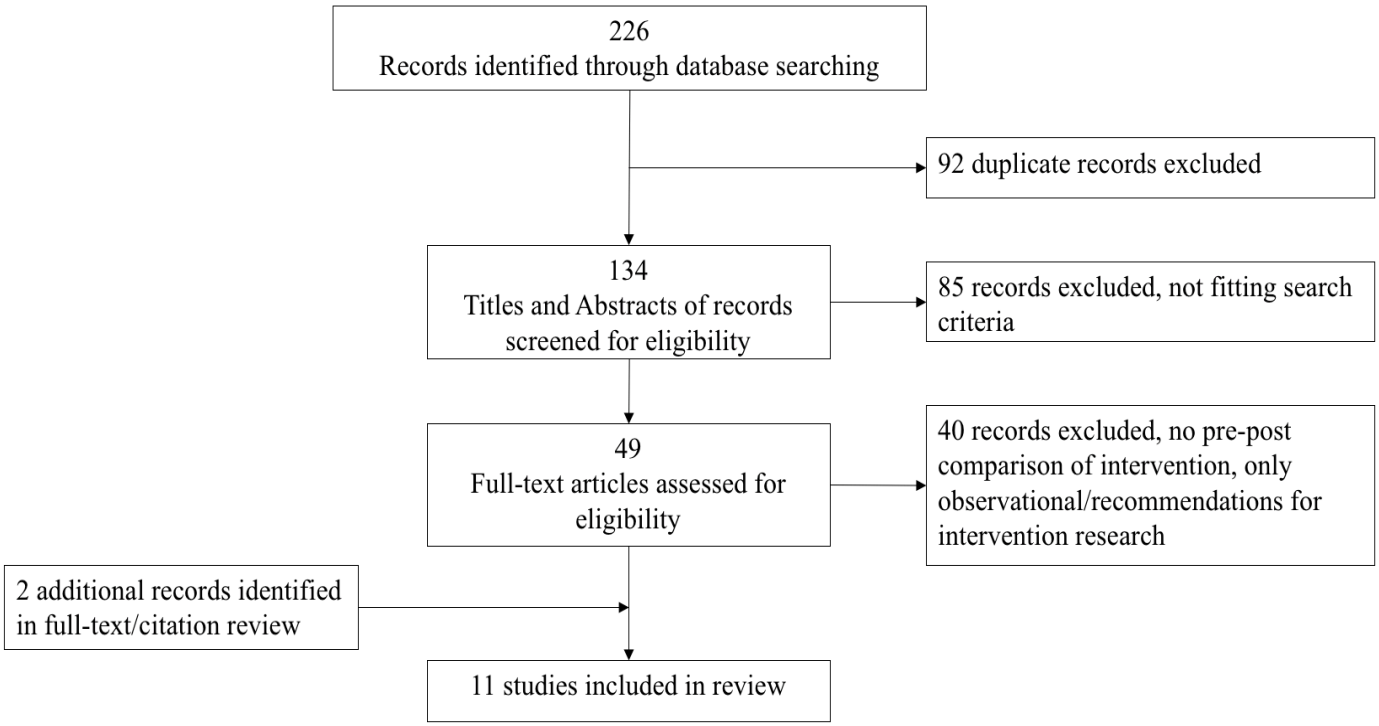

Figure 3. Flow chart on process of article identification (Updated October 6, 2019)

were identified and included the review (Heuvel, Demerouti, & Peeters, 2015; Sakuraya, Shimazu, Imamura, Namba, & Kawakami, 2016). Figure 3 summarizes the process of article identification.

Methodological quality of included papers was examined using the Quality Assessment Tool for Studies with Diverse Designs (QATSDD), a comprehensive gradient of indicators of good quality research (Sirriyeh, Lawton, Gardner, & Armitage, 2012). The evaluation criteria adapted from Sirriyeh et al. (2012) can be found in Appendix 2. Papers were assessed on 14 criteria for evaluating quantitative research using a four-point rating scale from 0 to 3. A score of 0 was assigned to the criteria where there was 'no mention at all', with scores of 1 'very slightly'; 2 'moderately'; and 3 'complete' being assigned to reflect improvements in quality and increased level of detail provided within the article. Full text of all 11 articles were read prior to assessment. The author subsequently conducted the assessment of the quality of the papers included in the review. Aspects pertaining to theoretical framework, clarity of aims/objectives, description of research setting and sample population, methodology and measures, data analysis, user involvement and strengths and limitations were assessed for each paper. The QATSDD scores were tabulated resulting in a potential range of 0 through 42, with higher scores reflecting higher levels of quality.

This review follows examples of qualitative syntheses of quantitative intervention studies, an approach useful for reviewing emerging literature in a given area (Mäkikangas, Kinnunen, Feldt, & Schaufeli, 2016; Suri & Clarke, 2009). It was not anticipated that a meta-analysis would be feasible, given the limited research to date, and the potential diversity in terms focus of prospective interventions.

2.4 Review Results

2.4.1 Study Characteristics

A brief summary of study design and characteristics can be found in Table 2. Of the 11 studies, seven were conducted in the Netherlands and one study each in Australia, Japan, Portugal and United Kingdom. The majority of intervention studies (9 of 11) utilized a quasi-experimental study design with pre- and post- test measures. Participants were assigned by workgroup or location to either intervention experimental or control conditions. The remaining two studies were longitudinal observational studies with a single pre-intervention measure and two post-intervention follow-up measurements. Eight of the studies measured participants at two points in time, pre- and post-intervention, while the remaining three studies utilized two post-intervention measures. Follow-up measurement times varied across all 11 studies, from immediately post-intervention to up to one year later. Intervention program length also varied considerably; from a 3-hour workshop delivered on one day to five workshops delivered over a period of nine months.

Table 2. Summary of articles selected for systematic review

Author and Date	**Population (N, % Female)**	**Design**	**Main Findings**	**Country**	**Quality Score**
Ângelo and Chambel (2013)	Elite firefighters (N=104, 3.8%)	Quasi-experimental pre-test-post-test design with control group	Time by intervention interaction associated with increased colleagues' social support and increasing vigour, however, also increased chronic demands.	Portugal	26
Biggs et al. (2014)	Police officers (N=368, 20.4%)	Quasi-experimental pre-test-post-test design with control group	Positive effect of intervention on perceptions of work characteristics, well-being of subordinates.	Australia	33
Gordon et al. (2018)	Medical specialists (N=119, 27.7%); and Nurses (N=58, 89.7%)	Quasi-experimental pre-test-post-test design with control group	Job crafting intervention groups associated with increases in job crafting behaviours, well-being including work engagement, health and reduced exhaustion, and job performance.	Netherlands	33
Heuvel et al. (2015)	Police district employees (N=86, 36.0%)	Quasi-experimental pre-test-post-test design with control group	Intervention group reported less negative affect and increased self-efficacy. Resource-seeking behaviour associated with higher reported levels of developmental opportunities and positive affect.	Netherlands	33

Knight, Patterson, Dawson, et al. (2017)	Acute care nursing staff (N=179, 88.2% at T1; N=83 at T2; 45 matched pairs)	Quasi-experimental pre-test-post-test design with control group	Affirmation of JD-R Model as work-related needs mediated relationship between resources and work engagement, while intervention had no effect on work engagement.	United Kingdom	33
Sakuraya et al. (2016)	Managers from manufacturing company and psychiatric hospital (N=50, 16.0%)	Longitudinal intervention study	Intervention program demonstrated positive effect on work engagement, improved job crafting and reduced psychological distress.	Japan	27
Van Steenbergen et al. (2018)	Financial services employees (N=126, 65.1%)	3-wage longitudinal observational study	Intervention effective in reducing mental demands and workload, stabilizing burnout and work engagement, however, decreasing autonomy and professional development opportunities.	Netherlands	33
Wingerden et al. (2016)	Healthcare professionals (N=67, 95.5%)	Quasi-experimental pre-test-post-test design with control group	Participants psychological capital, job crafting, work engagement and self- ratings of job performance increased after JD-R intervention.	Netherlands	29
Wingerden, Bakker, et al. (2017a)	Teachers (N=71, 91.5%)	Quasi-experimental pre-test-post-test design with control group	Job crafting, basic need satisfaction and work engagement increased for intervention group, analysis confirmed mediation within JD-R Theory.	Netherlands	32

Wingerden, Derks, et al. (2017)	Primary school teachers (N=102, 89.2%)	Quasi-experimental pre-test-post-test design with control group	Personal resources intervention had a positive causal effect on work engagement. Work engagement fully mediated relationship between psychological capital and self-rated job performance.	Netherlands	33
Wingerden, Bakker, et al. (2017b)	Primary school teachers for children with special educational needs (N=75, 82.7%)	Quasi-experimental pre-test-post-test longitudinal design with control group	Intervention had significant positive impact on job crafting behaviours at T2 and T3 in addition to increase in performance feedback, opportunities for professional development, self-efficacy and job performance.	Netherlands	33

2.4.2 Participants and Settings

Four of the 11 studies included participants working in a healthcare setting, including healthcare professionals (Wingerden et al., 2016) acute care nursing staff (Knight, Patterson, Dawson, et al., 2017), medical specialists and nurses (Gordon et al., 2018) and managers from a psychiatric hospital (Sakuraya et al., 2016). Three studies utilized uniformed participants, one with firefighters from an elite organization (Ângelo & Chambel, 2013) and two with police employees (Biggs et al., 2014; Heuvel et al., 2015). Three studies utilized primary school educators within the Netherlands (Wingerden, Bakker, et al., 2017a, 2017b; Wingerden, Derks, et al., 2017). The final two studies included managers from within manufacturing (Sakuraya et al., 2016) and employees from the financial services sector (Van Steenbergen et al., 2018).

Sample sizes varied from 50 to 368 participants, with an average of 115 participants. Complete participation across intervention and measurements are displayed in Table 3. Nine of 11 studies had a skewed gender distribution with representation of over 80% of participants from one gender, with five studies comprised of a predominantly female population (Knight, Patterson, Dawson, et al., 2017; Wingerden et al., 2016; Wingerden, Bakker, et al., 2017a, 2017b; Wingerden, Derks, et al., 2017), and the remaining four with a predominantly male sample (Ângelo & Chambel, 2013; Biggs et al., 2014; Gordon et al., 2018; Sakuraya et al., 2016). Each of the studies justified the skewed distribution as representative of the workforce in which the interventions were conducted (e.g., higher proportion of females in teaching, nursing; while higher proportion of males in firefighting and policing). The two remaining studies with the most balanced gender distribution had roughly a 2:1 ratio, one in favour of females (Van Steenbergen et al., 2018) with the other slanted towards males (Heuvel et al., 2015).

All studies provided some form of retention data, with the structure of reporting and rates varying widely (25.1-100.0%). Only four of 11 studies reported the potential target population from which recruitment took place (Biggs et al., 2014; Knight, Patterson, Dawson, et al., 2017; Sakuraya et al., 2016; Van Steenbergen et al., 2018). Three studies did not report attrition data across pre-intervention measures, intervention participation and post-intervention measures, one with teachers, one with healthcare professionals and another with an elite group of firefighters (Ângelo & Chambel, 2013; Wingerden et al., 2016; Wingerden, Bakker, et al., 2017a). Two studies with a second post-intervention measurement point retained 94.7% of participants in the context of primary education (Wingerden, Bakker, et al., 2017b), and 84.0% of managers in manufacturing and psychiatric hospital settings (Sakuraya et al., 2016).

2.4.3 Intervention Design

Table 4 provides an overview of the intervention programs utilized across included articles in this systematic review. Seven of the 11 studies designed their interventions to target a single component within the JD-R theory, while the remaining four attempted to achieve organizational outcomes through two or more components simultaneously. All of the studies designed their interventions to influence positive outcomes through the motivational processes of the JD-R Theory, relying heavily on Job Resources (N=6) and Job Crafting (N=6) as the components most frequently targeted within the included studies, with Personal Resources (N=3) making up the balance. Only one study included an intervention component directly targeting Job Demands, however they also targeted Job Resources and Crafting (Wingerden, Bakker, et al., 2017a).

There was considerable variety by way of intervention delivery and format. One study evaluated the impact of an instantaneous implementation of an organization-wide policy (Van Steenbergen et al., 2018). The length of intervention delivery across the remaining studies varied from a three-hour workshop session (Gordon et al., 2018) to 11 days of workshops delivered over a period of nine months (Knight, Patterson, Dawson, et al., 2017). Eight of the 11 intervention studies delivered their content in an initial setting and then reinforced or scaffolded material across a minimum of one additional subsequent session, with time lags ranging from two weeks to nine months. Intervention material was delivered through small group sessions with up to 20 participants per session in 10 of the 11 studies. Where reported, the intervention material was delivered primarily by members of the research team or an external consultant in conjunction with the research team. It is problematic that six of the 11 studies did not report who facilitated delivery of the intervention material, especially as it would pertain directly to the reproducibility of the interventions, but also speak to the long-term viability of implementation within an organization and the sustainability of positive outcomes or changes.

Overwhelmingly, each of the intervention studies affirmed support for the efficacy of the JD-R Theory both for understanding the relationships between antecedents and outcomes of work engagement and serving as a foundational basis for future organizational stress intervention research. However, not all interventions were successful at achieving the desired or anticipated outcomes of their interventions.

Table 3. Study participation across measurement points in articles included in systematic review

Author and Date	Measurement Points	Total Population	T1 N	N by Experimental Condition	T2 N	Retention from T1	T3 N	Retention from T1	Final N
Ângelo and Chambel (2013)	T1: Pre-intervention T2: 4-months post-intervention	*	104	Intervention: 67 Control: 37	104	100.0%	**	**	104
Biggs et al. (2014)	T1: 4-months pre-intervention T2: 7-months post-intervention	2637	853	Intervention: 146 Control: 222	377	44.2%	**	**	368
Gordon et al. (2018)	T1: Pre-intervention T2: Post-intervention	*	131	Intervention: 48 Control: 71	119	90.8%	**	**	119
	T1: Pre-intervention T2: 1-2 weeks post-intervention	*	120	Intervention: 32 Control: 26	58	48.3%	**	**	58
Heuvel et al. (2015)	T1: Pre-intervention T2: Post-intervention	*	99	Intervention: 39 Control: 47	86	86.9%	**	**	86
Knight, Patterson, Dawson, et al. (2017)	T1: Pre-intervention T2: Post-intervention T3: 1-month post-intervention	~485	179	Intervention: 115 Control: 64	45	25.1%	**	**	45

Sakuraya et al. (2016)	T1: Pre-transition T2: 3-months post-transition T3: 12-months post-transition	54	36	First session: 48 Second session: 44 Both sessions: 42	44	88.0%	42	84.0%	50
	T1: 2-weeks pre-intervention T2: 1-week post-intervention	25	14						
Van Steenbergen et al. (2018)	T1: 2-weeks pre-intervention T2: 2-weeks post-intervention3 T3: 1 year post-intervention	212	164	Intervention: 212	182	85.7% of Total	180	84.8% of Total 59.4% Matched Pairs	126
Wingerden et al. (2016)	T1: 2-weeks pre-intervention T2: 1-week post-intervention	*	67	Intervention: 43 Control: 24	67	100.0%	**	**	67
Wingerden, Bakker, et al. (2017a)	T1: 2-weeks pre-intervention T2: 2-weeks post-intervention T3: 1-year post-T2	*	71	Intervention: 41 Control: 30	71	100.0%	**	**	71
Wingerden, Derks, et al. (2017)	T1: 2-weeks pre-intervention T2: 1-week post-intervention	*	132	Intervention A: 26 Intervention B: 32 Intervention A+B: 26 Control: 18	102	77.3%	**	**	102

Wingerden, Bakker, et al. (2017b)	T1: Pre-intervention T2: 4-months post-intervention	*	75	Intervention: 45 Control: 30	75	100.0	71	94.7%	75

Table 4. Intervention description for included articles in systematic review

Author and Date	Aim	Target JD-R Component	Format	Content	Delivery	Outcomes
Ângelo and Chambel (2013)	"Analyze the effects of an intervention program to promote job resources (social support), and consequently firefighters psychological well-being (decrease burnout and increase engagement), using the JD-R model as the theoretical model" (p.198).	JR	21 hours of supervisor training over three days divided into education and action components.	Stress, importance of occupational health, coping strategies and leadership.	Small group (up to 10) delivery at training facility led by Principal Investigator.	Increase in social support, vigor dimension of work engagement; implemented training with control group one-year later with support for JD-R Theoretical basis for intervention.
Biggs et al. (2014)	"Drawing on the job demands-resources theory…employing a quasi-experimental research design to evaluate the effectiveness of an organizational intervention to improve work-related attitudes and work engagement and to decrease psychological strain and turnover intentions" (p.44).	JR, PR	Initial 360° review followed by five days of action-learning workshops.	Training on leadership styles and behaviours, provision of resources to enhance capabilities followed by individual coaching sessions.	Individual coaching and small group workshop developed and facilitated by an external consultant; review process completed by research team.	Positive effect on work characteristics, well-being, job satisfaction and work engagement, affirm mediation anticipated by JD-R Theory.

Gordon et al. (2018)	"investigate the impact of two tailored job crafting interventions in healthcare among medical specialists and nurses, who are trained to optimize and adjust their job demands and resources for personal 'fit' and organizational benefits" (p.99).	JC	3-hour workshop	Training on job crafting strategies, participation in situated experiential learning narrative exercises and development of personal crafting plan.	Small group (up to 15)	Increases in job crafting behaviours, work engagement, health and job performance, affirm job crafting as effective component of JD-R theory for targeting in future intervention research.
Heuvel et al. (2015)	"test the effectiveness of a newly developed job crafting intervention…to offer employees the opportunity to improve their work environment and work-related well-being using insights from job crafting and the JD-R model" (p.512-513).	JC	1-day training, four weeks job crafting period followed by half day reflection session.	Training on the role of job crafting in JD-R model, mapping of tasks, demands and resources.	Small group (up to 20).	Decrease in negative affect and increased self-efficacy, confirm potential for job crafting intervention to facilitate employees creating work environment to improve well-being.
Knight, Patterson, Dawson, et al. (2017)	"evaluate whether a participatory action research intervention with nursing staff on acute care older people…was effective for increasing work engagement" (p.634).	JR	Five core workshops (one 3-day, four 2-day) over nine-month period.	Workshops focused on resource strategies: collaboration, sharing, problem-solving,	Group (up to 16), delivered by research team.	Mixed results, no effect on work engagement, however mediating relationships within JD-R were affirmed.

				leadership and team-work.		
Sakuraya et al. (2016)	"to investigate the effectiveness of a newly developed job crafting intervention program on work engagement" (p.2).	JC	Two 120-minute sessions, separated by two-week period.	Sessions covered three aspects of JC (task, human relation and cognition), reviewed case study, sharing crafting experiences, developed JC plan followed by review and reflection of plans.	Group (up to 13), delivered by researcher and clinical psychologist.	Positive effect on work engagement, increases in job crafting and reduced psychological distress.

Van Steenbergen et al. (2018)	"to examine how a mandatory transition to New Ways of Working affected job characteristics and employees' burnout and work engagement" (p.738).	JR	Instantaneous implementat-ion of flexible work policy.	Policy change giving employees autonomy over where and when they work, supported by electronic communication and technology.	Top-down approach, organization-wide.	Positive results on job demands, however, mixed outcomes on job resources with no influence on work engagement or burnout.
Wingerden et al. (2016)	"assess the impact of a JD-R intervention – aimed at improving personal resources and optimizing job resources and challenging job demands – on work engagement and performance" (p.687).	PR, JR	Three 4-hour sessions over a four-week period.	Exercises to support personal resource development, job resources understanding, initiate job crafting plan and share and evaluate progress.	Group session, individual reflection and activities.	Positive impact on personal resources, job crafting, work engagement and job performance, affirming JD-R Theory as plausible foundation for intervention research.

Wingerden, Bakker, et al. (2017a)	"to assess the impact of a job crafting intervention – aimed at optimizing job demands and resources – on participants' work engagement" (p.165).	JC, JD, JR	Three 4-hour sessions over a four-week period.	Michigan Job Crafting Exercise aimed at increasing social job resources, increasing challenging job demands and increasing structural job resources.	Group session, individual reflection and assessment.	Positive impact on job crafting, work engagement and basic need satisfaction, affirmation for JD-R Theory underlying intervention.
Wingerden, Derks, et al. (2017)	"based on the principles of the JD-R model…to assess the effects of two organizational interventions, both independently and together, aimed at fostering work engagement and improving performance" (p.52).	PR, JC	Each intervention consisted of three sessions over six weeks.	PR intervention with three exercises, JC intervention based on Michigan Job Crafting Exercise.	Group sessions with individual application and reflections.	Positive impact of PR intervention on work engagement, increases in job crafting and personal resources, combine interventions had positive impact on job performance, provides support for JD-R Theory.

Wingerden, Bakker, et al. (2017b)	"to assess the impact of a job crafting intervention on work engagement and performance both immediately after the intervention and 1 year later" (p.107).	JC	One 8-hour session, followed by a 4-hour evaluation session, four weeks later.	Based on Michigan Job Crafting Exercise to facilitate job analysis and develop action plans, followed by review session.	Group sessions with individual application and reflections.	Interventions successful at increasing job crafting behaviours and promoting job resources yet showed mixed results on job demands and personal resources, contributing to JD-R Theory.
*JR = Job Resources, WE = Work Engagement, WB = Well-Being, JC = Job Crafting, PR = Personal Resources						

2.4.4 Outcome Measures

All studies relied heavily on participant's completion of the same self-report questionnaires both pre- and post-intervention. The number of scales or instruments employed across the 11 studies ranged from three to nine. Appendix 3 displays outcomes measures utilized by each study according to component of the JD-R Theory. Of the 11 studies, all but one (Heuvel et al., 2015) measured work engagement with the nine-item Utrecht Work Engagement Scale (Schaufeli, Bakker, & Salanova, 2006). Seven studies measured job crafting, four of which utilizes subscales developed by Tims, Bakker, and Derks (2012), while two used a scale developed by Petrou, Demerouti, Peeters, Schaufeli, and Hetland (2012). Three of five studies measuring Personal Resources used the Psychological Capital Questionnaire (Luthans, Avolio, Avey, & Norman, 2007) with scales assessing participants level of hope, optimism, self-efficacy and resilience, while the remaining two studies assessed self-efficacy and resilience (Wingerden, Bakker, et al., 2017b) and self-efficacy alone (Heuvel et al., 2015). Six studies evaluated Job Resources utilizing a variety of subscales tailored to their population and context, while five studies made use of a number of scales to assess Job Demands. Measures of Job Strain or Exhaustion were taken in four studies, each of which utilized a different scale: Maslach Burnout Inventory (Ângelo & Chambel, 2013), the General Health Questionnaire (Biggs et al., 2014), The Oldenburg Burnout Inventory (Gordon et al., 2018), and the Brief Job Stress Questionnaire (Sakuraya et al., 2016). Subjective ratings of job performance were garnered in four studies (Gordon et al., 2018; Wingerden et al., 2016; Wingerden, Bakker, et al., 2017a, 2017b). Finally, only one study conducted structured interviews in addition to survey measures to evaluate the impact of their intervention (Wingerden, Derks, et al., 2017).

2.4.5 Quality Appraisal

The QATSDD utilized for quality assessment has a maximum score of 42 and a minimum quality score of 0 (Sirriyeh et al., 2012). Complete scoring of each included article across all each of the 14 criterion can be found in Appendix 4. All articles reviewed scored within the range of 26-33 (61.9-78.6%). Highest scores were for clarity of statement of aims, clear description of research setting, fit between research question and method of analysis, and explicit utilization and evaluation of theoretical frameworks.

Generally, studies were rated poorly on providing evidence of sample size being considered in terms of analysis, with only one study including details around power calculations influencing sample size considerations for analytical requirements (Sakuraya et al., 2016). However, the poor ratings may falsely suggest that consideration was not given to sample size, as participation in the remaining studies was often limited by the size of the participating organization or work site partner. More often, consideration was given to the practicality of recruiting all employees within a ward, department or work location, rather than achieving statistical power to detect effect sizes of a certain weight.

Overall, studies also rated poorly with regards to providing evidence of user involvement in the design of their research. Indeed, only one study articulated the process through which the participating organization and its employees were given a voice in the design of the study and the development of the intervention (Knight, Patterson, Dawson, et al., 2017). All but one study reported using self-selected, volunteer participants in their intervention program, a standard and preferred practice.

2.5 Review Synthesis

The current review sought to evaluate three aspects of current literature pertaining to the JD-R Theory and interventions: (1) the efficacy of the JD-R Theory to serve as the theoretical foundation for interventions attempting to achieve desirable outcomes; (2) the overall methodological quality of current JD-R Theory intervention literature; and (3) the opportunities and challenges that exist for utilizing JD-R Theory for future applied intervention research.

2.5.1 Summary of Evidence

Efficacy of JD-R Theory

Overall, the intervention studies included in the present review offer support for the efficacy of the JD-R Theory to serve as foundational for their research. While the effectiveness of the interventions varied, each reported positively on their assessment of the anticipated relationships between constructs found within the JD-R Theory. Where interventions did not observe the anticipated effects, the mediating relationships within the JD-R Theory were affirmed (Knight, Patterson, Dawson, et al., 2017). The flexibility of the JD-R Theory is demonstrated by the variety of mechanisms through which interventions were designed to achieve outcomes. Indeed, interventions focused primarily on fostering job resources and empowering employees through job crafting programming, while other programs also sought to develop personal resources and mitigate job demands. Interventions adopted a primarily positive approach, attempted to influence outcomes including wellbeing and performance through work engagement and the motivational process of the JD-R Theory.

Methodological Strengths

With regard to the overall methodological quality of JD-R Theory intervention literature, several strengths emerged, especially as it pertains to methodological quality, including contributions to theory, clarity of aims and objectives, and cohesiveness across aims, methodology and analysis. Given the inclusion criteria of studies having to have adopted and evaluated the JD-R Theory within their intervention, it was expected and confirmed that contributions to theory was a strength. Another methodological strength lies within the clarity of purpose for the projects as clearly communicated within each study were explicit statements of the research aims and the objectives. Stemming from this clarity is well-justified data collection and analysis procedures and decision-making.

Methodological Limitations

Emerging from the review were four consistent methodological limitations: two issues pertaining to sample (size and homogeneity), an over-reliance on quantitative and self-report measures and a lack of user involvement in the design, implementation and evaluation both of the interventions themselves, but also the research process as a whole.

With regard to the sample population, two challenges consistently emerged across the included studies. First, the majority of the studies struggled with sample size. From a methodological perspective, this finding appeared inevitable as its consideration was rarely reported a priori. Indeed, only one study reported conducting power analyses to estimate required sample size for desired effect size (Sakuraya et al., 2016). While it is acknowledged that challenges regard to sample size are often the result of practical

realities including budgetary restrictions, organizational commitment and partnership, there remains room for improvement particularly as it relates to transparency in reporting. For example, only four of 11 included studies reported an estimate of the total target population within their recruitment efforts, which shed light on both participation rate but also assists with contextualizing the participating population within the organization (Biggs et al., 2014; Knight, Patterson, Dawson, et al., 2017; Sakuraya et al., 2016; Van Steenbergen et al., 2018). Few issues emerged pertaining to attrition, appearing to be a function of both small sample sizes and occupation type (e.g., full-time permanent employees working in stable, predictable occupations). Studies with lower retention rates across pre- and post-intervention follow-up measurement points remained comparable to other high-risk stressful occupations (Tuckey, Chrisopoulos, & Dollard, 2012).

The second challenge pertaining to sampling relates to the homogeneity of samples. The majority of included studies included a single profession (e.g., teachers or nurses) While homogenous samples often proves challenging to extrapolate findings, opportunity remains for connecting their characteristics to similar occupation groups. The greater challenge emerges around having only one participating organization or worksite, where studies could have done more to describe the context in which the research took place (Nielsen & Miraglia, 2017). However, there would be value in researchers focusing on reporting the types of environmental and workplace characteristics present during implementation processes and discussing their potential influence. As such, a number of similar occupational groups could have gleaned greater knowledge.

For the most part, studies relied heavily on quasi-experimental research designs affirming previously posited positions of an over-reliance in organizational intervention literature (Nielsen & Miraglia, 2017; Nielsen et al., 2017). However, the calls to move beyond the randomised control trials and quasi experimental approaches remain unanswered as studies that employed a longitudinal study design without a control group lamented that aspect (Sakuraya et al., 2016; Van Steenbergen et al., 2018). Of the included studies, only Biggs et al. (2014) acknowledged the potential limitation of quasi-experimental designs resulting in disparate groups (Lipsey & Cordray, 2000), though they argue the approach remains appropriate when conducting interventions in organizational research settings (Adkins & Weiss, 2003). Finally, as all studies relied nearly exclusively on self-report measures, it is worth noting the potential for method bias when interpreting results (Podsakoff, Mackenzie, & Podsakoff, 2012).

Finally, despite repeated calls and evidence for the inclusion of a participative approach to organizational intervention research, the majority of the studies did not report involving participants in the design, implementation or evaluation processes (Giga et al., 2003; Nielsen, 2013; Nielsen & Randall, 2012). While a handful of included studies made reference to involving participants in actively crafting the intervention, only one formally adopted and documented the processes involved in a participatory action approach to their intervention (Knight, Patterson, Dawson, et al., 2017). Contrary to expected, the study adopting the participatory action approach also retained the fewest participants across their evaluation of the intervention (Knight, Patterson, Dawson, et al., 2017). Within the context of JD-R Theory, researchers should be mindful that participation in the intervention research process does also not produce inadequately

resourced demands on participants over and above that of their regular job responsibilities.

Opportunities and Challenges for Future Interventions

Several recommendations for future JD-R Theory intervention development and evaluation emerged from the included studies: diversifying occupation populations, considering sample size, expanding methodological approaches and refining meaningful measurement periods and tools. While it is acknowledged that challenges exist with conducting intervention research across a number of occupation types, future research could look to alleviate the concern by including multiple worksites or units and documenting the corresponding similarities and differences across them.

Opportunities exist to demonstrate greater foresight with regard to sample size and achieving desired effects. Indeed, small sample size was reported as a limitation in all but one of the 11 included studies (Biggs et al., 2014), and that study subsequently struggled with attrition across measurement points. It is therefore recommended that adopting a more participative approach to organizational intervention research as a means to increase participation rates (Nielsen & Randall, 2012; Wingerden, Bakker, et al., 2017a). Further, actively resourcing support mechanisms for participants across the interventions is advised, leveraging advances in technology where possible. Along this thread, Heuvel et al. (2015) recommended "staying in closer contact via email or social media while participants are practicing their crafting goals may help to make the intervention more effective" (p.527).

Future JD-R Theory interventions would benefit from diversifying their methodological approaches, to include mixed methods approaches and allow for more process-oriented, objective and observer rating measures within their evaluations. For example, incorporating a qualitative component such as semi-structured interviews or open-ended questionnaires could be effective as understanding what components of the interventions were most impactful at achieving desired outcomes (Knight et al., 2019; Wingerden, Derks, et al., 2017). This type of approach could facilitate a full-process evaluations to determine why and how organizational interventions are effective (Knight et al., 2019; Knight, Patterson, Dawson, et al., 2017; Nielsen & Abildgaard, 2013; Nielsen & Miraglia, 2017). Further, evaluations should seek to include a measurement of intervention uptake, or the extent to which participants incorporated components of the intervention to fit their jobs, alongside their strengths, skills and working preferences (Gordon et al., 2018). Finally, outcomes of the interventions were consistently evaluated at the individual-level, with little to no evaluation of team, group or organizational-level outcomes.

Additionally, a gap remains in identifying optimal periods for follow-up measurement points and intervention evaluation. Indeed, whereas some studies conducted their follow-up measurement point within a week or two of intervention completion and called for longer periods (Gordon et al., 2018; Wingerden et al., 2016; Wingerden, Derks, et al., 2017), others conducted longer follow-up periods of four to seven months and posited that shorter time periods may have been more effective (Ângelo & Chambel, 2013; Biggs et al., 2014). While four studies included two post-intervention measurement points (Knight, Patterson, Dawson, et al., 2017; Sakuraya et al., 2016; Van Steenbergen et al., 2018; Wingerden, Bakker, et al., 2017b), it should be cautioned

that the multiple follow-up evaluations do not guarantee clarity regarding the longevity and impact of intervention effects but rather run the risk of increasing bias associated with method variance and sample attrition (Biggs et al., 2014; Semmer, 2006).

Finally, there remains opportunity for a greater diversification of measures used within JD-R Theory-driven intervention research. While it is acknowledged that consistency of measures facilitates comparisons across studies, the persistent use of measurement tools can result in missing key context-driven variables. Opportunities exist for pursuing relevant evaluations of personal differences and the broad array of job characteristics that may mediate intervention effectiveness (Knight, Patterson, Dawson, et al., 2017; Van Steenbergen et al., 2018; Wingerden et al., 2016).

2.6 Review Conclusion

The current review evaluated three aspects of current JD-R Theory intervention literature. The evidence for the JD-R Theory as a foundational theoretical basis to guide the development, implementation and evaluation of applied organizational intervention research is solid and consistent. Several methodological strengths were identified within the intervention literature; however, opportunities remain pertaining to the adoption of a more participative approach, diversification of occupation groups and measurement tools, and consideration of sample size and expanded evaluations of intervention process and context. Further, the emphasis on psychological antecedents and consequences of well-being within the JD-R theory is well documented, with opportunity for the inclusion of physical personal resources including fitness and physical activity.

2.7 RE-AIM Framework

In an effort to address the gap in JD-R Theory intervention literature pertaining to expanded evaluations of intervention implementation process and context, the current study will employ the RE-AIM Framework. The RE-AIM Framework, conceptualized over two decades ago, provides an effective, flexible and practical evaluative framework for intervention research for determining effectiveness, but also contextualizing findings with opportunities to identify barriers and facilitators to inform future research (Glasgow et al., 2019; Glasgow et al., 1999). The RE-AIM Framework proposes 34 potential criteria to be evaluated which are distributed across five dimensions: reach, effectiveness, adoption, implementation, and maintenance (Glasgow et al., 2019).

2.7.1 RE-AIM Dimensions

Reach

Reach has been defined as "the absolute number, proportion, and representativeness of individuals who are willing to participate in a given initiative, intervention or program" (Glasgow et al., 2019, p. 3). The most commonly employed criterion of reach has been the reporting of the percentage of individuals who participated based on a valid denominator or all potential participants in a target population (Gaglio, Shoup, & Glasgow, 2013).

Effectiveness

Effectiveness, or efficacy, has been defined as the "impact of an intervention on important outcomes, including potential negative effects, quality of life and economic outcomes" (Glasgow et al., 2019, p. 3). Historically and persistently, the emphasis

within the effectiveness dimension of the RE-AIM Framework has been on the reported subjective or objectives measures related to the primary outcomes, however, there have been calls to expand effectiveness measures to include unintended consequences and to compare results to broader goals, established guidelines or normative data (Gaglio et al., 2013; Glasgow et al., 2019).

Adoption

Adoption is a dimension of the RE-AIM Framework that operates at the setting- and staff-levels, defined as "the absolute number, proportion, and representativeness of a) settings; and b) intervention agents who are willing to initiate a program" (Glasgow et al., 2019, p. 3). To date, the majority of reporting relating to adoption has been limited to adoption rates while it is suggested that future research should report in greater detail contextual factors influencing uptake within a specific setting (Glasgow et al., 2019).

Implementation

Implementation is a dimension of the RE-AIM Framework that is measured at both the setting and individual levels (Glasgow et al., 2019). At the setting level, implementation includes the "intervention agents' fidelity to the various elements of an intervention's protocol, including consistency of delivery as intended and the time required…including adaptations made and the costs of implementation" (Glasgow et al., 2019, p. 4).

Maintenance

The final dimension of the RE-AIM Framework is maintenance, which is assessed at the setting and individual levels. At the setting level, maintenance refers to "the extent

to which a) behavior is sustained six months or more after treatment or intervention; and b) a program or policy becomes institutionalized or part of the routine organizational practices and policies" (Glasgow et al., 2019, p. 4). At the individual level, maintenance has been measured through the long-term effects of the program on outcomes after delivery is complete (Glasgow et al., 2019).

2.7.2 RE-AIM Application

Since its inception, the RE-AIM Framework has been applied across a diverse number of research settings. Indeed, several reviews have been completed evaluating the utilization and efficacy of the RE-AIM Framework across a number of contexts and settings and provided recommendations for future applications (Antikainen & Ellis, 2011; Gaglio et al., 2013; Harden et al., 2015; Harden et al., 2018; Kessler et al., 2012; Kwan et al., 2019). In their synthesis of 71 studies utilizing the RE-AIM Framework, Gaglio et al. (2013) found that while no studies reported on all 34 individual criteria, 62% reported in some capacity on all five dimensions, with Reach and Implementation most commonly reported. There is agreement within reviews that interventions utilizing the RE-AIM Framework should make every effort to report on each dimension in some capacity, while acknowledging the challenges associated with conducting intervention research in the context within live settings (Gaglio et al., 2013; Harden et al., 2018; Kessler et al., 2012). Further, it has been emphasized that a pragmatic approach should be taken, with clarity and transparency around the process of dimension and criteria selection prioritized (Harden et al., 2018). Despite the structure afforded by the RE-AIM Framework, challenges common to intervention planning and evaluation including data acquisition, lack of resources and changing priorities and personnel over time still remain (Kwan et al., 2019). As such, recently calls have recommended a more

fluid and iterative application of the RE-AIM Framework, and in particular during the implementation period (Glasgow et al., 2019).

Within the context of organizational intervention research, the RE-AIM Framework has proved valuable for balancing the importance of internal and external validity required for meaningful research (Hone, Jarden, & Schofield, 2015). In their review of 40 positive psychology intervention effectiveness trials using the RE-AIM Framework, Hone et al. (2015) found that reporting levels varied substantially, from 84% of studies reporting on Adoption criteria to only 16% reporting on Maintenance criteria. Particularly underreported criteria across the intervention literature reviewed included overall participation rates, a comparison between differences in participants and non-participants, intervention costs and any commentary pertaining to maintenance of the program (Hone et al., 2015). More specifically, the RE-AIM Framework has been used to provide meaningful intervention and process evaluations of workplace intervention areas including ergonomics (Welch et al., 2020), active commuting (Dubuy et al., 2013), theory-based physical activity, (Antikainen & Ellis, 2011), health promotion (Caperchione & Coulson, 2010) and obesity prevention (Estabrook, Zapka, & Lemon, 2012).

Harden et al. (2018) provided evidence for and a pragmatic guide for the application of the RE-AIM Framework within corporate settings. Considerations for the use of the RE-AIM Framework include acknowledgements of costs and challenges associated with 'real world' research, tracking most relevant criteria based on local interest and resource availability, and leveraging existing data when applying the framework at the end of an initiative knowing that it can be used to inform future iterations of intervention

research (Harden et al., 2018). As the RE-AIM Framework will be applied to the current project as an evaluative framework after the implementation period was complete within a live emergency response organization particular attention will be given to common RE-AIM criteria within each dimension according to recommendations from Harden et al. (2018), Gaglio et al. (2013) and Kessler et al. (2012).

2.8 Current Project

As wildland fires become an increasingly global concern, a thorough understanding of the demands and resources associated with the safe management of fires is of critical importance. Indeed, a thorough understanding of context is critical for not only the successful implementation and evaluation of programming but also to aid in our understanding process, wherein one can infer how the material will be implemented and experienced (Karanika-Murray & Biron, 2015b). Whereas many of the aforementioned JD-R Theory intervention studies were completed in contexts where demands and resources have longstanding documentation and remain relatively stable and predictable over time (e.g., teaching or nursing), no thorough research has been conducted in the context of wildland firefighting. Compiling, considering and evaluating components of the JD-R Theory is therefore deemed a vital step in not only the subsequent intervention research in the current study but also foundational for future research conducted across the broader field of wildland fire and emergency management. Secondary to the pre-season documentation is contributing to our understanding of how components within the JD-R Theory naturally evolve across a fire season, which will inform process considerations and future research and practice both within the confines of the partnering organization and across the wildland fire community as a whole.

2.8.1 Aims

Building upon the JD-R Theory, guided by the RE-AIM Framework and based on our current knowledge and understanding of wildland firefighting in Canada, the aims of the current research are two-fold:

1. To evaluate the efficacy of two resource-building intervention programs delivered independently and simultaneously over the course of a wildland fire season (from T1 to T2) on:
    a. primary outcomes, including job demands, job resources and personal resources;
    b. secondary outcomes, including work engagement and job stress; and,
    c. broader organizational outcomes including incidence of injury.
2. To document aspects of intervention process, including reach, adoption, implementation and maintenance for both physical fitness and psychosocial education interventions across a wildland fire season.

2.8.2 Hypotheses

With regard to intervention evaluation and in accordance with the RE-AIM Framework., measures of various criterion within the Reach, Adoption, Implementation and Maintenance dimensions are presented as descriptive results in the chapters that follow. In order to evaluate the two intervention programs, the following hypotheses are presented in line with the effectiveness dimension of the RE-AIM Framework:

<u>Primary Outcomes</u>

With regard to effectiveness criteria of primary outcomes, or assessments of the change in job demands, job resources and personal resources across a wildland fire season, and

guided by the descriptive findings, the current research project seeks to evaluate the impact of two resource-building intervention programs, delivered independently in two separate experimental conditions, and simultaneously in an additional experimental group of WFFs. Based off the established relationships between constructs within the JD-R Theory, the following are hypothesized:

H1: Levels of psychosocial risk associated with job demands will be maintained across a wildland fire season for WFFs participating in either or both intervention programs as compared to those who did not;

H2: Evaluations of job resources will be maintained across a wildland fire season for those participating in either or both intervention programs as compared to those who did not;

H3: WFFs level of personal resources, including a) physical fitness and b) psychological capital, will be maintained across a wildland fire season for those receiving either or both intervention programs as compared to those who did not;

Secondary Outcomes

With regard to effectiveness criteria of evaluating the intervention on measures of secondary outcomes, including work engagement and job stress across a wildland fire season, the following is hypothesized:

H4: WFFs participating in any intervention program will demonstrate significant a) increases in work engagement and b) lower job stress over the course of the fire season as compared to those WFFs in a control group.

Organizational Outcome

An overarching objective on the part of the partnering organization of the intervention programs is the reduction of injury incidence amongst WFFs. With regard to effectiveness criteria relative to this objective, the following is hypothesized:

H5: WFFs participating in the delivery of any intervention program will have a lower incidence rate of reported injuries over the course of the fire season as compared to those who did not participate, and as compared to the preceding five-year average within the organization.

CHAPTER 3. Methodology

3.1 Philosophical Approach

The current research is guided by a post-positivist theoretical perspective emerging out of an objectivist epistemological position as described by Crotty (1998). Taking a quantitative approach, the research focuses on the objective description and explanation of phenomena guided by hypotheses informed by the Job Demands-Resources Theory and testing aspects of intervention effectiveness as described within the RE-AIM Framework (Bakker & Demerouti, 2014; Glasgow et al., 2019). This was adopted in an effort to gather empirical, consistent and verifiable data in a systematic and controlled manner from which conclusions could be drawn where at all possible (Parkin, 2009). An objective methodology also attempts to limit the subjectivity and influence of the researcher. Indeed, this approach lends itself well to the measurement of certain physiological constructs (e.g., height and weight) or contextual organizational variables (e.g., number fires burned or hours worked) although subjectivity is acknowledged through the completion of self-report questionnaires or participation in fitness testing procedures. Further adding to this dilemma is the acknowledged tension that exists between the gathering of empirical and valid data to evaluate the efficacy of intervention programs and a need to consider the unique, organic and evolving contexts in which they are delivered. The current research attempts to address this tension by following all validated protocols, while measuring and documenting, where at all possible, contextual factors that may have an influence on the data collected. Additionally, the selection of research measures was also a function of project scope and practical aspects and considerations, including nature of work of the partnering organization (e.g., emergency response) and the geographical expanse over which the worksites are situated. Further, as previously elucidated, to date no empirical

documentation of wildland firefighter physical and psychological resources, including measures of fitness and psychosocial risk have been undertaken, creating the need. Finally, all decisions pertaining to measure selection and project methodology received input, collaboration and approval from multiple levels within the partnering organization.

3.2 Intervention Development

3.2.1 Development Process

The development process of both fitness training and psychosocial education intervention programs were guided by Participatory Action Research principles (Giga et al., 2003). As such, the design, implementation and evaluation processes were undertaken collaboratively in an iterative process with on-going communication and feedback led by the author and between members of the research team, and multiple levels of stakeholders within the partnering organization. In the six months that preceded recruitment of locations via the Regional Management Group Meetings in the Spring of 2016, several meetings took place to allow for input into the current study, including aspects of both the intervention material itself and the evaluation measures and procedures.

Primarily, the Organization's Health and Wellness Specialist in conjunction with the Fire Science Lead was the conduit through which all participatory sessions were coordinated. The initial high-level project conceptualization meeting took place in July 2015 with physical fitness and psychosocial risk factors emerging as priority areas for intervention. Representation from the organization communicated a desire to support WFFs both physically and psychologically in meeting the demands of a wildland fire

season. Through consultation with the Health and Wellness Specialist and Fire Science lead, it was agreed that two independent intervention programs would be developed to address each research area separately, as opportunity existed internally to support existing fitness programming while organizationally there was a strong desire to begin addressing psychosocial risk factors. From September 2015 through February 2016, several in-person and conference call meetings were coordinated by the author and the Health and Wellness specialist to provide input on the development of both intervention program material, content and delivery, including representation from local (Sudbury FMH), regional (Northeast Regional Fire Centre) and senior management, fire and operations staff, health and safety personnel and wildland firefighters who drew on existing internal programming, policies and procedures in addition to field experiences in shaping feedback and input.

3.2.2 Development Influences

Two models of organizational interventions strongly influenced the development, implementation and evaluation of the current intervention programs (Karanika-Murray & Biron, 2015b; Robson et al., 2012). With regard to intervention program development, Robson et al. (2012) provided a conceptual model for workplace training interventions to guide prevention efforts with respect to occupational health and safety. The model proposes that when training takes place, there are immediate outcomes that can result such as increased knowledge, altered beliefs or improvements in attitudes that are influenced by both training (trainer, format of session) and individual (demographic, learning style) factors. The immediate outcomes are then influenced by post-intervention workplace factors, including maintenance strategies and organizational culture, and can lead to intermediate outcomes such as changes in behaviour. Finally,

when effective and as an ultimate consequence, the intermediate outcomes carry the potential to develop into significant personal (reduction in injury or illness incidence) and organizational impacts (improvements in productivity). As such, consideration was given to both training, workplace and individual-level factors through the design and delivery process of both intervention program materials.

The process of intervention development, delivery and evaluation methodology was also guided by the framework of Karanika-Murray and Biron (2015a) which proposes four elements to consider: content, context, process, and outcomes. Content refers to the substance or material of the intervention. As a result, special consideration was given in developing workshop and training material that was empirically driven but also presented in a way that was visually appealing and accessible to wildland firefighters (Karanika-Murray & Biron, 2015a). Context refers to an understanding of the environment in which the intervention will occur and its potential to impact outcomes. As such, the research team relied on consultations with both upper and local levels of management and multiple site visits to various locations across the organization to gain a thorough understanding of the environment in which the intervention would be delivered. The third element, process, refers to the manner in which the intervention is delivered and received by wildland firefighters (Karanika-Murray & Biron, 2015a). The current intervention program material was delivered jointly, with the researcher and representation from the organization traveling to each location prior to, during and following the intervention period and involved in every step of the data collection process. Finally, outcome refers to considerations with respect to the measurement and evaluation of the effects of the intervention (Karanika-Murray & Biron, 2015a). The consideration and selection of relevant measures used to evaluate both the intervention

and contribute to theory was a mutual process with endorsement by several levels of management, wildland firefighters and the research team.

3.3 Fitness Training Intervention

With physical fitness as a critical personal resource for the safe and effective work of WFFs, the organization laid the foundation for a fitness training program for WFFs, entitled 'Commit to be Fit' in 2013 (O.M.N.R.F., 2014a). The purpose of the program is "to build strength, flexibility and endurance and increase mental alertness under the assumption that regular engagement in a structured physical fitness program that is consistent with the demands of the job will ultimately lead to marked and measurable reductions in work-related musculoskeletal injuries" (O.M.N.R.F., 2014a, p. 1). The Commit to be Fit program offers wildland firefighters one hour of paid work time within their first two hours of work to engage in physical activity and exercises of their choosing when stationed at their home location. A physical space was allocated at each work location and outfitted with training equipment, facilitating a variety of exercises and activity modalities (e.g., strength training, flexibility, cardiovascular health, etc).

Development of the fitness training intervention program began following the 2014 wildland fire season to provide structure to the existing Commit to be Fit program. Feedback was collated from both wildland firefighters and local management teams by the provincial program lead who worked directly with the research team to develop the fitness training intervention for the 2016 fire season. The design process included several consultations with various levels of management across the organization with the overall aim of enhancing and evaluating the Commit to be Fit program by formalizing a training structure, providing accountability, and educating wildland

firefighters with regards to task-specific physical fitness principles. The fitness intervention contained five elements: 1- Educational workshop; 2- Formalized training schedule; 3- Logging system; 4-Wearable fitness tracker; and 5- Personalized feedback (see Appendix 5 for all fitness training intervention materials).

Educational Workshop

A 30-minute educational workshop was delivered jointly by the researcher and the organization's Health and Wellness Specialist in a group setting at the outset of the fire season. All participants from the fitness experimental intervention groups attended a single session at their home location. The workshop presented wildland firefighters as 'occupational athletes', illustrated with examples of the physical demands required to perform their routine tasks and stressing the importance maintaining a high level of physical fitness. Energy systems (e.g., anaerobic vs. aerobic) and basic training principles (e.g., specificity, periodization, variation, and maintenance) were also discussed in addition to an overview of the remaining four elements of the intervention.

Training Schedule

A formalized training schedule was developed for the wildland firefighters to follow over the course of the season. It was communicated to participants that participation in the exercise program was expected on days when wildland firefighters were stationed at their home base but not on active deployment. The schedule was designed to encourage variation in activity, rotating wildland firefighters through cardiovascular fitness, plyometric training, weight training, and active rest days. The schedule was also developed collaboratively between the organization's Health and Wellness Specialist

with input from WFFs and the researcher based on availability of equipment and in an effort to allow for efficient participation.

Logging System

A system for logging participation in the fitness training program was developed as an accountability and motivation tool for participants. WFFs were asked to complete a record of their activity either on paper or electronically. A touchscreen tablet was placed in a locked floor stand in the training room at each participating location with a workout log survey preloaded utilizing a free offline and secure application. WFFs were also permitted to complete the workout log in paper format and place the completed log in a locked box adjacent to the tablet.

Wearable Fitness Tracker

Wildland firefighters were provided with a wrist-worn fitness tracker. Wearable fitness trackers, especially within the context of organization-wide implementation have proven effective over time at increasing participation in aerobic activity (Finkelstein et al., 2016). The fitness trackers were provided to the wildland firefighters at the beginning of the season, oriented to the corresponding smartphone application, and encouraged to use them throughout the wildland fire season to support, monitor and track their activity levels at their discretion. Data from fitness trackers were not requested by either the research team or the organization; as they were provided as an incentive to engage and support participation in the fitness program.

Personalized Feedback & Training Support

Personal feedback from the initial pre-season fitness measures session was sent to each of the participating wildland firefighters via email. This feedback allowed the wildland firefighters to appreciate their relative strengths and weaknesses compared to the provincial average, in addition to general population and elite-level athlete normative data. The organization's Health and Wellness Specialist visited each participating location twice throughout the wildland fire season, to provide support to the wildland firefighters and reinforce each of the four previous elements of the intervention. Additionally, the Health and Wellness Specialist was able to respond to questions and issues that arose throughout the season, serving as a knowledge resource and subject matter expert for explanations of an individual's feedback and demonstrations of exercises and equipment.

3.4 Psychosocial Education Intervention

The psychosocial education intervention program was designed as a new initiative within the organization aimed at improving WFFs knowledge and understanding of psychosocial risk factors, both in general, and then contextually in wildland fire. Further, the intervention aimed at educating and reassuring WFFs of the support systems and resources that are accessible to them over the course of a wildland fire season. In collaboration with the partnering organization's management, Health and Wellness Specialists and wildland firefighters, a series of educational fact sheets pertaining to psychosocial risk factors were developed. The topics and content for each of the fact sheets were derived from resources that have emerged from the development of a National Standard of Canada 'Psychological Health and Safety in the Workplace-

Prevention, Promotion, and Guidance to Staged Implementation' (CAN/CSA-Z1003-13/BNQ 9700-803/2013), or hereafter, the Standard.

The Standard seeks to outline for organizations the "requirements for a documented and systematic approach to develop and sustain a psychologically healthy and safe workplace" (C.S.A. & B.N.Q., 2013, p. 2). Within the Standard, organizations are encouraged to use a free resource entitled 'Guarding Minds @ Work' (GM@W) as an audit tool in assessing psychosocial risk factors within the workplace and to identify gaps within an organization's existing psychological health and safety programs (C.S.A. & B.N.Q., 2013; Samra, Gilbert, Shain, & Bilsker, 2012a, 2012b). Within GM@W, psychosocial risk factors are defined as any element that influences an employees' psychological response to work and work conditions, potentially causing psychological health problems, and can include the way work is carried out and the context in which work occurs (Samra et al., 2012b). The GM@W resource includes comprehensive information pertaining to the 13 psychosocial factors identified within the Standard as having an impact on both organizational and individual health (Samra et al., 2012a).

The psychosocial education intervention had two primary components (see Appendix 6). First, a 45-minute workshop was developed and delivered jointly by the researcher and the organization's Health and Wellness Specialist. The workshop was designed to provide an overview of psychosocial risk factors both in general and then specifically relating the 13 factors to the context of the organization and wildland firefighting. The second component was the delivery of a fact sheet, a one-page A4 fact sheet highlighting one psychosocial risk factor sent weekly to WFFs by email and posted in

at least two common areas around their work location in an 11" by 17" size format. Content for the education intervention fact sheets were derived from the GM@W resources and subsequently tailored for wildland firefighting and the partnering organization. Each fact sheet followed a consistent format and was divided into three sections: an overview of the risk factor in the context of wildland firefighting; a discussion on its relevance to wildland firefighting; and an overview of psychosocial risk factors generally. The topics for each of the fact sheets were categorized as representing a job demand or job resource and described in the section below.

Job Demands

Civility and Respect: assesses the extent to which WFFs are respectful to their co-workers and considerate of their interactions with those inside and out of their organization.

Psychological Job Demands: refers to the social and emotional requirements by WFFs to do their job effectively.

Work-Life Balance: evaluates the extent to which WFFs are able to manage multiple demands in their lives.

Job Resources

Psychological Support: measures the extent to which the work environment is supportive of WFFs' psychological and mental health concerns.

Organizational Culture: assesses the extent to which the workplace environment is characterized by honesty, trust, and fairness.

Leadership and Expectations: refers to the ability of WFFs to know what they need to do and how their work contributes to the goals of the organization.

Growth and Development: assesses the level of encouragement and support WFFs receive in developing their social, emotional and technical job skills.

Recognition and Reward: is reflective of the extent to which WFF efforts are acknowledged, appreciated and compensated in a fair and timely manner.

Involvement and Influence: refers to a WFF's level of inclusion in discussions surrounding how their work is done and how important decisions are made.

Workload Management: refers to the ability of WFFs to successfully complete tasks and responsibilities within a given time frame.

Engagement: assesses the level of WFFs connection to their work and motivation to do their jobs well.

Psychological Protection: assesses the level with which WFFs feel safe to express themselves honestly in the workplace without fearing negative consequences to themselves, their job or their place in the organization.

Protection of Physical Safety: reflects the level of action taken by management and supervisors to ensure the physical welfare of WFFs.

3.5 Study Design and Procedures

3.5.1 Overview: Research Design

The current study utilized a cluster randomised control trial design to evaluate the impact of two interventions delivered as standalone programs or in combination as compared to a control group. Random assignment of experimental condition was completed by location and matched by geographic region as each FMH operates independently from one another. This procedure was followed to avoid contamination effects, as WFFs work in close proximity to each other within each location and to avoid members of the experimental conditions influencing members of the control group or vice versa. Locations from each region agreeing to participate in the study and were subsequently randomly assigned using a random number generator to one of three experimental conditions: 1- Fitness Training Intervention; 2- Psychosocial Education Intervention; 3- Both Interventions; or 4- Control Group. As such, all participants at each location received the same experimental condition. All participants at each location volunteered and did not receive any financial compensation for their contribution. A complete diagram of experimental conditions and overview of research activity can be found in Appendix 7.

3.5.2 Power Analysis

Several sample-size calculations were conducted using G*Power 3.1.9.2 for Mac (Faul, Erdfelder, Buchner, & Lang, 2009; Faul, Erdfelder, Lang, & Buchner, 2007). Using an average effect size of 0.4 to 0.5 as observed in previous wildland firefighter research

and based on an $\alpha = 0.05$ and $\beta = 0.80$ several estimates were made (Budd et al., 1997; Vincent et al., 2015). Power estimates for conducting paired sample t-tests and independent samples t-tests with the same parameters estimated a required sample size of 51 per group for a total sample of 102. Estimates for conducting Analysis of Variance (ANOVA) tests revealed 56 participants would be required for repeated measures and between subjects, and a total sample size of 76 for a one-way ANOVA with four groups. Finally, estimates of sample size for linear multiple regression analyses using a partial R^2 between 0.10 and 0.30 with five predictors were that 28 to 90 participants would be required (Gordon & Lariviere, 2014).

Given the above sample size calculations, and distribution of wildland firefighters across locations, the researcher determined that a minimum of eight locations should be targeted for participation in an effort to recruit 25 wildland firefighters per location. A resulting total sample size of 200 wildland firefighters would yield roughly 50 participants per experimental condition and would represent over a quarter of the entire provincial workforce.

3.5.3 Study Protocol

3.5.3.1 Recruitment of Locations and Randomisation

Recruitment of participating locations, or FMHs began in the spring immediately preceding the fire season under study. Each geographic region of the province convenes a week-long Spring Regional Management Group (RMG) meeting, wherein members of staff and management from all seven locations in each region gather to coordinate all activities for the upcoming fire season. During the Spring RMG, a one-hour session was dedicated to the current research project for recruitment of locations. With the

support of the organization's Fire Science Team, a high-level overview of project aims, and the logistics surrounding the study procedure and organizational and personnel requirements was presented. Randomisation by location to one of four groups was disclosed to attendees during recruitment though the specific aspects of the interventions were not disclosed. Subsequent to the session, local management teams were provided with up to two weeks to confirm their locations interest in participating, including acceptance of terms, availability of personnel and agreement of randomisation to experimental condition. The names of each location from each region agreeing to participate in the study were entered into a random generator (Random.Org) as a list and randomly assigned to one of three experimental conditions: 1- Fitness Training Intervention; 2- Psychosocial Education Intervention; 3- Both Interventions; or 4- Control Group. This was repeated for both regions to ensure that there would be representation from both geographic regions across all experimental conditions.

3.5.3.2 Recruitment of Participants

All individuals 18 years of age or older and employed as a full-time wildland firefighter at each of the eight participating locations were eligible to take part in the research. Subsequent to their location agreeing to participation and random allocation to one of three experimental conditions or the control group, participants were recruited at their respective location within the first month of the 2016 wildland fire season. Each of the participating locations organized an information session to all available WFFs (see Appendix 8 for typical setting and set-up). WFFs attending the session were given an overview of the purpose of the study and methodology including details of what would be expected of them, depending on their location's experimental condition. Prospective participants received an information sheet outlining the study along with two copies of

a consent form and were given the opportunity to ask questions (See Appendix 9 and 10).

3.5.3.3 Ethical Considerations

The recruitment of WFFs was not without anticipated ethical challenges. To begin, WFFs were recruited within their place of employment during an information session at the beginning of the fire season. Described by Oliver (2010) as obtaining access to participants via 'gatekeepers', the researcher's relationship with the partnering organization required special consideration. The researcher established a productive and transparent working relationship with the organization's senior management and the research project was permitted to be conducted with full autonomy. Essential on the part of the research team was the clear communication of the research plan and the parameters required for valid data collection to occur in a way that was mutually beneficial and not seen as enforced (Oliver, 2010).

Participation in organizational initiatives are considered mandatory and managed by the organization; however, involvement in the intervention research project was completely voluntary. During the recruitment information session, both the researcher and a member of the organization's local management team were present and made every effort to ensure that participation in the intervention was voluntary. Further, it was made clear that should anyone choose to participate, individual results would be kept confidential and not shared with their employer. Data would only be presented to the organization in aggregate form and by experimental condition. While the organization provided access to the WFFs to participate in the pre- and post-season measures during

regularly schedule paid work time, there was no additional compensation for those who chose to participate.

Where possible, physical fitness measures were taken individually in order to ensure confidentiality, and free of influence from fellow participants. All were encouraged to engage to their fullest potential but within their comfort. Should they have wished to stop any of the fitness tests, they were assured that they could do so without fear of repercussion. Neither raw data nor any interpretations from the tests were communicated to the participants verbally during testing.

3.5.3.4 Ethical Approval

All activities pertaining to primary data collection and the implementation and evaluation of both intervention programs were completed by the author as a doctoral student at Lancaster University for the purposes of this dissertation, necessitating ethical approval. As a result, ethics certification for the project was received from Lancaster University's Faculty of Health and Medicine Research Ethics Committee prior to the commencement of recruitment and data collection. At the time of the research, the author was also employed as a Research Associate with the Centre for Research in Occupational Safety and Health (CROSH) at Laurentian University. As funding for the project was procured through the collaborative research agreement between the research centre and the MNRF-AFFES, ethical approval was also required at Laurentian University to release the funds. As a result, ethical approval for the current study was also sought from Laurentian University's Research Ethics Board in Sudbury, Ontario, Canada. Both ethics approval certificates can be reviewed in Appendix 11.

3.5.4 Data Collection Procedure

Subsequent to informed consent, participants were required to complete the Physical Activity Readiness Questionnaire (PAR-Q) as a screening tool to determine their ability to engage in physical fitness testing. Following clearance, participants completed all baseline measures, including assessments of fitness and paper-based surveys and questionnaires (see Appendix 12 for complete survey measures and testing protocol, along with photos). Participants at locations assigned to intervention conditions took part in the corresponding programming on that same day. Intervention programming was delivered over the course of the wildland fire season, and a period of a minimum of 13 weeks. Follow-up testing occurred between 14- and 16-weeks after baseline testing and a minimum of one week following completion of all intervention program delivery, and within the last month of the wildland fire season.

3.6 Intervention Measures and Evaluation

The current study utilized the RE-AIM Framework to guide the evaluation post-intervention completion for a comprehensive assessment of intervention delivery, adherence and impact. The current evaluation was informed by previous reviews stating that despite limited feasibility for evaluating all criteria within RE-AIM, research should make every effort to report on at least one criteria for each of the five dimensions in some capacity (Gaglio et al., 2013; Harden et al., 2018; Kessler et al., 2012). Further, a pragmatic approach was taken, with clarity around which dimensions were selected and the informing data source for each (Harden et al., 2018). To this end, 19 criteria of the RE-AIM Framework spread across the five dimensions are identified along with the corresponding data source are presented in Table 5 and described over the section that follows.

Table 5. Intervention evaluation by RE-AIM Framework criteria with data source

Criteria	Data Source
REACH	
1. Exclusion criteria (% excluded or characteristics)	Study protocol: location recruitment data
2. Percentage of individuals who participate, based on valid denominator	Information sessions Eligibility screening
3. Characteristics of participants compared with nonparticipants to local sample	Limited organizational data Baseline demographic survey
EFFECTIVENESS	
4. Measure of primary outcomes	Measures of Job Demands, and Personal and Job Resources
5. Measure of secondary outcomes	Measures of work engagement and job stress
6. Measure of broader outcome relative to organizational goal	Incidence of injury relative to five-year average
ADOPTION – Setting Level	
7. Setting exclusions (% or reasons or both)	Study protocol: Recruitment data
8. Percentage of settings approached that participate (valid denominator)	Study protocol: Randomisation acceptance
9. Characteristics of settings participating (both comparison and intervention) compared with either (1) nonparticipants or (2) some relevant resource data	Organizational and regional geographic descriptive data
ADOPTION – Individual Level	
10. Staff exclusions (% or reasons or both)	Study protocol: information sessions, T1 demographic questionnaire
11. Percent of staff offered that participate	Study protocol: T1/T2 Testing
12. Characteristics of staff participants vs nonparticipating staff or typical staff	Organizational data

IMPLEMENTATION	
13. Percent of perfect delivery or calls completed (e.g. fidelity, adherence or consistency)	Study protocol: Psychosocial education intervention - email responses; fitness training intervention - workout logs, Both: T2 follow-up survey
14. Adaptations made to intervention during study (not fidelity or adherence)	Personal records Staff communication
15. Cost of intervention – time	Study protocol: Time of session Personal records
16. Use of qualitative methods to understand implementation	T2 open-text feedback from follow-up survey
MAINTENANCE – Setting Level	
17. If program is still on-going at > 6 month post-study funding	Personal records, email correspondence
18. If and how program was adapted long-term (which elements retained after program completed)	Ongoing research, personal records
19. Some measure/discussion of alignment to organization mission or sustainability of business model	Organizational policy

3.6.1 Reach: Locations and Participants

Reach is the dimension of the RE-AIM Framework that concerns the reporting of the percentage of individuals who participated based on a valid denominator (Gaglio et al., 2013; Glasgow et al., 2019). At the setting level, the total number of potential locations was recorded during the recruitment presentations during the management group meetings. At the individual level, the total number of WFFs at each participating location's information session was recorded, in addition to the number of WFFs who offered consent and chose to participate. Exclusion criteria for both the location and individual participant levels were recorded. Moreover, characteristics of included locations and participants were documented where available from organizational data (e.g., geographic region and location characteristics, number of WFFs assigned to the crew).

3.6.2 Effectiveness: Measures of Primary, Secondary and Broader Outcomes

Effectiveness evaluates the level of impact an intervention has on relevant outcomes (Glasgow et al., 2019). Assessment of intervention effectiveness was completed by three criteria: primary outcome, secondary outcomes and a broader organizational outcome. Measures of each type of outcome were selected out of their alignment with both intervention objectives and the JD-R Theory, as depicted in Figure 4. Primary outcome measures mapped onto either job demands or job resources components of the JD-R Theory. Secondary outcome measures included assessments of engagement and strain, while the broader organizational outcome evaluated was injury incidence. Job crafting and self-undermining components of the JD-R Theory were not assessed. Given the high demands and unpredictable nature of wildland firefighting activities, it was determined that there was not sufficient capacity for their measurement throughout the

intervention period. Additionally, the potential mechanisms of action pertaining to any observed effects on the primary, secondary and broader organizational outcomes were further explored by measures of implementation, further discussed in Section 3.6.4.

Agreement on the measures of primary, secondary and broader outcomes was reached through a collaborative process with the partnering organization, influenced both by the availability of equipment, space and resources for testing, time afforded by the organization to participate, and the need to provide meaningful feedback to both participants and the organization at large. Additional consideration was given to the reality of conducting research during a live wildland fire season, wherein the participants could have been interrupted at any moment to respond to a fire and not placed in a compromised position, physically or psychologically.

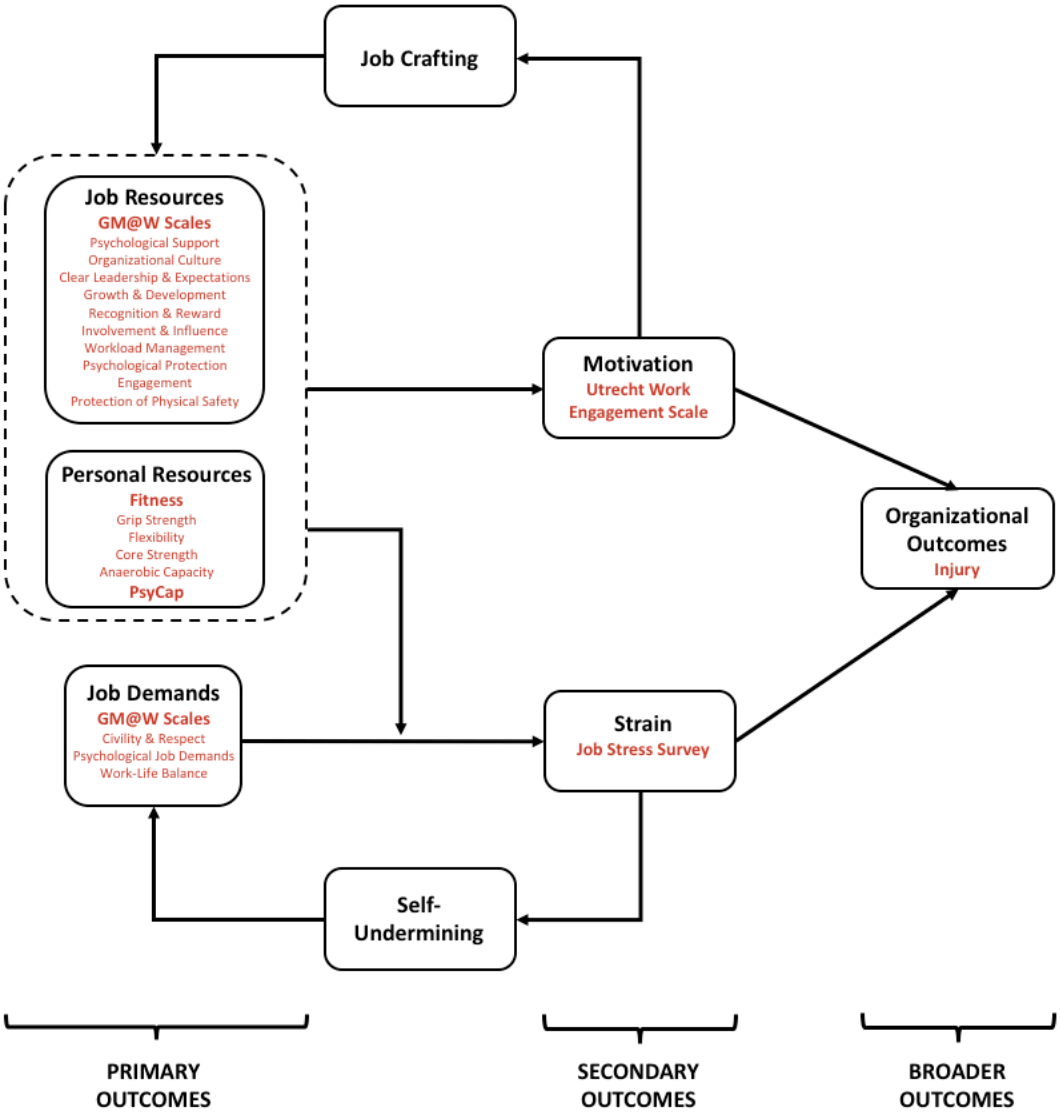

Figure 4. Primary, secondary and broader organizational outcome measures mapped onto the JD-Theory

3.6.2.1 Measures of Primary Outcomes

Job Demands

The Guarding Minds at Work (GM@W) survey was used to evaluate psychosocial factors in the workplace (Samra et al., 2012a). The survey is a 68-item questionnaire that provides an index score on 13 psychosocial risk factors based on the experiences of participants within the context their workplace. Each risk factor score can be reported as either a score ranging from 5 through 20 with high scores indicative of lower

demands or classified into one of four categories based on normative data: 5-9 ‘Serious Concerns’; 10-13 ‘Significant Concerns; 14-16 ‘Minimal Concerns’; and 17-20 ‘Relative Strength’. Of the 13 factor scores, three were classified as reflecting Job Demands: Civility and Respect, Psychological Job Demands, and Work-Life Balance.

Job Resources

The following ten risk factor scores, each comprised of five items from within the GM@W survey (Samra et al., 2012a) were classified as Job Resources: Organizational Culture, Psychological Support, Clear Leadership and Expectations, Growth and Development, Recognition and Reward, Involvement and Influence, Workload Management, Psychological Protection, Engagement and Protection of Physical Safety.

Personal Resources

Wildland firefighting within the context of the target population has previously documented the inherent physical and psychological demands of the occupation (Gordon & Lariviere, 2014; Mcgillis et al., 2017; Robertson et al., 2017). In an effort to understand the personal resources that WFFs bring to their work tasks, both physical and psychological resources were assessed.

Physical Resources (Fitness)

WFFs are required to demonstrate their aerobic capacity and aptitude for wildland firefighting and to qualify for their occupation on an annual basis by meeting the National Fitness Standard through a passing time on the WFX-FIT Fitness test (C.I.F.F.C., 2012). The WFX-FIT is a task-based circuit that must be completed in a minimum of 17 minutes and 15 seconds to qualify for work as a WFF in Ontario, and

under 14 minutes and 30 seconds to qualify for national exchange. As all participants in the study passed the WFX-FIT, a base-level of cardiovascular fitness was assumed and not reassessed within the current study. Indeed, cardiovascular fitness of WFFs has been assessed and discussed elsewhere (Gaskill et al., 2003). As a result, the collection of physical fitness measures completed with participants were aimed at being complementary to the WFX-FIT and followed established and validated protocols providing ample time for warm-up and cool down, both of which were established to minimize the risk of injury and experiences of discomfort. Further, tests were selected based on the availability of normative data from the Canadian population, from which participants could orient and interpret their results.

Finally, as the current research was guided by participatory action research principles, each of the specific measures was selected and approved by multiple stakeholders, including WFFs, staff and management. A key consideration on input from stakeholders was the selection of testing measures that could be completed with minimal equipment, simple procedures, and without exhausting or jeopardizing the participants ability to complete work tasks over the balance of their shift. Tests were also selected such that progress throughout the fire season could be monitored through self-assessment and in a sustainable fashion across locations.

Anthropometrics

Participant height was measured using a Seca 213 portable stadiometer. Weight was measured using a digital scale. Body Mass Index (BMI) was subsequently calculated.

Grip Strength

Grip strength is a measure of hand and forearm strength, evaluating the total force applied during a maximal isometric contraction (Klavora, 2015). Maximum grip strength was measured for both dominant and non-dominant hands using a Smedley Digital Grip Tester and following standardized procedures (Roberts et al., 2011).

Flexibility

Flexibility was assessed using the sit and reach test, evaluating the flexibility of the lower back and hamstring muscles (Wells & Dillon, 1952). Using a Baseline 12-1085 Sit and Reach Trunk Flexibility Box, participants followed standard protocol and scores were recorded to the nearest half centimeter.

Core Strength

Core strength was evaluated using the Core Muscle Strength and Stability Test which is designed to evaluate abdominal and lower back muscle strength and stability (Mackenzie, 2002; Quinn, 2019). The test guided participants through a maximum of nine stages of varying lengths and plank positions. Participants continued through the stages until they were unable to hold the position with the correct form, and both the time and end stage were recorded. This test has been commonly used in both muscle strength assessment and training evaluation contexts (Alsayani, Savkin, Akkaya, & Büker, 2018; Boguszewski, Radomska, Kerbaum-Visser, & Białoszewski, 2018; Yeung, 2011)

Anaerobic Capacity

Anaerobic capacity refers to the ability of an individual to meet significant, short-term demands for high-energy production without oxygen and is reflective of their immediate alactic and short-term lactic energy systems (Klavora, 2015). Anaerobic performance was evaluated using the Running-based Anaerobic Sprint Test (RAST) a test developed at the University of Wolverhampton (Draper & Whyte, 1997) and has demonstrated test validity and reliability (Bongers et al., 2015; Zagatto, Beck, & Gobatto, 2009). The RAST requires each participant to undertake six consecutive 35-metre sprints on a flat surface with 10 seconds allotted for recovery between each sprint. Each sprint time was measured using the Brower Timing TC System to the nearest hundredth of a second. Subsequently, the following output variables were able to be calculated for each participant: power output (Body mass * $Distance^2$ / $Time^3$) for each sprint, allowing identification of maximum and minimum and average power outputs (in Watts), a Fatigue Index (FI) representing the decline in power output every second (FI = [Maximum power – minimum power] / total time for 6 sprints), and a relative peak power output (Maximum power / body weight in watts produced per kilogram).

Psychological Resources (Psychological Capital)

Participants completed the 24-item Psychological Capital Questionnaire (PsyCap) developed by Luthans, Youssef, and Avolio (2007). Psychological capital is characterized by four main characteristics: hope, self-efficacy, resiliency, and optimism (Luthans, Youssef, et al., 2007). Hope reflects an employee's motivation to complete tasks in a foreseen manner; Self-efficacy measures an employee's belief in their ability to accomplish tasks well and in a timely manner; Resiliency is reflective of an employee's perception of their ability to persevere in the face of adversity and

uncertainty and to meet the demands of unforeseen challenges; and finally, Optimism assesses an employee's perspective with respect to anticipated outcomes.

3.6.2.2 Measures of Secondary Outcomes

Work Engagement

Work engagement has been defined as a state of mind at work that is marked by three distinct and measurable characteristics: vigour, dedication and absorption (Bakker & Schaufeli, 2008; Schaufeli, 2002). Vigour reflects the level of energy an employee invests in their work; dedication assesses the level of involvement and commitment of employees to their work; and absorption refers to the level of engrossment an employee displays in their work. The Utrecht Work Engagement Scale is a 17-item questionnaire that prompts participants to respond on a seven point likert scale to a series of statements about how they feel at work (Schaufeli & Bakker, 2003).

Strain

Job stress was evaluated as a part of the post-season questionnaires via the Job Stress Survey (JSS) (Spielberger & Vagg, 1994). The JSS is a 30-item questionnaire assessing the perceived severity and frequency of events perceived as stressful within the workplace. The JSS prompts participants to consider the six months prior to survey completion and as such for the current research it was only appropriate for it to be administered once at the end of the fire season (T2).

3.6.2.3 Measure of Broader Organizational Outcome

All participants consented to provide access to year-end injury reports, which would indicate whether they had, over the course of the fire season, completed a first aid injury

report or suffered a lost-time injury. Further, the organization provided all injury statistics as it pertained the five-year period immediately preceding the study period to allow for a comparison.

3.6.3 Adoption: Intervention Participation

At the setting level, the number of settings that were approached following randomisation was recorded, in addition to the number accepting and participating across the study period. As each location's experience of the wildland fire season can be very unique, a comparison of various characteristics is considered. Both the number of fires and hectares burned within the response jurisdiction of each location, region and province as a whole will be utilized as a reflection of job demands over the course of the fire season. At the individual level, the number of hours worked over the course of the fire season were recorded in an attempt to objectively summarize the demands of the given wildland fire season.

At the individual, or employee level, adoption refers to the absolute number or proportion of individuals who are willing to initiate and participate in a program (Glasgow et al., 2019). With regard to eligibility for the current study, individuals were required to work as a full-time wildland firefighter at one of the participating locations. All individuals meeting that criteria were invited to an information session during their regularly scheduled work hours. The number of individuals attending the information session was recorded, in addition to all who returned a completed consent form and screening tool. In an effort to ensure representativeness, and subsequent to providing informed consent, participants were asked to disclose the following: age, gender, years of experience as a wildland firefighter and role on fire crew for the current season.

3.6.4 Implementation

At the individual level, implementation refers to aspects of intervention delivery including fidelity, adherence and adaptations made to the intervention over the course of the study period (Glasgow et al., 2019). Intervention implementation was evaluated using four criteria found within the RE-AIM Framework: fidelity, adaptations, cost and open-ended feedback.

3.6.4.1 Implementation Fidelity and Adherence

Efforts were made to evaluate the implementation of intervention material by monitoring their utilization of program resources both during and following completion of the fire season. In-season, participants receiving the psychosocial education intervention were sent an email weekly with one psychosocial factor fact sheet and asked to reply when they read it or engaged with the material in any capacity. Participants in the fitness training intervention condition were asked to record their participation in the fitness program when on base by logging their activity on the tablet application or completion of a paper record. Post-season, a feedback survey was given to all participants containing a number of questions regarding program quality, content relevance, participation and integration into their routine. It was at this juncture that participants were asked to comment on both the usefulness and how often they accessed intervention program resources.

3.6.4.2 Adaptations

As the delivery of both intervention programs across multiple locations occurred during a live fire season, adaptations were recorded through notetaking and in conversation with the organizations Health and Wellness Specialist. Feedback loops and regular

check-ins with the local management teams were established in order to ensure responsivity to changing or unforeseen challenges that arose through the implementation period.

3.6.4.3 Cost of Intervention

The researcher time associated with the conducting the recruitment and information sessions, data collection procedures, intervention delivery were estimated using individual journaling and recording of meeting dates, times and lengths. Time associated with travel across jurisdictions was also recorded. Though a subjective measure drawn from the personal records of the researcher, a commentary pertaining to the time associated with developing the intervention material in conjunction with the partnering organization is also presented by way of informing and contextualizing the current intervention project.

3.6.4.4 Open-ended Questions

Subsequent to the completion of the intervention period, participants assigned to one or both of the experimental conditions were provided with a feedback survey to gather their opinions surrounding the challenges and strengths associated with the implementation of the intervention programs. This included opportunity for participants to reply to an open-ended question querying any feedback or suggestions for improvement to any aspects of the intervention program. The complete post-intervention feedback surveys for both fitness training and psychosocial education intervention programs can be found in Appendix 13.

3.6.5 Maintenance

Assessed at the setting level, the maintenance dimension of the RE-AIM Framework typically evaluates the extent to which behaviour change is sustained six months following intervention delivery (Glasgow et al., 2019). While the cyclical nature of a Canadian wildland fire season and the confines of a dissertation precluded an evaluation six months follow-up, there remains opportunity to address the maintenance criteria evidenced by the extent to which programs have become institutionalized within organizational policy and practice. As such, commentary informed by personal records, email correspondence and ongoing search will be offered with regard to the long-term maintenance, sustainability of the research programs, post-study funding, and the alignment of organizational policy toward the intervention programs will be offered to address the maintenance criteria of the RE-AIM Framework.

3.7 Analyses

A thorough examination of frequency and descriptive data characteristics at T1 across all participating WFFs are presented. As no intervention program across any experimental condition had been implemented at that juncture, doing so provides a comprehensive perspective of the reach of the study, documenting WFFs personal and job resources and job demands at the outset of a fire season. Further, this exploration of data characteristics including assumptions of normality and assessment of reliability via Cronbach's alpha (Bland & Altman, 1997) and examination for outliers will be practical in determining suitability for use in various subsequent parametric statistic techniques evaluating intervention effectiveness. Correlation matrices and chi square tests will be utilized to discern associations between variables.

In order to test Hypotheses 1 through 4 generated to assess the effectiveness of the interventions on primary and secondary outcomes, a single score was calculated between T1 and T2 measurement points for all variables to determine the difference or change in each measure across the wildland fire season for all participants. Statistically, this approach has demonstrated efficacy and a close relationship to traditional average-based change statistics (Estrada, Caperos Montalbán, & Pardo, 2020; Estrada, Ferrer, & Pardo, 2019). In this instance, calculating and utilizing individual change scores across pre- and post-measurement points facilitates the interpretation and dissemination of results (Estrada et al., 2019). Pragmatically, and through consultation with the partnering organization, there was a strong desire to simply consider a single score for each metric that was representative of the change that occurred across the fire season. Neither the starting (T1) nor ending (T2) values were of great importance to multiple levels of management, as greater emphasis was placed on understanding the change that occurs across a wildland fire season. Moreover, the approach also allows for specific consideration of the effects of the intervention and avoiding arbitrary general cut-offs (Estrada et al., 2019) as there are currently no objective or meaningful established normative values for the primary or secondary outcomes measures under evaluation.

Subsequently, a comparison across experimental conditions and to the control group to determine intervention effectiveness was possible. Assessing differences between experimental conditions for the primary (e.g., resources and demands) and secondary (e.g., work engagement, strain) was completed using a two-way multivariate analysis of variance (MANOVA) to test Hypotheses 1 to 4. As participants have been allocated to experimental condition by location and region, multilevel modeling was used to compared differences in experimental condition while accounting for the variability and

level of correlation between scores at individual bases and regions of the province within each group. Finally, with regard to evaluating effectiveness of the intervention on broader organizational outcomes, binomial tests of proportion were used to compare incidence rate of injury across the wildland fire season observed within intervention groups as compared to the organization's five-year average rate to test Hypothesis 5.

Finally, feedback was sought from participants of both intervention programs with regard to their experiences across the wildland fire season. Qualitative Content Analysis was used to identify themes and provide a simple synthesis of similarities and differences in participant responses (Bengtsson, 2016; Gibbs, 2007; Vaismoradi & Snelgrove, 2019). A deductive, concept-driven approach was taken wherein the participant feedback was reviewed and coded for correspondence with identified categories, further described in Section 4.5.4 (Bengtsson, 2016; Elo et al., 2014).

CHAPTER 4. Results

4.1 Chapter Overview

The results chapter is divided into five sections according to the dimensions of the RE-AIM Framework. Section 4.2 provides detailed descriptions of both setting and individual-level reach of the intervention study within the partnering organization across multiple locations. Section 4.3 details aspects of intervention adoption, including descriptive statistics on participation rates of both settings and individuals allowing for comparison across several characteristics. Contextual and fire-season specific comparisons are also offered at both the setting and individual-levels. Section 4.4 begins with a comprehensive look at the baseline characteristics of all participants in an effort to ensure that there were no significant differences between experimental conditions. Subsequently, the balance of the Section 4.4 evaluates the effectiveness of both intervention programs with regard to the primary outcomes (Hypotheses 1 through 3), secondary outcomes (Hypothesis 4) and broader organizational outcomes (Hypothesis 5). Section 4.5 outlines results pertaining to four criteria of implementation: fidelity and adherence, adaptations made, associated time costs and additional implementation feedback. Finally, Section 4.6 concludes with a commentary pertaining to the long-term maintenance of both intervention programs within the partnering organization.

4.2 Reach

4.2.1 Setting-Level Participation

Following the recruitment sessions at the two regional management group meetings, eight of the 14 (57.1%) Fire Management Headquarters (FMHs) agreed to participate in the current research project, four from northeastern Ontario, and four from northwestern Ontario, as depicted in Figure 5. Once the eighth location confirmed

participation and the potential for the prospective power analysis requirements were met, recruitment was finalized and locations from each region were assigned a number and randomly allocated to experimental condition. The limit on location recruitment was capped at eight due to the practical limitations and scope of the current doctoral dissertation research and the extent of in-kind organizational commitment time and resources being reached. Management from one Attack Base offered participation in the current study, however, they were excluded based on the criteria established to include only FMH locations.

Setting-Level Characteristics

Each FMH was at least 100KM in distance from the next closest participating location (e.g., from 5 to 3) with the furthest distance spanning greater than 1500KM (e.g., from 4 to 7). By way of population, Location 4 represented the most populous community, with nearly 165,000 citizens and Location 8 represented the least populous with a population just under 2000 (see Table 6). With regard to the six locations that did not participate, four were found within towns and two within cities across northeastern and northwestern Ontario, with populations within the range of the communities represented within the study. Further, and with regard to the size of the locations based on personnel, the average number of crews assigned to the eight participating locations was nearly the same as the six locations not reached by the current study (e.g., roughly 12 crews per FMH).

Table 6. Setting characteristics including population and personnel allocation of participating locations and non-participating locations

Location ID	Experimental Condition	Region	Population	Designation	# of Crews
1	Control	NWR	7739	Town	10
2	Control	NER	5321	Town	12
3	Fitness	NWR	5272	Town	12
4	Fitness	NER	164,689	City	18
5	Psychosocial	NWR	7749	City	12
6	Psychosocial	NER	41,788	City	12
7	Dual	NWR	15,096	City	12
8	Dual	NER	1964	Town	10
-	-	NER	2905	Town	12
-	-	NER	51,553	City	7
-	-	NER	18,062	Town	12
-	-	NWR	4107	Town	15
-	-	NWR	110,172	City	11
-	-	NWR	4636	Town	18

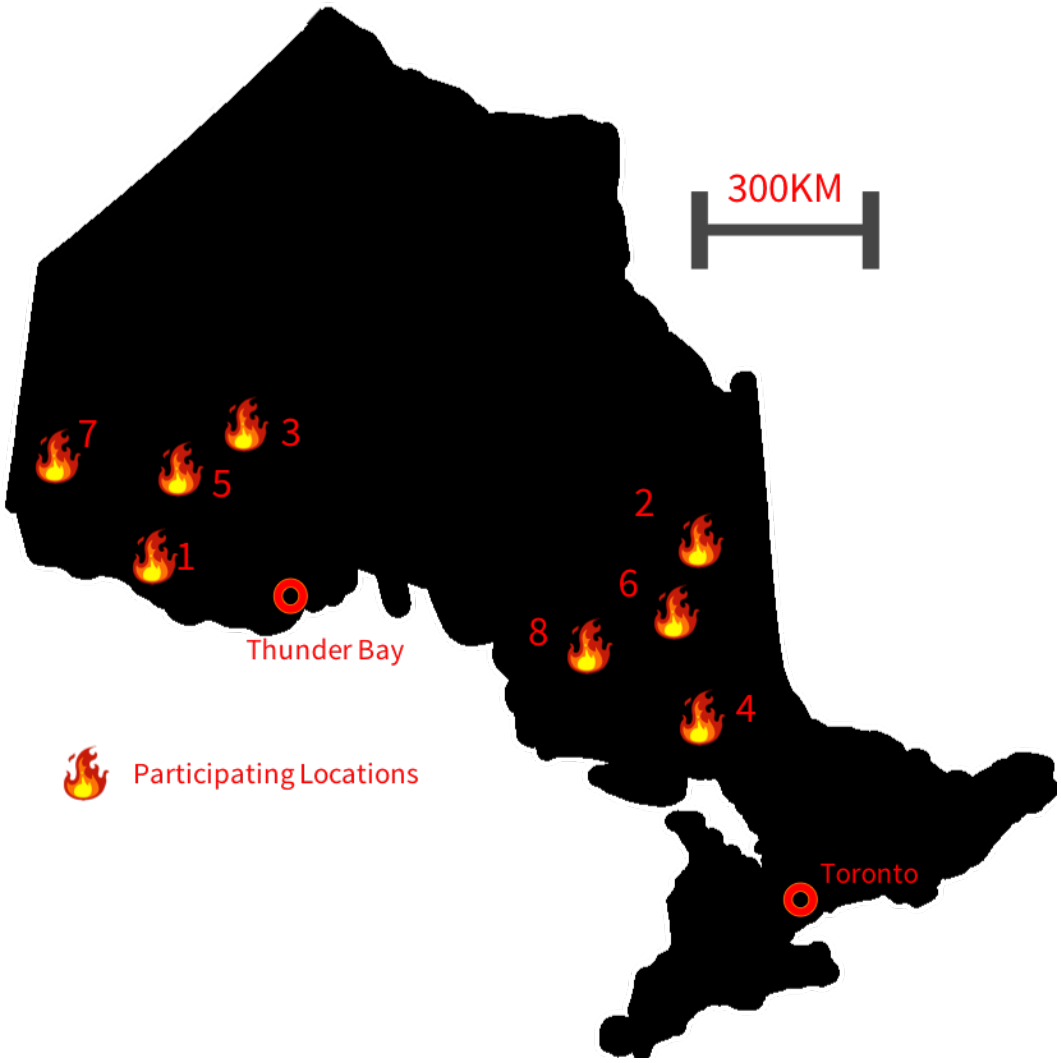

Figure 5. Map of the Province of Ontario, Canada with approximate locations of eight participating Fire Management Headquarters

4.2.2 Individual-Level Participation

At the outset of the 2016 fire season, 292 wildland firefighters attended information sessions about participation in the current study across eight locations. Of the 292 wildland firefighters, 255 (87.3%) consented to participate in baseline testing (T1). No information was able to be gathered with regard to the 12.7% of individuals who chose not to participate in the current study, nor for their rationale behind the decision (e.g., ability to complete fitness testing, availability of time, etc), precluding direct

comparison of their characteristics relative to the participating WFFs. Additional and detailed descriptive data pertaining to the participants can be found under the Adoption criteria of the RE-AIM Framework-guided evaluation in the section that follows. In addition, the detailed CONSORT Flow diagram detailing the enrollment of locations, their allocation to experimental condition, and subsequent recruitment and retention of participants is presented in Figure 6.

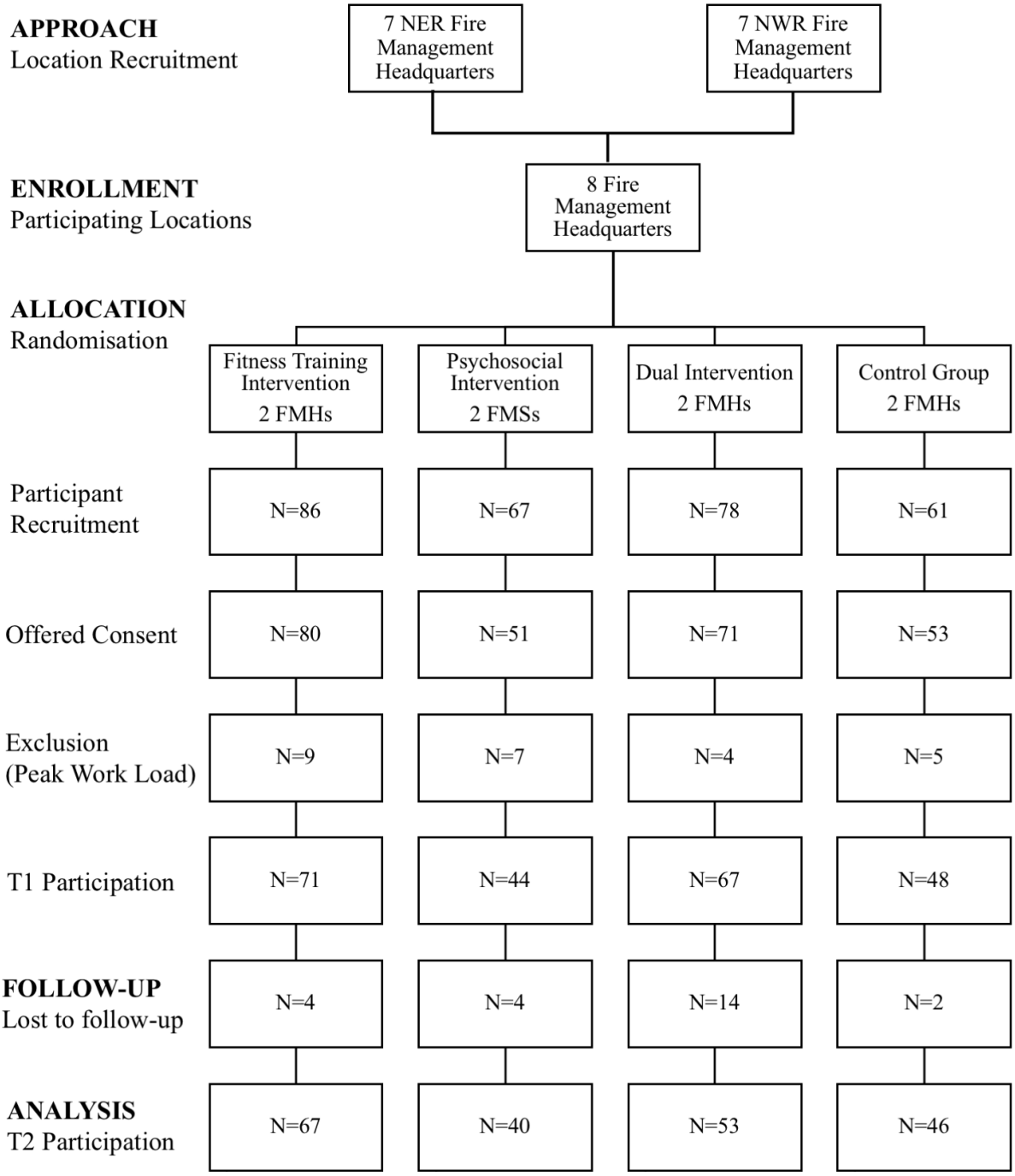

Figure 6. CONSORT Flow Diagram

4.3 Adoption

4.3.1 Setting-Level Adoption

Subsequent to agreement to participate in the current study, each location was subjected to the randomisation process and re-approached with the comprehensive details pertaining to their allocation of experimental condition for confirmation of participation. Management and staff representation from each participating FMH affirmed their support for participating in the current project and committed to providing the time and space resources necessary for participating according to protocol. As such, no additional exclusions were made.

4.3.2 Comparison of Setting-Level Characteristics

Organization-wide, there were a total of 636 wildland fires responded to that burned 83,009.5 hectares over the course of the 2016 fire season (O.M.N.R.F., 2017). Table 7 provides a breakdown of number of fires by region of the province. The majority of fires were human caused (73.7%) as displayed in Table 8. While often smaller in size, human caused fires often pose a greater threat because of their proximity to other people and personal property. Estimates of the cost of the 2016 fire season in Ontario through October 31, 2016 was pegged at $106.9M CDN, with $42.5M CDN directly related to fire suppression activities (O.M.N.R.F., 2017). With regard to comparing fire activity and intensity between participating locations, those assigned to the fitness intervention group responded to the greatest number of wildland fires across the season (N=190), while the locations delivering both fitness training and psychosocial education intervention programs were responsible for fire suppression of a greater number of hectares burned (N=2044.1). Complete fire activity by experimental condition can be found in Table 9. In addition to the local fire suppression efforts, a total of 126 WFFs

participated in two deployments to a neighbouring jurisdictions for a combined total of 2,910 days worked (O.M.N.R.F., 2017). While the specific fire activity data for the six non-participating location was not made available, it is noted that the total proportion of fires responded to be the participating locations (59.1%) relative to the provincial total is similar to the proportion of participating locations (57.1%) and allotment of WFF crews (56.6%). The disproportionate number of hectares burned between participating and non-participating locations was the result of one large fire which consumed a significant portion of forest early in the fire season at one of the non-participating locations.

Table 7. 2016 Fire season activity by region

	Number of Fires	**Hectares Burned**
Northeast Region	421	3,900.3
Northwest Region	215	79,109.2
2016 Total	**636**	**83,009.5**
***10 Year Average**	957	110,969

Table 8. 2016 Fire season activity by cause of fire

Cause of Fire	**Number of Fires**	**Hectares Burned**
Human	466	6,099.7
Lightning	170	76,909.8
2016 Total	**636**	**83,009.5**

Table 9. Fire activity by experimental condition as objective measure of job demands

Location	Experimental Condition	Region	Number of Fires	Hectares Burned
1	Control	NWR	21	5.4
2	Control	NER	12	36.7
		Control Condition Total	**33**	**42.1**
3	Fitness	NWR	35	489
4	Fitness	NER	155	272.2
		Fitness Intervention Condition Total	**190**	**761.2**
5	Psychosocial	NWR	20	10.1
6	Psychosocial	NER	29	16.8
		Psychosocial Intervention Condition Total	**49**	**26.9**
7	Dual	NWR	42	2002.4
8	Dual	NER	62	41.7
		Dual Intervention Condition Total	**104**	**2044.1**
		Total, Participating FMHs	**376**	**2874.2**
		Total, All other FMHs	**260**	**80,135.3**

4.3.3 Individual-Level Adoption and Exclusion

At the outset of each fire season the organization hires surplus wildland firefighters with the designation of 'peak workload', qualified wildland firefighters who participate in all pre-season training with regular full-time staff. However, peak workload employees only remain with the organization if the severity of the fire season necessitates. From the 255 participants approximately 9% were peak workload employees (N=25) and due to the relatively steady intensity of the fire season they did not continue employment through the summer or adopt their corresponding level of the intervention. As a result, 230 wildland firefighters participated in the intervention over the 2016 fire season. Post-season follow-up testing (T2) was conducted at least three months following T1 with 206 wildland firefighters participating, representing an overall retention rate of 89.6%.

4.3.4 Comparison of Individual-Level Characteristics

Demographic Variables

Detailed descriptive statistics on participants demographic information for the complete sample and by intervention condition can be found in Table 10. Reflective of the overall workforce, the sample was predominantly male (N=179, or 77.8%). Within each wildland fire crew of four WFFs, there are two crew members, one crew boss and one crew leader. Roughly two-thirds (N=153 or 66.5%) of participants were crew members, while crew leaders and crew bosses made up the remaining 17.8% (N=41) and 15.7% (N=36) of the population respectively. The average age of participating wildland firefighters at T1 was 24.02 years (SD=5.08), with ages ranging from 18 to 50 years. With respect to experience as a wildland firefighter, just over one quarter of all participants (26.1%) were employed during the 2016 fire season for the first time, while the fire season under evaluation represented year 28 for the most seasoned participant. The average experience in wildland firefighting was 3.89 fire seasons (SD=3.30 fire seasons). The number of fire seasons' experience by role on their crew is presented in Table 11. Retention rates representative of adoption across the four levels of the intervention and over time and by gender can be found in Table 12.

Table 10. Descriptive characteristics by experimental condition

Characteristic	Total Sample		Experimental Condition							
			Control		Psychosocial		Fitness		Fitness + Psychosocial	
	T1	*T2*	*T1*	*T2*	*T1*	*T2*	*T1*	*T2*	*T1*	*T2*
N	230	206	48	46	44	40	71	67	67	53
Gender										
Female	51 (22.2)	43 (20.9)	8 (16.7)	7 (15.2)	13 (29.5)	10 (25.0)	15 (21.1)	13 (19.4)	15 (22.4)	13 (24.5)
Male	179 (77.8)	163 (79.1)	40 (83.3)	39 (84.8)	31 (70.5)	30 (75.0)	56 (78.9)	54 (80.6)	52 (77.6)	40 (75.5)
Age (years)										
Under 21	51 (22.2)	46 (22.3)	14 (29.2)	14 (30.4)	14 (31.8)	12 (30.0)	10 (14.9)	11 (15.5)	12 (17.9)	10 (18.9)
21 to 24	98 (42.6)	92 (44.7)	23 (47.9)	22 (47.8)	16 (36.4)	16 (40.0)	27 (40.3)	28 (39.4)	31 (46.3)	27 (50.9)
25 and over	77 (33.5)	66 (32.0)	11 (22.9)	10 (21.7)	14 (31.8)	12 (30.0)	29 (43.3)	31 (43.7)	21 (31.3)	15 (28.3)
Unknown	4 (1.7)	2 (1.0)	-	-	-	-	1 (1.5)	1 (1.4)	3 (4.5)	1 (1.9)
Years of Experience										
1 (Rookie)	60 (26.1)	55 (26.7)	11 (22.9)	10 (21.7)	17 (38.6)	16 (40.0)	15 (22.4)	18 (25.4)	14 (20.9)	14 (26.4)
2 to 4	101 (43.9)	90 (43.7)	24 (50.0)	24 (52.2)	18 (40.9)	16 (40.0)	29 (43.3)	30 (42.3)	29 (43.3)	21 (39.6)
5 or more	69 (30.0)	61 (29.6)	13 (27.1)	12 (26.1)	9 (20.5)	8 (20.0)	23 (34.3)	23 (32.4)	24 (35.8)	18 (34.0)
Role on Crew										
Crew Member	153 (66.5)	137 (66.5)	34 (70.8)	33 (71.7)	30 (68.2)	27 (67.5)	43 (64.2)	46 (64.8)	43 (64.2)	34 (64.2)
Crew Boss	41 (17.8)	36 (17.5)	6 (12.5)	5 (10.9)	8 (18.2)	7 (17.5)	15 (22.4)	15 (21.1)	12 (17.9)	9 (17.0)
Crew Leader	36 (15.7)	33 (16.0)	8 (16.7)	8 (17.4)	6 (13.6)	6 (15.0)	9 (13.4)	10 (14.1)	12 (17.9)	10 (18.9)

Table 11. Years of experience in fire seasons by role on fire crew

Role on Crew	Mean Number of Fire Seasons	Standard Deviation
Crew Member	2.4	1.84
Crew Boss	5.7	3.37
Crew Leader	7.8	3.54

Table 12. Participation by experimental condition and gender over duration of the study

	Control			Psychosocial Intervention			Fitness Intervention			Psychosocial + Fitness Intervention		
	M	*F*	*Total*	*M*	*F*	*Total*	*M*	*F*	*Total*	*M*	*F*	*Total*
T1	40	8	48	31	13	44	56	15	71	52	15	67
T2	39	7	46	30	10	40	54	13	67	40	13	53
Retention Rate (%)	97.5	87.5	95.8	96.8	76.9	90.9	96.4	86.7	94.4	76.9	86.7	79.1

Workload Distribution

Over the course of the 2016 fire season, participants worked an average of 982.5 hours (SD=169.27). A one-way ANOVA was conducted to determine if the number of hours worked over the fire season was different across the four intervention conditions. Data is presented in Table 13. There was homogeneity of variances, as assessed by Levene's test for equality of variances (p=.566). The number of hours worked was statistically different by experimental condition, F (3,226) = 4.249, p = .006. Tukey post hoc analysis revealed that the mean increase in hours worked from the control group (M = 911.8, SD = 216.16) to both the fitness training intervention condition (M = 993.3, SD = 161.71) and the dual intervention condition (M = 1021.5, SD = 149.23), with mean increases of 81.6 hours, 95% CI [1.4, 161.7] and 109.7 hours, 95% CI [28.6, 190.9] respectively, was statistically significant (p<.05).

Table 13. Hours worked by experimental condition as objective measure of job demands across fire season, N=206

Location	Experimental Condition	Region	Mean Hours Worked*	Standard Deviation
1	Control	NWR	930.1	263.37
2	Control	NER	891.9	152.84
Control Condition Average			**911.8**	**216.16**
3	Fitness	NWR	1046.7	162.79
4	Fitness	NER	949.6	148.00
Fitness Intervention Condition Average*			**993.3**	**161.71**
5	Psychosocial	NWR	989.9	133.76
6	Psychosocial	NER	974.9	126.20
Psychosocial Intervention Condition Average			**982.8**	**128.92**
7	Dual	NWR	1074.7	152.03
8	Dual	NER	955.9	118.03
Dual Intervention Condition Average*			**1021.5**	**149.23**

*Hours worked was statistically significantly different between experimental conditions, $F(3,226) = 4.249$, $p = .006$.
**Hours worked by Fitness Intervention and Dual Intervention Condition participants were significantly higher than participants in the Control Condition

4.4 Evaluation of Intervention Effectiveness

4.4.1 Establishing Baseline: Understanding T1 Measurements

Prior to the completion of the analyses associated with the evaluation of intervention effectiveness as it related to the primary, secondary and broader organizational outcomes, a thorough assessment of baseline, or T1 data was undertaken to ensure that groups did not differ significantly at the outset of the study period and fire season. A complete correlation matrix across all T1 measures with corresponding assessments of Cronbach's alpha can be found in Appendix 14.

4.4.1.1 Job Demands

Three scales from the Guarding Minds at Work survey were used to quantify participants rating of job demands at both T1 and T2: Psychological Job Demands,

Civility and Respect and Work-Life Balance. Descriptive data for each scale and by experimental condition is presented in Table 14. One-way ANOVA tests determined that there were no statistically significant differences between experimental conditions at T1. As the Guarding Minds at Work provides normative reference data for Canadian workplaces pertaining to the distribution of scores across four categories, the results segmented in that manner are presented in Table 15.

4.4.1.2 Job Resources

Ten scales from the Guarding Minds at Work survey (Samra et al., 2012a) were classified as Job Resources: Organizational Culture, Psychological Support, Clear Leadership and Expectations, Growth and Development, Recognition and Reward, Involvement and Influence, Workload Management, Psychological Protection, Engagement and Protection of Physical Safety. Distribution of the scores across all 10 scales were negatively skewed, while five of the 10 were positively kurtosed. A one-way ANOVA was conducted to determine if the scores on each of the 10 scales were different by experimental condition. Descriptive data is presented in Table 16 while data by normative data category can be found in Table 17. The differences between the experimental conditions was not statistically significant for any of the scales at T1.

Table 14. Descriptive data of subjective ratings of job demands at T1

Scale	Experimental Condition																
	Total Sample					Control			Psychosocial			Fitness			Fitness + Psychosocial		
	N	*M*	*SD*	*SI*	*KI*	*N*	*M*	*SD*	*N*	*M*	*SD*	*N*	*M*	*SD*	*N*	*M*	*SD*
Psychological Job Demands	221	16.77	2.441	-3.573*	-0.819	48	16.81	2.590	43	16.84	2.069	69	16.59	2.653	61	16.90	2.357
Civility & Respect	221	16.50	2.750	-3.646*	0.359	48	16.77	2.417	42	15.98	2.967	69	16.49	3.013	62	16.66	2.541
Work-Life Balance	223	16.20	2.846	-3.552*	-1.367	48	16.87	2.506	43	16.40	2.362	70	16.17	3.212	62	15.58	2.889

*Represents a statistically significant skewness index at +/-2.58 level.
Note: N=Number of valid responses, M=Mean, SD=Standard Deviation, SI=Skewness Index, KI=Kurtosis Index

Table 15. Categories of responses on subjective ratings of job demands at T1 by normative category, N (%)

Scale	Total Sample				
	Total N	*Serious Concerns*	*Significant Concerns*	*Minimal Concerns*	*Relative Strength*
Psychological Job Demands	221	-	25 (11.3)	70 (31.7)	126 (54.8)
Civility & Respect	221	2 (.9)	26 (11.8)	81 (36.7)	112 (50.7)
Work-Life Balance	223	4 (1.8)	35 (15.7)	69 (30.9)	115 (51.6)

Table 16. Descriptive data of subjective ratings of job resources at T1

Scale	Total Sample					Experimental Condition: Control			Psychosocial			Fitness			Fitness + Psychosocial		
	N	*M*	*SD*	*SI*	*KI*	*N*	*M*	*SD*	*N*	*M*	*SD*	*N*	*M*	*SD*	*N*	*M*	*SD*
Psychological Support	220	16.75	2.583	-4.634*	1.058	48	17.17	2.452	42	16.48	2.340	68	16.81	2.898	62	16.55	2.487
Organizational Culture	223	16.51	2.831	-5.920*	2.840*	48	16.69	2.784	43	16.14	2.989	70	16.57	3.024	62	16.56	2.565
Clear Leadership and Expectations	222	16.87	2.602	-5.049*	1.323	48	16.94	2.778	42	16.31	2.504	70	16.87	2.859	62	17.21	2.189
Growth and Development	223	17.26	2.603	-6.718*	3.478*	48	17.52	2.222	43	17.07	2.293	70	17.03	3.121	62	17.44	2.460
Recognition and Reward	223	16.94	2.747	-5.294*	1.488	48	16.98	3.021	42	16.74	2.647	70	16.89	2.942	62	17.10	2.400
Involvement and Influence	222	16.82	2.513	-3.509*	-1.532	48	17.19	2.549	42	16.38	2.389	70	16.61	2.672	62	17.08	2.370
Workload Management	220	17.14	2.235	-3.634*	-1.364	48	17.42	2.550	42	16.67	1.984	69	17.38	2.321	61	16.97	2.008
Engagement	223	18.81	1.782	-17.07*	39.531*	48	19.13	1.214	44	18.86	1.407	69	18.62	2.333	62	18.73	1.681

Psychological Protection	222	17.05	2.586	-6.012*	2.603*	48	17.29	2.240	43	16.53	2.881	70	17.21	2.553	61	17.02	2.668
Protection of Physical Safety	223	18.28	2.034	-7.933*	4.278*	48	18.33	1.917	43	17.70	2.503	70	18.31	1.923	62	18.60	1.842

*Represents a statistically significant skewness or kurtosis z-score at the +/-2.58 level.
Note: N=Number of valid responses, M=Mean, SD=Standard Deviation, SI=Skewness Index, KI=Kurtosis Index

Table 17. Categories of responses on subjective ratings of job resources at T1 by normative category, N (%)

Scale	**Total Sample**				
	Total N	*Serious Concerns*	*Significant Concerns*	*Minimal Concerns*	*Relative Strength*
Psychological Support	220	4 (1.8)	20 (9.1)	69 (31.4)	127 (57.7)
Organizational Culture	223	6 (2.7)	25 (11.2)	67 (30.0)	125 (56.1)
Clear Leadership and Expectations	222	3 (1.4)	20 (9.0)	69 (30.1)	130 (58.6)
Growth and Development	223	3 (1.3)	18 (8.1)	52 (23.3)	150 (67.3)
Recognition and Reward	223	4 (1.8)	21 (9.4)	62 (27.8)	136 (61.0)
Involvement and Influence	222	-	27 (12.2)	64 (28.8)	131 (59.0)
Workload Management	220	-	19 (8.6)	60 (27.3)	141 (64.1)
Engagement	223	1 (.4)	3 (1.3)	18 (7.8)	201 (90.1)
Psychological Protection	222	3 (1.4)	17 (7.7)	64 (28.8)	138 (62.2)
Protection of Physical Safety	223	-	7 (3.1)	39 (17.5)	177 (79.4)

4.4.1.3 Personal Resources: Physical Fitness

Physical resource data emerging from fitness testing for males and females were compiled and analysed separately. While the testing procedures remained identical, comparable normative data for physical fitness tests are often stratified by sex. The complete correlation matrices for all physical fitness measures for both males and females can be found in Appendix 15.

Anthropometrics

Participant height and weight were assessed at T1, facilitating the calculation of Body Mass Index (BMI). Data are presented in Table 18 and Table 19 for both males and females respectively. An independent samples t-test was run to determine if there were differences in height, weight and body mass index between males and females. Height (*M*=1.80, *SD*=.062) and weight (*M*=83.07, *SD*=13.312) of male participants was higher than female participants, a statistically significant difference of 0.14m (95%CI, 0.12 to 0.16) and 12.78kg (95%CI, 8.74 to 16.81) for each measure respectively, $t(221) = -13.325$, $p < .001$ and $t(221) = -6.244$, $p < .001$. There was no statistically significant difference between males and females' measures of Body Mass Index, $t(221) = -.350$, $p = .727$. A one-way ANOVA was conducted to determine if there were differences in body mass index for all participants across experimental conditions, a result that was not statistically significant, $F(3,219) = 1.226$, $p = .301$.

Table 18. T1 Anthropometric measures for male participants by experimental condition

	Intervention Condition														
Research Measure	**Total Sample**			**Control**			**Psychosocial**			**Fitness**			**Fitness + Psychosocial**		
	N	*M*	*SD*	*N*	*M*	*SD*	*N*	*M*	*SD*	*N*	*M*	*SD*	*N*	*M*	*SD*
Height (m)	175	1.80	0.062	40	1.79	0.069	31	1.80	0.063	54	1.80	0.058	50	1.81	0.060
Weight (kg)	175	83.07	13.312	40	79.59	12.451	31	83.43	12.567	54	84.92	14.790	50	83.64	12.590
Body Mass Index (kg/m^2)	175	25.61	3.721	40	24.78	2.928	31	25.72	3.637	54	26.28	4.005	50	25.49	3.975

Table 19. Anthropometric measures for female participants by experimental condition

	Intervention Condition														
Research Measure	**Total Sample**			**Control**			**Psychosocial**			**Fitness**			**Fitness + Psychosocial**		
	N	*M*	*SD*	*N*	*M*	*SD*	*N*	*M*	*SD*	*N*	*M*	*SD*	*N*	*M*	*SD*
Height (m)	48	1.66	0.064	7	1.71	0.065	11	1.63	0.049	15	1.70	0.054	15	1.63	0.052
Weight (kg)	48	70.30	9.245	7	71.37	8.126	11	66.00	7.952	15	72.65	9.575	15	70.59	10.032
Body Mass Index (kg/m^2)	48	25.41	3.198	7	24.50	3.506	11	25.00	3.585	15	25.07	2.875	15	26.47	3.122

Grip Strength

Participants completed three assessments of grip strength with each hand, with the highest value preserved as the measurement of maximum grip strength. Total grip strength was calculated by adding the best right- and left-hand measurements and was utilize as the most representative measure of grip strength. A Welch t-test was completed to determine if there were differences total grip strength measurements between males and females as the assumption of homogeneity of variances was violated. Total grip strength was higher among males (M = 116.5, *SD* = 15.78) as compared to females (*M* = 74.3, *SD* = 9.11), a statistically significant difference of 42.24kg (95% CI, 38.73 to 45.75), $t(132.001) = 23.787$, $p < .001$.

As measurement of grip strength differ by sex, subsequent analyses were conducted separately. Data is presented for both males and females in Table 20. A Welch t-test was conducted to determine if total grip strength was different for experimental condition as the assumption of homogeneity of variance was not met when considering male participants. The differences between experimental conditions on total grip strength was not statistically significant amongst male participants, Welch's $F(3, 90.095) = 1.433$, $p = .238$. As homogeneity of variance was met for female participants, a one-way ANOVA was conducted to determine if there was a difference in total grip strength across experimental conditions for females. The difference was not statistically significant, $F(3,44) = .129$, $p = .942$.

Table 20. T1 Measurements of grip strength (in KGs) by gender and across experimental condition

		Intervention Condition													
Research Measure	**Gender**	**Total Sample**			**Control**			**Psychosocial**			**Fitness**			**Fitness + Psychosocial**		
		N	*M*	*SD*	*N*	*M*	*SD*	*N*	*M*	*SD*	*N*	*M*	*SD*	*N*	*M*	*SD*
Right Hand (kg)	Males	175	60.05	8.500	40	59.61	10.338	31	58.26	6.536	54	60.65	7.996	50	60.85	8.540
	Females	48	38.50	4.974	7	40.70	3.796	11	38.46	4.915	15	40.26	5.039	15	35.73	4.504
Left Hand (kg)	Males	175	56.46	7.951	40	55.09	9.309	31	54.88	5.418	54	57.40	7.685	50	57.51	8.274
	Females	48	35.77	4.718	7	37.89	5.153	11	34.42	4.987	15	37.31	4.047	15	34.24	4.528
Total Grip Strength (kg)	Males	175	116.51	15.781	40	114.70	19.225	31	113.14	11.021	54	118.06	14.914	50	118.36	16.102
	Females	48	74.27	9.113	7	78.59	8.764	11	72.88	9.255	15	77.56	8.190	15	69.97	8.684

Flexibility

Measurements of flexibility are reported in centimeters and represent participants best attempt on the Sit and Reach test with data presented in Table 21. An independent samples t-test determined that female participants performed better on the sit and reach test as compared to male participants, a statistically significant difference of 7.19cm (95% CI, 4.60 to 9.79), $t(221) = 5.461$, p , .001. A one-way ANOVA was conducted to determine if measures of flexibility differed across experimental condition for both males and females. There was no statistically significant difference across conditions for males, $F(3,171) = 1.919$, $p = .128$, however a statistically significant difference emerged for females $F(3,44) = 3.261$, $p = 0.03$. Tukey post hoc analysis revealed that the difference (8.21, 95% CI (.95 to 15.46)) between the fitness training intervention condition and the psychosocial education intervention condition was statistically significant ($p = .021$).

Core Strength

Assessment of core strength yielded times ranging from 53 seconds to 3 minutes, with data presented for both males and females overall and across experimental condition in Table 22. An independent samples t-test found no statistically significant differences between male and female participants, $t(221) = 1.446$, $p = .150$. One-way ANOVA did not reveal any statistically significant difference across experimental conditions, $F(3,219) = .279$, $p = .841$.

Table 21. T1 Measurements of flexibility (in cm) by gender and across experimental conditions

		Intervention Condition														
Research Measure	**Gender**	**Total Sample**			**Control**			**Psychosocial**			**Fitness**			**Fitness + Psychosocial**		
		N	*M*	*SD*	*N*	*M*	*SD*	*N*	*M*	*SD*	*N*	*M*	*SD*	*N*	*M*	*SD*
Flexibility (cm)	Males	175	29.03	8.275	40	28.94	8.068	31	32.03	7.539	54	28.69	8.950	50	27.60	7.873
	Females	48	36.22	7.322	7	37.57	6.425	11	31.73	6.657	15	39.93	5.444	15	35.17	8.261

Table 22. T1 Measurements of core strength (in minutes) by gender and across experimental conditions

		Intervention Condition														
Research Measure	**Gender**	**Total Sample**			**Control**			**Psychosocial**			**Fitness**			**Fitness + Psychosocial**		
		N	*M*	*SD*	*N*	*M*	*SD*	*N*	*M*	*SD*	*N*	*M*	*SD*	*N*	*M*	*SD*
Core Strength (min)	Males	176	2.66	0.577	40	2.59	0.579	31	2.70	0.564	54	2.70	0.558	51	2.64	0.615
	Females	47	2.52	0.597	7	2.72	0.478	11	2.71	0.502	14	2.31	0.706	15	2.48	0.578

Anaerobic Capacity

Completion of the Running-based Anaerobic Sprint Test allowed for the calculation of several variables relating to the anaerobic capacity of participants, as presented in Table 23. Welch t-tests were run to determine if there were differences across all five anaerobic capacity measures between males and females. Statistically significant differences emerged on all five measures as displayed in Table 24. As such, subsequent analyses including anaerobic capacity were stratified by sex. One-way ANOVA's were conducted to determine whether differences emerged by experimental condition for all five measures of anaerobic capacity. No statistically significant differences emerged for either males or females across experimental conditions.

Table 23. T1 Measurements of anaerobic capacity by gender and across experimental conditions

		Intervention Condition														
Research Measure	**Gender**	**Total Sample**			**Control**			**Psychosocial**			**Fitness**			**Fitness + Psychosocial**		
		N	*M*	*SD*	*N*	*M*	*SD*	*N*	*M*	*SD*	*N*	*M*	*SD*	*N*	*M*	*SD*
Maximum Power (watts)	*Males*	172	682.3	143.12	40	639.4	121.89	29	681.6	147.25	53	682.16	133.50	50	717.19	160.02
	Females	48	392.75	80.938	7	384.22	74.433	11	399.43	80.522	15	383.75	91.105	15	400.84	80.363
Minimum Power (watts)	*Males*	172	390.69	83.150	40	378.69	62.810	29	382.95	120.25	53	395.03	79.849	50	400.19	75.457
	Females	48	237.87	46.797	7	255.73	47.153	11	237.98	51.277	15	224.00	45.702	15	243.34	45.106
Average Power (watts)	*Males*	172	521.03	96.195	40	493.80	82.630	29	525.09	112.70	53	525.37	94.983	50	535.86	95.742
	Females	48	304.73	57.076	7	310.63	59.286	11	308.26	54.14	15	294.60	65.925	15	309.52	53.184
Fatigue Index (watt/sec)	*Males*	172	8.34	3.194	40	7.49	2.972	29	8.50	3.146	53	8.16	2.656	50	9.12	3.764
	Females	48	3.94	1.557	7	3.30	1.220	11	4.19	1.572	15	3.97	1.768	15	4.03	1.531
Relative Peak Power Output (watts/kg)	*Males*	172	8.32	1.604	40	8.12	1.541	29	8.34	1.768	53	8.17	1.530	50	8.62	1.636
	Females	48	5.68	1.339	7	5.48	1.295	11	6.16	1.555	15	5.30	1.097	15	5.80	1.413

Table 24. Results of Welch t-tests demonstrating statistically significant differences between males and females

Variable	*t*	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
MAX Power	18.112	136.284	.000	289.55	257.94	321.16
MIN Power	16.496	137.059	.000	152.82	134.50	171.14
AVG Power	19.609	128.801	.000	216.30	194.47	238.12
Fatigue Index	13.266	161.134	.000	4.40	3.74	5.05
Relative Peak Power Output	11.543	88.304	.000	2.64	2.19	3.09

4.4.1.4 Personal Resources: Psychological Capital

All participants completed the Psychological Capital Questionnaire (PCQ), allowing for four subscales to be calculated with possible scores ranging from 6 to 36: Efficacy (M = 27.58, SD = 4.921) Hope (M = 29.78, SD = 4.287), Resiliency (M = 28.90, SD = 3.623) and Optimism (M = 26.96, SD = 4.165). PCQ results are presented in Table 25. One-way ANOVAs determined that there was a statistically significant difference between experimental conditions for both the Efficacy (F(3,208) = 2.964, p = .033) and Hope (F(3,213) = 2.663, p = .049) scales. Tukey post hoc analysis revealed that the increase from the control group to the fitness and psychosocial intervention group (2.80, 95% CI (.28 to 5.32) was statistically significant (p = .023) for the Efficacy scale, as well as the difference (2.29, 95% CI (.15 to 4.42) for the Hope scale (p = .031).

4.4.1.5 Motivation: Work Engagement

A composite work engagement score and three subscale scores were computed from the Utrecht Work Engagement Scale. One-way ANOVAs were conducted and determined that there were no statistically significant differences between experimental conditions across all work engagement scores and subscales. Table 26 displays complete results for work engagement across experimental conditions.

Table 25. T1 Measurement of psychological capital across experimental conditions

				Intervention Condition										
PsyCap Scale	**Total Sample**			**Control**			**Psychosocial**			**Fitness**			**Fitness + Psychosocial**		
	N	*M*	*SD*	*N*	*M*	*SD*	*N*	*M*	*SD*	*N*	*M*	*SD*	*N*	*M*	*SD*
Efficacy	212	27.58	4.921	45	28.98	4.639	41	28.10	5.281	70	27.49	4.928	56	26.18	4.597
Hope	217	29.78	4.287	46	31.11	3.825	41	30.05	4.086	68	29.59	4.792	62	28.82	3.969
Resiliency	221	28.90	3.623	47	29.79	2.694	43	28.93	3.608	70	28.79	4.201	61	28.33	3.492
Optimism	212	26.96	4.165	47	26.74	2.908	39	27.21	4.281	67	27.34	4.747	59	26.54	4.280

Table 26. T1 Work engagement scores across experimental conditions

	Intervention Condition														
Work Engagement Scale	**Total Sample**			**Control**			**Psychosocial**			**Fitness**			**Fitness + Psychosocial**		
	N	*M*	*SD*	*N*	*M*	*SD*	*N*	*M*	*SD*	*N*	*M*	*SD*	*N*	*M*	*SD*
Average Score	223	4.63	0.663	48	4.76	0.600	44	4.70	0.613	70	4.56	0.761	61	4.55	0.614
Vigour Scale	223	4.85	0.716	48	4.95	0.586	44	4.91	0.737	70	4.84	0.811	61	4.72	0.673
Dedication Scale	223	4.88	0.806	48	5.07	0.727	44	5.00	0.660	70	4.73	0.962	61	4.80	0.736
Absorption Scale	223	4.20	0.791	48	4.31	0.778	44	4.23	0.759	70	4.15	0.882	61	4.16	0.721

4.4.2 Intervention Effectiveness: Primary Outcome

Guided by input from the partnering organization, given the lack of significant differences across experimental conditions on outcome variables, and yielding to their desire for insight into the impact or change that occurs across a wildland fire season several accommodations were made. First, a thorough analysis of the changes from T1 to T2 for the control group only was completed across all primary and secondary outcomes and can be found in Appendix 16. Second, a single metric for each of the primary and secondary outcome variables for all participants was computed by subtracting their T2 value from the T1 value, an established approach effective for simplifying pre- and post-test comparisons with a control group (Estrada et al., 2020; Estrada et al., 2019). Further, as there were significant differences across several primary outcome measures of physical fitness between male and female participants, the computation of a single difference score across the intervention period allowed for a unified comparison of all participants in a single analysis as no significant differences among change scores were observed based on gender (see Table 27).

Table 27. Independent Samples T-test for change scores of primary and secondary outcomes by gender

Variable	Gender	N	Mean	STD	*t*	df	Sig.
Job Demands							
Civility & Respect	Male	152	-1.15	2.500	-.275	188	.784
	Female	38	-1.03	2.531			
Psychological Job Demands	Male	154	-1.12	2.284	.149	192	.881
	Female	40	-1.18	1.781			
Work-Life Balance	Male	155	-.70	2.799	-.578	193	.601
	Female	40	-.40	3.241			
Job Resources							
Psychological Support	Male	152	-.86	2.395	-1.401	187	.163
	Female	37	-.24	2.465			
Organizational Culture	Male	155	-1.63	2.775	-.374	193	.709
	Female	40	-1.45	2.087			
Leadership & Expectations	Male	155	-1.13	2.686	-.330	192	.742
	Female	39	-.97	2.300			
Growth & Development	Male	155	-1.01	2.459	-.539	193	.590
	Female	40	-.78	2.259			
Recognition & Reward	Male	153	-.98	2.581	-.241	191	.810
	Female	40	-.88	1.924			
Involvement & Influence	Male	154	-1.07	2.716	.114	192	.910
	Female	40	-1.13	2.388			
Workload Management	Male	154	-.86	2.511	.091	191	.928
	Female	39	-.90	2.326			
Engagement	Male	155	-1.01	1.778	-.524	193	.601
	Female	40	-.85	1.231			

Variable	Gender	N	Mean	STD	*t*	df	Sig.
Psychological Protection	Male	153	-.78	2.353	.257	191	.798
	Female	40	-.90	3.161			
Protection of Physical Safety	Male	155	-.46	2.014	-.735	193	.463
	Female	40	-.20	1.843			
Work Engagement Average	Male	157	-.25	.651	-.575	197	.566
	Female	42	-.18	.579			
Personal Resource: Psychological Capital							
Efficacy	Male	150	-.57	4.477	-1.281	188	.202
	Female	40	.50	5.378			
Hope	Male	156	-.19	3.938	1.029	194	.305
	Female	40	-.95	4.925			
Resilience	Male	155	.63	3.658	.062	194	.950
	Female	41	.59	3.873			
Optimism	Male	150	-1.89	4.108	1.136	186	.257
	Female	38	-2.74	4.163			
Personal Resource: Physical Fitness							
Grip Strength	Male	154	1.36	10.048	-.761	194	.448
	Female	42	2.59	5.416			
Flexibility	Male	153	1.41	4.473	.178	193	.859
	Female	42	1.27	3.199			
Core Strength	Male	149	0:06.18	0:31.320	-.884	187	.378
	Female	40	0:11.18	0:32.702			
MAX Power	Male	137	-13.49	84.248	-.078	171	.938
	Female	36	-12.33	59.620			
Fatigue Index	Male	125	-.70	2.655	-.740	157	.461
	Female	34	-.35	1.303			
Relative Peak Power Output	Male	137	-.30	.941	-.117	171	.907
	Female	36	-.28	.866			

To this end, separate two-way multivariate analyses of variance tests were run to determine the effect of experimental condition on primary outcome measures of job demands, job resources, and personal resources and provide a test of Hypotheses 1 through 3. Significant models resulted in the subsequent evaluation of each measure within the category utilizing a linear multilevel model analysis. As participants were randomly assigned to each experimental condition by their work location and matched to another location by region, both of these factors were considered covariates in the analysis to remove any differences that may be occurring at that level. Comparisons between individual experimental conditions (e.g., fitness training intervention vs. control group) can be found in Appendix 17.

4.4.2.1 Job Demands (H1)

Testing of Hypothesis 1 was completed through a two-way MANOVA run with two independent variables – fitness training intervention and psychosocial education intervention – and three job demands dependent variables. The combined difference scores on civility and respect, psychological job demands, and work-life balance were used to assess subjective job demands. There was a statistically significant interaction effect between those receiving the fitness training intervention and the psychosocial education intervention on the combined dependent variables, $F(3,183) = 2.754$, $p = .044$, Wilks' $\Lambda = .957$; partial $\eta^2 = .056$. Further examination of the between-subjects effects revealed no statistically significant interaction effect on any of the three subjective measures individually. The simple main effect for participants receiving the psychosocial education training intervention and those who did not was statistically significant, $F(3,183) = 3.647$, $p = .014$, Wilks' $\Lambda = .376$; partial $\eta^2 = .043$. As such,

multilevel modeling was completed for each of the three subjective measures of job demands over the course of the fire season while controlling for base and region. Statistically significant differences for those receiving the psychosocial education intervention were found for all three measures of subjective job demands, including civility and respect (see Table 28), psychological job demands (see Table 29), and work-life balance (see Table 30).

Table 28. Change in civility and respect score over fire season by experimental condition, N=190

			Fitness Training Intervention	
			Yes	**No**
		Overall	-1.03 (2.455) *N=113*	-1.27 (2.573) *N=77*
Psychosocial Education Intervention*	**Yes**	-.58 (2.457) *N=86*	-.75 (2.244) *N=51*	-.34 (2.754) *N=35*
	No	-1.58 (2.456) *N=104*	-1.26 (2.611) *N=62*	-2.05 (2.152) *N=42*
*z = -2.84, p = .005				

Table 29. Change in psychological job demands score over fire season by experimental condition, N=194

			Fitness Training Intervention*	
			Yes	**No**
		Overall	-.89 (1.999) *N=114*	-1.48 (2.397) *N=80*
Psychosocial Education Intervention**	**Yes**	-.61 (2.157) *N=88*	-.43 (1.972) *N=51*	-.86 (2.394) *N=37*
	No	-1.56 (2.125) *N=106*	-1.25 (1.959) *N=63*	-2.00 (2.299) *N=43*
*z = -1.99, p = .046 **z = -3.22, p = 0.001				

Table 30. Change in work-life balance score over fire season by experimental condition, N=195

			Fitness Training Intervention	
			Yes	**No**
		Overall	-.50 (2.798) *N=115*	-.84 (3.021) *N=80*
Psychosocial Education Intervention*	**Yes**	-.11 (2.814) *N=89*	.21 (2.452) *N=52*	-.57 (3.236) *N=37*
	No	-1.08 (2.891) *N=106*	-1.08 (2.947) *N=63*	-1.07 (2.840) *N=43*
*z = -2.14, p = .032				

4.4.2.2 Job Resources (H2)

Testing of Hypothesis 2 was completed via a two-way MANOVA run with both psychosocial education and fitness training interventions as independent variables and ten dependent job resource variables. The combined difference scores on psychological support, organizational culture, leadership and expectations, growth and development, recognition and reward, involvement and influence, workload management, engagement, psychological protection and physical safety were used to assess job resources. There was a statistically significant main effect for the psychosocial education intervention on the combined dependent variables, $F(10,169) = 3.363$, $p = .001$, Wilks' $\Lambda = .834$; partial $\eta^2 = .166$. As such, multilevel modeling was completed for the each of the 10 measures of job resources individually while controlling for base and geographic region. The effect of the psychosocial education intervention was statistically significant for all but one measure of job resources (recognition and reward) with mean scores and standard deviations found in Table 31 through Table 40. The effect for both fitness training and psychosocial education intervention programs was significant for one resource score, organizational culture.

Table 31. Change in psychological support score over fire season by experimental condition, N=189

			Fitness Training Intervention	
			Yes	**No**
		Overall	-.51 (2.190) *N=111*	-1.06 (2.684) *N=78*
Psychosocial Education Intervention*	**Yes**	-.21 (2.257) *N=87*	-.31 (2.293) *N=51*	-.06 (2.229) *N=36*
	No	-1.20 (2.462) *N=102*	-.68 (2.103) *N=60*	-1.93 (2.762) *N=42*
*z = -2.29, p = .022				

Table 32. Change in organizational culture score over fire season by experimental condition, N=195

			Fitness Training Intervention*	
			Yes	**No**
		Overall	-1.30 (2.410) *N=115*	-2.00 (2.917) *N=80*
Psychosocial Education Intervention**	**Yes**	-.61 (2.299) *N=89*	-.56 (2.071) *N=52*	-.68 (2.615) *N=37*
	No	-2.42 (2.643) *N=106*	-1.92 (2.510) *N=63*	-3.14 (2.696) *N=43*
*z = -1.96, p = .049 **z = -5.15, p < .001				

Table 33. Change in leadership and expectations score over fire season by experimental condition, N=194

			Fitness Training Intervention	
			Yes	**No**
		Overall	-1.02 (2.551) *N=115*	-1.22 (2.702) *N=79*
Psychosocial Education Intervention*	**Yes**	-.56 (2.309) *N=88*	-.69 (2.183) *N=52*	-.36 (2.497) *N=36*
	No	-1.55 (2.764) *N=106*	-1.29 (2.808) *N=63*	-1.93 (2.685) *N=43*
*z = -2.75, p = .006				

Table 34. Change in growth and development score over fire season by experimental condition, N=195

			Fitness Training Intervention	
			Yes	**No**
		Overall	-.97 (2.419) *N=115*	-.94 (2.425) *N=80*
Psychosocial Education Intervention*	**Yes**	-.48 (2.237) *N=89*	-.60 (2.251) *N=52*	-.32 (2.237) *N=37*
	No	-1.36 (2.496) *N=106*	-1.29 (2.524) *N=63*	-1.47 (2.482) *N=43*
*z = -2.62, p = .009				

Table 35. Change in recognition and reward score over fire season by experimental condition, N=193

			Fitness Training Intervention	
			Yes	**No**
		Overall	-.83 (2.308) *N=114*	-1.14 (2.659) *N=79*
Psychosocial Education Intervention*	**Yes**	-.61 (2.409) *N=88*	-.61 (2.410) *N=52*	-.61 (2.441) *N=36*
	No	-1.25 (2.468) *N=105*	-1.02 (2.221) *N=62*	-1.58 (2.779) *N=43*
*z = -1.74, p = .082				

Table 36. Change in involvement and influence score over fire season by experimental condition, N=194

			Fitness Training Intervention	
			Yes	**No**
		Overall	-.95 (2.540) *N=115*	-1.28 (2.796) *N=79*
Psychosocial Education Intervention*	**Yes**	-.58 (2.472) *N=88*	-.83 (2.455) *N=52*	-.22 (2.486) *N=36*
	No	-1.50 (2.723) *N=106*	-1.05 (2.624) *N=63*	-2.16 (2.760) *N=43*
*z = -2.56, p = .011				

Table 37. Change in workload management score over fire season by experimental condition, N=193

			Fitness Training Intervention	
			Yes	**No**
		Overall	-.96 (2.451) *N=114*	-.73 (2.505) *N=79*
Psychosocial Education Intervention*	**Yes**	-.25 (2.268) *N=87*	-.39 (2.173) *N=51*	-.06 (2.414) *N=36*
	No	-1.37 (2.524) *N=106*	-1.41 (2.582) *N=63*	-1.30 (2.464) *N=43*
*z = -3.21, p = .001				

Table 38. Change in engagement score over fire season by experimental condition, N=195

			Fitness Training Intervention	
			Yes	**No**
		Overall	-.92 (1.728) *N=115*	-1.05 (1.614) *N=80*
Psychosocial Education Intervention*	**Yes**	-.71 (1.597) *N=89*	-.71 (1.730) *N=52*	-.70 (1.412) *N=37*
	No	-1.20 (1.721) *N=106*	-1.10 (1.720) *N=63*	-1.35 (1.730) *N=43*
*z = -2.09, p = .037				

Table 39. Change in psychological protection score over fire season by experimental condition, N=193

			Fitness Training Intervention	
			Yes	**No**
		Overall	-.67 (2.256) *N=114*	-1.01 (2.889) *N=79*
Psychosocial Education Intervention*	**Yes**	-.01 (1.909) *N=88*	.02 (1.679) *N=51*	-.05 (2.210) *N=37*
	No	-1.48 (2.795) *N=105*	-1.22 (2.511) *N=63*	-1.86 (3.167) *N=42*
*z = -4.25, p < .001				

Table 40. Change in physical safety score over fire season by experimental condition, N=195

			Fitness Training Intervention	
			Yes	**No**
		Overall	-.43 (1.644) *N=115*	-.36 (2.388) *N=80*
Psychosocial Education Intervention*	**Yes**	-.01 (1.862) *N=89*	-.33 (1.543) *N=52*	.43 (2.180) *N=37*
	No	-.74 (2.020) *N=106*	-.52 (1.731) *N=63*	-1.05 (2.370) *N=43*
*z = -2.60, p = .009				

4.4.2.3 Personal Resources (H3)

Physical Fitness (H3a)

A two-way MANOVA was conducted for all six difference measures of physical fitness with the two intervention conditions as independent variables in order to evaluate Hypothesis 3a. The psychosocial condition was statistically significant for all measures, $F(6,149) = 2.528$, $p = .023$, Wilks' $\Lambda = .908$; partial $\eta^2 = .092$. Multilevel modeling was completed for each the change in scores across the fire season of all physical fitness measures to determine which measure influenced the significant result, while controlling for both work location and geographic region. Both age and sex were added to the multilevel modeling evaluations, however, they did not yield any significant effects across all six measures. Table 41 through Table 46 display the mean and standard deviations for the change in scores from pre- to post-season measures by experimental condition. Only the change in maximum power produced yielded a significant result, with participants receiving the psychosocial education intervention (*M*=-28.59, *SD*=72.365) demonstrating a significantly greater decline as compared to those who did not (*M*=-2.32, *SD*=83.001).

Table 41. Change in total grip strength (kg) over fire season by experimental condition, N=196

			Fitness Training Intervention	
			Yes	**No**
		Overall	1.88 (10.217) *N=115*	1.25 (7.730) *N=81*
Psychosocial Education Intervention	**Yes**	2.34 (8.728) *N=90*	3.83 (9.700) *N=51*	.39 (6.964) *N=39*
	No	1.01 (9.678) *N=106*	.33 (10.448) *N=64*	2.05 (8.384) *N=42*

Table 42. Change in flexibility score (in cm) over fire season by experimental condition, N=195

			Fitness Training Intervention	
			Yes	**No**
		Overall	1.23 (4.684) *N=114*	1.59 (4.393) *N=81*
Psychosocial Education Intervention	**Yes**	1.54 (3.986) *N=89*	2.24 (4.158) *N=50*	.64 (3.609) *N=39*
	No	1.24 (4.428) *N=106*	.44 (4.945) *N=64*	2.46 (3.177) *N=42*

Table 43. Change in core strength (in minutes) over fire season by experimental condition, N=189

			Fitness Training Intervention	
			Yes	**No**
		Overall	.11 (.556) *N=109*	.13 (.487) *N=80*
Psychosocial Education Intervention	**Yes**	.15 (.511) *N=84*	.16 (.537) *N=45*	.13 (.487) *N=39*
	No	.10 (.540) *N=105*	.08 (.571) *N=64*	.14 (.493) *N=41*

Table 44. Change in maximum power (in watts) produced over fire season by experimental condition, N=173

			Fitness Training Intervention	
			Yes	**No**
		Overall	-18.27 (87.643) *N=99*	-6.53 (67.351) *N=74*
Psychosocial Education Intervention*	**Yes**	-28.59 (72.365) *N=72*	-34.66 (80.928) *N=38*	-21.80 (61.917) *N=34*
	No	-2.32 (83.001) *N=101*	-8.06 (90.726) *N=61*	6.45 (69.791) *N=40*
*$z = 2.26$, $p = .024$				

Table 45. Change in fatigue index (watts/second) over fire season by experimental condition, N=159

			Fitness Training Intervention	
			Yes	**No**
		Overall	-.82 (2.475) *N=97*	.33 (2.349) *N=62*
Psychosocial Education Intervention	**Yes**	-1.02 (2.593) *N=65*	-1.14 (2.381) *N=38*	-.85 (2.905) *N=27*
	No	-35 (2.286) *N=94*	-.61 (2.531) *N=59*	.08 (1.749) *N=35*

Table 46. Change in relative peak power output (watts per kg) over fire season by experimental condition, N=173

			Fitness Training Intervention	
			Yes	**No**
		Overall	-.33 (.959) *N=99*	-.24 (.878) *N=74*
Psychosocial Education Intervention	**Yes**	-.45 (.898) *N=72*	-.47 (.900) *N=38*	-.42 (.910) *N=34*
	No	-.18 (.930) *N=101*	-.24 (.991) *N=61*	-.09 (.831) *N=40*

Psychological Capital (H3b)

Assessing of Hypothesis 3b was completed using a two-way MANOVA considering the change in the four PsyCap measures by the two intervention programs as independent variables. This analysis yielded a significant interaction effect, $F(4,163) = 2.741$, $p = .030$, Wilks' $\Lambda = .937$; partial $\eta^2 = .063$. Results for each of the four scales can be found in Table 47 through Table 50. Multilevel modeling controlling for base and geographic region revealed a significant effect for participation in the fitness training intervention on the Hope scale (*M*=.22, *SD*=3.531) over those who did not (*M*=-1.16, *SD*=4.832). Participation in the psychosocial education intervention approached significance on the Hope scale as well.

Table 47. Change in PsyCap efficacy score over fire season by experimental condition, N=190

			Fitness Training Intervention	
			Yes	**No**
		Overall	.04 (4.616) *N=111*	-.87 (4.762) *N=79*
Psychosocial Education Intervention	**Yes**	.36 (4.730) *N=84*	1.21 (4.736) *N=47*	-.73 (4.556) *N=37*
	No	-.90 (4.598) *N=106*	-.83 (4.363) *N=64*	-1.00 (4.988) *N=42*

Table 48. Change in PsyCap resilience score over fire season by experimental condition, N=196

			Fitness Training Intervention*	
			Yes	**No**
		Overall	1.02 (3.570) *N=114*	.06 (3.811) *N=82*
Psychosocial Education Intervention	**Yes**	.72 (4.017) *N=88*	1.18 (3.657) *N=50*	.11 (4.422) *N=38*
	No	.54 (3.424) *N=108*	.89 (3.524) *N=64*	.02 (3.246) *N=44*
*z = -1.81, p = .071				

Table 49. Change in PsyCap hope score over fire season by experimental condition, N=196

			Fitness Training Intervention*	
			Yes	**No**
		Overall	.22 (3.531) *N=116*	-1.16 (4.832) *N=80*
Psychosocial Education Intervention**	**Yes**	.26 (4.030) *N=88*	.75 (3.515) *N=51*	-.41 (4.616) *N=37*
	No	-.84 (4.210) *N=108*	-.20 (3.514) *N=65*	-1.81 (4.973) *N=43*
*z = -2.37, p = .018 **z = -1.94, p = .053				

Table 50. Change in PsyCap optimism score over fire season by experimental condition, N=188

			Fitness Training Intervention	
			Yes	**No**
		Overall	-2.14 (4.257) *N=111*	-1.95 (3.947) *N=77*
Psychosocial Education Intervention	**Yes**	-1.69 (4.072) *N=83*	-1.04 (4.015) *N=49*	-2.62 (4.030) *N=34*
	No	-2.35 (4.158) *N=105*	-3.00 (4.273) *N=62*	-1.42 (3.844) *N=43*

4.4.3 Intervention Effectiveness: Evaluation of Secondary Outcomes (H4)

4.4.3.1 Motivation: Work Engagement (H4a)

With regard to the testing of Hypothesis 4a, multilevel modeling controlling for base and geographic location of participants did not reveal a statistically significant effect for participation in either intervention condition on the change in work engagement scores over the course of the fire season. Mean and standard deviations by experimental condition are presented in Table 51.

Table 51. Change in UWES work engagement score over fire season by experimental condition, N=199

			Fitness Training Intervention	
			Yes	**No**
		Overall	-.18 (.642) *N=116*	-.31 (.622) *N=83*
Psychosocial Education Intervention	**Yes**	-.18 (.610) *N=88*	-.13 (.617) *N=50*	-.23 (.604) *N=38*
	No	-.28 (.653) *N=111*	.22 (.663) *N=66*	-.38 (.635) *N=45*

4.4.3.2 Job Stress (H4b)

Completion of the Job Stress Survey at T2 allowed for the calculation of several composite index and subscale scores and evaluation of Hypothesis 4b, with descriptive results presented in Appendix 18. Controlling for base and geographic region, multilevel modeling was conducted for participation in either intervention program for all composite and subscale scores. Participants in the fitness training intervention (*M*=47.37, *SD*=7.633) reported statistically significantly higher scores on the Job Pressure Index as compared to those who did not participate in the fitness training intervention (*M*=45.12, *SD*=7.109). Participants in the psychosocial education intervention (*M*=48.48, *SD*=8.558) reported statistically significant lower scores on the

level of organizational support frequency subscale than those who did not (*M*=51.91, *SD*=10.736).

4.4.4 Intervention Effectiveness: Evaluation of Broader Outcome (H5)

Over the course of the wildland fire season, 20 participants reported experiencing a workplace injury (see Table 52). A chi-square test for association was conducted between experimental conditions and the reporting of a workplace injury across the wildland fire season. Due to the relatively small control group sample and the low activity fire season relative to intervention groups, binomial tests of proportions were used to evaluate whether the incidence of injury observed in the intervention groups were different from the five-year average of reported injuries across the wildland fire season in Ontario and provide an evaluation of Hypothesis 5 (Leduc, C. et al., 2018). Given an average of 121.6 injuries per 760 WFFs across the five-year period preceding the, an average proportion of 16.0% was utilized. Binomial test of proportion indicated a significant result for the observed incidence rate of 9.9% as lower for participation in any intervention group as compared to the five-year average of 16%. The observed incidence rate for the intervention group implementing both fitness training and psychosocial education interventions (1.5%) was also statistically significantly different from the five-year incidence rate (p <.001).

Table 52. Frequency of reported injuries by experimental condition, N=230

Experimental Condition	Injury reported during fire season (%)		Total
	No	***Yes***	
Control	46 (95.8)	2 (4.2)	48
Psychosocial	38 (86.4)	6 (13.6)	44
Fitness	60 (84.5)	11 (15.5)	71
Fitness + Psychosocial*	66 (98.5)	1 (1.5)	67
Total, any intervention group**	**164 (90.1)**	**18 (9.9)**	**182**

***p* = .0002 (two-sided test) as compared to five-year incidence rate of 16%
****p*=.0255 (two-sided test) as compared to five-year incidence rate of 16%

4.5 Implementation

4.5.1 Intervention Implementation: Fidelity and Adherence

4.5.1.1 Fitness Training Intervention

In-Season (During Intervention) Monitoring

Participants receiving the fitness training intervention were asked to log their participation in the fitness training hour where possible. This tracking was voluntary, and participants were in no way obliged to log their activity. An independent samples t-test was used to determine if participants in the two experimental conditions receiving the fitness training intervention differed on the number of workouts logged across the fire season. A total of 1162 workout activities were logged across all participants receiving the fitness training intervention ($M = 8.42$, $SD = 9.144$). Participants receiving the fitness intervention only (M=11.87, SD=10.123) logged a greater number of training activities than those receiving both the fitness and psychosocial interventions (M=4.76, SD=6.201), a statistically significant difference of 7.112 (95% CI, 4.266 to 9.958), $t(136) = 4.941$, $p < .001$. Using a chi-square test for association, it was found that a statistically significant and moderately strong association between reporting

behaviour and experimental condition as 85.9% of participants in the fitness intervention only group recorded at least one training session, whereas only 61.2% of participants in the fitness and psychosocial intervention group logged at least one activity ($\chi^2(1) = 10.926$, $p = .001$; $\varphi = 0.281$, $p = .001$).

A component of the fitness training intervention training program was the provision of a training schedule, prompting participants to diversify the modalities of their training activities: with an emphasis on either a single component (cardiovascular training, weight training or plyometrics) or a combination of multiple components. The workout activity recorded by training modality and length of workout by experimental condition is presented in Table 53.

Post-Season (After Intervention) Assessment

Participants were asked to reflect on several aspects of the intervention resources provided to them over the course of the fire season, including participation in the logging component, and utilization of feedback (see Appendix 19). Only 11% of participants reported recording their workout activity ‘every time’, while over a quarter reported never or rarely recording activity. The majority reported receiving their fitness testing results by email (80.7%) and discussing them with their peers (80.3%). Roughly half of the participants (48.2%) reported using the feedback to guide their in-season training activity.

Table 53. Descriptive fitness training activity data recorded by experimental condition

	Overall		**Fitness Intervention Only**		**Psychosocial + Fitness Interventions**	
Item	**N**	**%**	N	%	N	%
*Workout Type**						
Cardiorespiratory Only	**306**	**26.3**	240	28.6	66	20.2
Weight Training Only	**265**	**22.7**	172	20.5	93	28.5
Plyometrics Only	**177**	**15.2**	123	14.7	54	16.6
Cardio + Weight	**116**	**10.0**	80	9.5	36	11.0
Cardio + Plyometrics	**119**	**10.2**	102	12.2	17	5.2
Weight + Plyometrics	**111**	**9.5**	70	8.3	41	12.6
Cardio + Weight + Plyometrics	**52**	**6.1**	52	6.2	19	5.8
Workout Length						
10-20 minutes	**25**	**2.2**	14	1.2	11	3.4
20-30 minutes	**127**	**11.1**	85	10.3	42	13.1
30-40 minutes	**384**	**33.4**	289	34.9	95	29.6
40-50 minutes	**302**	**26.3**	214	25.8	88	27.4
50-60 minutes	**196**	**17.1**	142	17.1	54	16.8
60+ minutes	**115**	**10.0**	84	10.1	31	9.7
Workout Appraisal						
Felt Poor	**48**	**4.4**	40	5.2	8	2.5
Felt Alright	**223**	**20.5**	158	20.5	65	20.3
Felt Great	**819**	**75.1**	572	74.3	247	77.2
* $\chi^2(6) = 29.541$, $p < .001$; $\varphi = 0.159$, $p < .001$						

4.5.1.2 Psychosocial Education Intervention

In-Season (During Intervention) Monitoring

Participants receiving the psychosocial education intervention were sent one fact sheet per week by email over the course of the intervention period. Participants were asked to reply to the email if they engaged specifically with the fact sheet attached. Table 54 depicts the number of participants by experimental condition that replied to confirm their engagement with the fact sheet sent by email during the intervention period. A chi-square test for association was conducted between fact sheet engagement via email and experimental condition. All expected cell frequencies were greater than five. There was a statistically significant association between fact sheet engagement and experimental condition for six of the 13 fact sheets, with mostly moderately strong associations ranging from .20 to .30. An independent samples t-test was used to determine if participants in the two experimental conditions receiving the intervention material differed on the number of fact sheets they engaged with over the course of the intervention period. Overall, participants in the psychosocial intervention experimental group (M=5.09, SD=4.992) reported engaging with a greater number of fact sheets sent by email as compared to the psychosocial and fitness interventions experimental group (M=2.94, SD=4.365), a statistically significant difference of 2.151 (95% CI, .373 to 3.928), $t(109) = 2.397$, p=.018.

Table 54. Email responses indicating engagement during the intervention period with psychosocial education material for each fact sheet with chi-square test of association between experimental conditions

Fact Sheet Topic	Psychosocial Intervention		Psychosocial and Fitness Intervention		χ^2	df	*p*	φ
	Yes	No	Yes	No				
JD: Civility & Respect	20 (45.5)	24 (54.5)	16 (23.9)	51 (76.1)	5.641	1	.018*	.225*
JD: Psychological Job Demands	16 (36.4)	28 (63.6)	18 (26.9)	49 (73.1)	1.128	1	.288	.101
JD: Work-Life Balance	15 (34.1)	29 (65.9)	11 (16.4)	56 (83.6)	4.625	1	.032*	.204*
JR: Psychological Support	27 (61.4)	17 (38.6)	26 (38.8)	41 (61.2)	5.417	1	.020*	.221*
JR: Organizational Culture	21 (47.7)	23 (52.3)	20 (29.9)	47 (70.1)	3.644	1	.056	.181
JR: Clear Leadership and Expectations	19 (43.2)	25 (56.8)	16 (23.9)	51 (76.1)	4.583	1	.032*	.203*
JR: Growth and Development	14 (31.8)	30 (68.2)	15 (22.4)	52 (77.6)	1.224	1	.269	.105
JR: Recognition and Reward	18 (40.9)	26 (59.1)	14 (20.9)	53 (79.1)	5.185	1	.023*	.216*
JR: Involvement and Influence	17 (39.5)	26 (60.5)	16 (23.9)	51 (76.1)	3.056	1	.080	.167
JR: Workload Management	16 (36.4)	28 (63.6)	14 (20.9)	53 (79.1)	3.222	1	.073	.170
JR: Engagement	16 (36.4)	28 (63.6)	12 (17.9)	55 (82.1)	4.795	1	.029*	.208
JR: Psychological Protection	14 (31.8)	30 (68.2)	8 (11.9)	59 (88.1)	6.604	1	.010*	.244*
JR: Physical Safety	11 (25.0)	33 (75.0)	11 (16.4)	56 (83.6)	1.231	1	.267	.105
Overall	**30 (68.2)**	**14 (31.8)**	**31 (46.3)**	**36 (53.7)**	**5.152**	**1**	**.023***	**.215***
***significant at the .05 alpha level**								

Post-Season (After Intervention) Assessment

At the conclusion of the intervention period, participants were asked to report on their engagement with the intervention material either by email or around their work location. Results are found in Table 55. The vast majority reported receiving the intervention material by email (92.5% overall), while over two-thirds reported reading the material provided (71.0%).

Table 55. T2 Measures of psychosocial education intervention material engagement

	Psychosocial Intervention		Psychosocial and Fitness Intervention					
T2 Measure	Yes	No	Yes	No	χ^2	df	*p*	φ
Did you receive the fact sheets by email?	37 (92.5)	3 (7.5)	49 (92.5)	4 (7.5)	-	-	-	-
Did you read the fact sheets?	25 (62.5)	15 (37.5)	41 (77.4)	12 (22.6)	2.443	1	.118	.162
Did you discuss any of the fact sheet content with any of your peers?	27 (69.2)	12 (30.8)	34 (65.4)	18 (34.6)	.149	1	.699	.04

4.5.2 Adaptations to Intervention

As the delivery of both intervention programs across multiple locations spread across 1500KM and occurred during a live fire season, regular check-ins with the organization's Health and Wellness Specialist and the representative from the local management teams were established in order to ensure responsivity to changing or unforeseen challenges that arose through the implementation period. The minor adaptations to the intervention process recorded through notetaking are presented for each of the intervention programs in the section that follows.

4.5.2.1 Fitness Training Intervention Adaptations

Several components of the fitness training intervention were executed as envisioned and did not require any adaptations across the intervention period. For instance, the delivery of the initial workshop, provision of the wearable fitness tracker and training schedule were completed in a single day at the outset of the intervention fire season. Based on the capacity of the researcher and the scope of the data collection procedure, the provision of feedback regarding individual performance on fitness measures varied in terms of time across a period of three weeks post-testing.

Second, significant adaptations were made throughout the intervention period as it related to the logging of fitness training activities. Over the first few weeks of the intervention period, several challenges relating to the technology associated with the logging application and tablet emerged. While constantly connected to power, the tablet charging cord was accessible and frequently became a borrowed source of power for individuals to charge their mobile device while in the training room participating in a workout. Forgetting to plug the tablet back in at the conclusion would result in the tablet's battery dying and not often not discovered until the following day, thereby missing the opportunity for individuals to log their workouts. One location in particular was hampered by an individual(s) who repeatedly attempted to hack the device which often left it locked out by its own security system. Finally, with only one tablet and several crews participating in a workout at the same time, there would often be a line to log the workouts resulting in participants opting to not log their activity for the sake of time. Though the provision of a paper logging option was provided at these locations, both of the aforementioned challenges caused interruptions that disrupted the routine and flow of recording training activity.

4.5.2.2 Psychosocial Education Intervention Adaptations

The delivery of the initial education workshop at the outset of the psychosocial education intervention was delivered consistently and without adaptation across the four assigned locations. The fact sheets were distributed by email to the involved participants each week on the common day as foreseen. A small adaptation was made after the second week of posting the posters up around the work locations: namely, leaving the posters from the previous week up for an additional two weeks. This was done to ensure that all participating WFFs would have had the opportunity to view the posters around their work location, as their work schedule allows for off-base deployments to last a maximum of 14 days with a minimum two-day recovery period before returning back to base.

4.5.3 Cost of Intervention: Time

The preparation, planning and development of the two intervention programs within the current project were the result of extensive time commitments on behalf of both the researcher and members of the partnering organization over a period of roughly eight months that immediately preceded the fire season in question. However, no systematic recording of the time cost was completed during this time. The following subsections are designed to provide an overview and estimate of the time cost for both organizational and researcher perspectives for the actual measurement, intervention initiation and delivery and drawn from personal records and journaling taken across the intervention period.

4.5.3.1 Organization Time Cost

Recruitment of Locations and Individuals

Through the Fire Science division of the partnering organization, a provincial Health and Wellness Specialist was identified as the conduit through which all research activity would be coordinated. As such, and across the intervention period, two-thirds of her time was dedicated to the coordination, support and execution of the interventions. The recruitment of locations for participation in the current study required a time commitment of one hour from members of the local management teams of all 14 locations within the organization. As the regional management groups already meet together in one location for a period of three days during each spring, the Fire Science division was able to secure a one-hour time slot for presenting the aims of the study. Subsequent to the recruitment and random allocation to experimental condition, there was a subsequent conference call with the location that did not exceed one half-hour in length to confirm participation with local management and discuss expectations and scheduling for testing procedures. Each site identified a representative to coordinate scheduling and the delivery of intervention material across the wildland fire season with the organization's health and wellness specialist.

The recruitment procedures required all potential WFFs across eight locations to attend an information session that did not last longer than one half hour. All participating WFFs underwent identical T1 and T2 measurements that did not last longer than two hours. Participants in the fitness training intervention participated in the initial education workshop which lasted no longer than one half hour, while participants in the psychosocial education intervention participated in their initial workshop that did not exceed 45 minutes in length. Participants at locations receiving both interventions

participated in a single session that did not exceed one- and one-half hours in length during which time both fitness training and psychosocial education initial workshops were completed.

Throughout the intervention period, the time cost associated with the intervention material (e.g., time to log fitness workouts, interacting with fact sheet material, reviewing fitness feedback, etc.) varied by individual and was not recorded in any direct measure. A summary of the estimated time cost associated with the current intervention study is presented in Table 56.

Table 56. Organization time cost associated with study participation

Activity	Personnel	Time Estimate	Approximate Time Cost in Personnel Hours
Coordination of all intervention activities	Health and Wellness Specialist	0.67 FTE for 6 months	700 Hours
Location recruitment	Management teams from 14 FMHs across 2 regions (N=52 Total)	1 Hour	52 Hours
Local coordination	Coordinator at each participating FMH (N=8)	8 Hours	64 Hours
Participant recruitment	All eligible WFFs at 8 FMHs (N=292)	0.5 Hours	146 Hours
T1 Testing	All T1 participants (N=255)	1.5 Hours	382.5 Hours
Fitness training intervention workshop	Participants at fitness training intervention and dual intervention locations (N=138)	0.5 Hours	69 Hours
Psychosocial education workshop	Participants at psychosocial and dual intervention locations (N=111)	0.75 Hours	83.25 Hours
Fitness training intervention activity	Participants at fitness training intervention and dual intervention locations (N=138)	Up to 1.0 hour daily	-*
Psychosocial education intervention activity	Participants at psychosocial and dual intervention locations (N=111)	Up to 1.0 hour weekly	-*
T2 Testing	All T2 participants (N=206)	1.5 Hours	309 Hours
Minimum Estimate Cost of Personnel Hours			**1805.75 Hours**
*Unable to estimate as the true number of training activity is unknown			

4.5.3.2 Researcher Time Cost

The costs associated with researcher time during the data collection and implementation procedures were largely driven by the vast geographic region across which the eight participating locations are spread. For instance, over the course of pre- and post-intervention data collection procedures, the researcher traveled over 5000KM by air, and 9000KM by car. Further, the cyclical nature of a wildland fire season precluded staggering intervention deliveries by location or experimental condition and required two intense periods of data collection pre- and post-intervention. The researcher was supported by a research assistant for both pre- and post-season data collection periods that occurred over two periods of 16 consecutive days. Supporting implementation throughout the 13-week intervention period required full-time commitment on the part of the researcher, as this time was used to ensure delivery of material, provision of feedback and coordination and calibration of data collection equipment and procedures. No record of time was kept pertaining to the time spent compiling, organizing and analyzing the data collected in the time that followed intervention completion at the conclusion of the fire season.

4.5.4 Additional Implementation Feedback

4.5.4.1 Fitness Training Intervention

Responding to the post-intervention survey, the majority of participants in the fitness training intervention confirmed they received their personalized fitness results via email (80.7%) and found the information provided to be somewhat or very useful (93.0%). Roughly four in five (80.3%) participants reported discussing their fitness testing results with their colleagues while approximately half (48.2%) stated that their results were used to guide their training over the course of the fire season. Finally, the majority of

participants (56.8%) believed that the fitness tests utilized in the current study adequately captured components of physical fitness required to successfully complete their job tasks as a wildland firefighter.

An open-ended question at the conclusion of the intervention period sought feedback on any aspect of the program design, implementation or evaluation. A total of 55 responses were received from participants, varying in length from a few words to a couple of sentences. A deductive, concept-driven approach was taken to the qualitative content analysis, classifying the responses into one of two codes (Bengtsson, 2016; Elo et al., 2014). The two codes were 'positive' and 'challenge'. Positive codes were assigned to responses that provided affirmation for aspects of the intervention program. A challenge code was applied to responses that identified difficulties experienced across the intervention process and suggestions for how the program could address similar challenges moving forward.

Positive codes indicating support for the fitness training intervention program content and delivery was recorded in 30 of the 55 responses (54.5%, see Table 57). Examples of positive responses for the fitness intervention components included "Excellent graphic design. Very well explained and exciting study to participate in" and "I love it. People need feedback to see where they stand, individually or compared to others. Both were offered!". Other responses highlighted the benefits of participation: "I am grateful for the focus on fitness as it promotes physical and mental health".

Challenges were noted in the 32 responses (58.2%, see Table 57). Examples of responses that identified challenges with implementation of the fitness training

intervention touched on the mechanism of the recording workouts throughout the fire season, as the unsupervised iPad in the training room frequently encountered technical difficulties. Indeed, one participant remarked: “Occasionally I was not sure if a workout was logged or not. There was no way to check if you had logged or not” and another “good program, but I did not log workouts after the iPad broke”.

Some participants noted the challenges associated with regular participation due to the unpredictable nature of wildland firefighting: “consistency was difficult simply due to the nature of the job. Trying to maintain a workout either daily or weekly is often disrupted by a trip to a fire or a forward attack base”. Other participants also reported the challenge with identifying the fitness measures that adequately represent the tasks associated with wildland firefighting: “just because you can sprint fast doesn’t necessarily mean you can walk through knee-deep sphagnum moss with a pack on your back for six hours straight!” and “being a FireRanger requires stamina and staying power, physical and mental, and can’t be tested in one hour”.

Table 57. Content analysis results of participant feedback by intervention program

Intervention	**N**	**Content Analysis Category**	
		Positive	*Challenge*
Fitness Training	55	30	32
Psychosocial Education	21	13	11

4.5.4.2 Psychosocial Education Intervention

A total of 93 participants across four locations participated in pre- and post-intervention measurements in addition to receiving the psychosocial intervention material over the course of the wildland fire season. The majority of participants confirmed receipt of the

weekly fact sheets (92.5%) and affirmed that sending the fact sheets by email and posting around their work location was the most effective ways to communicating with them around the topic (91.1%). The majority reported reading the fact sheets (71.0%) and found the information therein to be both useful (93.1%) and relevant to issues faced by WFFs over the course of a fire season (98.7%). However, less than one-third (32.9%) stated that they discussed any of the information with their colleagues either occasionally or often. Complete feedback pertaining to the psychosocial intervention by experimental condition receiving the material can be found in Appendix 20.

Participants were also given the opportunity to provide feedback on any aspect of the program material, delivery and implementation. 21 participants provided brief responses, varying in length from a few words to a few sentences. As with the fitness training intervention, a qualitative content analysis was completed, classifying responses with as either positive or a challenge. Positive codes were recorded in 13 of the 21 responses (61.9%, see Table 57). Participants expressed their approval for both the material content (e.g., "Good information for both work-life and at home, outside of work") manner of presentation (e.g., "Enjoyed them being posted around the base") and their overall aesthetic (e.g., "visually appealing). Challenges codes were applied to 11 of the 21 responses (52.4%, see Table 57). The primary suggestion for improvement of the program with regard to implementation centred overwhelmingly around the call for greater management involvement in the topic areas found within the fact sheets. For example, one participant commented: "These fact sheets should be provided to management as well as they sometimes forget what it is like to be a FireRanger on the front lines and overlook the topics of the sheets". Another remarked: "Perhaps there could have been more facilitation of conversation by upper management to ensure

consistent review of the content". This idea of facilitation of content delivery across the wildland fire season was re-iterated by several other participants (e.g., "fact sheets would have been more beneficial if they were read to us in briefing").

4.6 Maintenance

4.6.1 Fitness Training Intervention

Correspondence with the organization's Health and Wellness Specialist revealed that elements of the fitness training intervention continue to be embedded within the Commit to be Fit program across the organization across subsequent fire seasons. For instance, the organization continues to develop and refine their fitness training schedule to encourage and diversify participation in a number of training activities. Further, support has been strengthened internally for the Commit to be Fit program and the availability of equipment and training time at the outset of the work shift has been standardised across all locations, including those in the control group and not participating in the current study. Organizational policy has been developed internally to ensure sustainability and accountability of the program over the fire seasons to come.

4.6.2 Psychosocial Education Intervention

Correspondence and ongoing research with the partnering organization inform the ongoing maintenance of the psychosocial education intervention in the fire seasons that followed the current study period. The organization renewed their commitment to the collaborative research agreement to disseminate and re-engage staff as it pertained to psychosocial education intervention material over the fire season that immediately followed, and the material was expanded to reach all staff within the organization, not only wildland firefighters. The education material has been expanded from the fact

sheets presented in the current study to a number of other medium, including video clips, posters, and discussion cards.

CHAPTER 5. Discussion

5.1 Introduction and Summary of Findings

Using the RE-AIM Framework as an evaluative guide, the current study makes several key contributions to our understanding of intervention research, especially within the context of wildland firefighting. Further, the project offers a first application of the JD-R Theory to a previously not studied industry for the development of two intervention programs targeting physical and psychological aspects of health and well-being. Specifically, an opportunity was provided for the evaluation of the effectiveness of the intervention programs utilising a cluster randomised control trial study design to improve both personal and job resources while mitigating job demands (primary outcomes), foster work engagement and decrease job stress (secondary outcomes) while decreasing incidence of injury (broader organizational outcome) across a wildland fire season. To this end, five hypotheses were tested. Second, and to provide additional context and understanding with regard to the outcomes of the hypothesis testing, the RE-AIM Framework provided the structure to examine the intervention programs' reach and adoption rates at both the participant and setting levels. Success at both reach and adoption levels enabled a broadening of our understanding of WFFs level of job demands and resources via assessment of psychosocial risk factors, personal resources including physical fitness and psychological capital, and level of work engagement at the outset of a wildland fire season. Finally, employing the RE-AIM Framework allowed for a comprehensive examination of individual and organizational factors influencing the implementation and maintenance of both intervention programs.

5.2 Intervention Effectiveness

Utilizing the RE-AIM Framework and in-line with the predominant application in intervention research, the current study sought first and foremost to evaluate intervention effectiveness (Harden et al., 2015). To this end, an examination of primary, secondary and organizational outcomes was conducted through the testing of several hypotheses. Guided by input from the partnering organization and informed by existing intervention research, the current evaluations of intervention effectiveness took a practical approach with regard to the implementation and measurement period. Both intervention programs commenced with a pre-intervention measurement point followed by the delivery of an initial workshop and reinforced across the 13 weeks that comprise the bulk of a wildland fire season. Following a lag period of a minimum of one week, but not greater than three weeks, post-intervention measures were taken. Follow-up measurement points across previous JD-R Theory informed intervention research vary significantly, often with little rationale provided with regard to the decision process. Indeed, whereas some studies conducted their follow-up measurement point within a week or two of intervention completion and called for longer periods (Gordon et al., 2018; Wingerden et al., 2016; Wingerden, Derks, et al., 2017), others conducted longer follow-up periods of four to seven months and posited that shorter time periods may have been more effective (Ângelo & Chambel, 2013; Biggs et al., 2014). On a practical level, the seasonality of the wildland fire season precludes longer follow-up periods, as WFFs move on to other occupations and roles over the Canadian winter. This is not indifferent from the farming industry where intervention efforts have had long-term follow-up measurement periods challenges by crossing over seasons (Rasmussen et al., 2003). As a result, the decision to contain measurement points within a single wildland

fire season was made, with measurement points taken as far apart in time as possible to evaluate primary, secondary and organizational outcomes.

5.2.1 Primary Outcomes

With regard to effectiveness criteria of primary outcomes, and guided by the descriptive findings, the current research projects sought to evaluate the impact of two resource-building intervention programs, delivered independently in two separate experimental conditions, and simultaneously in an additional experimental group of WFFs. Based off the established relationships between constructs within the JD-R Theory, the following was hypothesized:

H1: Levels of psychosocial risk associated with job demands will be maintained across a wildland fire season for WFFs participating in either or both intervention programs as compared to those who did not.

Across participating WFFs, assessments of psychosocial risk associated with all three measures of job demands increased over the course of the wildland fire season. This is evidenced by the negative scores across all experimental groups representing a decline in scores from T1 to T2, however there were differences in the scores between them. As a result, H1 is accepted, as there was a significant interaction effect between both intervention programs as compared to the control group on the combination of all three measures of job demands. A further examination revealed that the simple main effect for participants in the psychosocial education intervention was also significant, and subsequent multilevel modelling revealed that the significant difference held when considering each of the three measures of job demands independently. Therefore, the

change in the three job demands scores (civility and respect, psychological job demands and work-life balance) was significantly less for those participating in the psychosocial education intervention program as compared to those who did not.

H2: Evaluations of job resources will be maintained across a wildland fire season for those participating in either or both intervention programs as compared to those who did not.

As with the differences across the wildland fire season for the measures of job demands, WFF assessments of job resources also declined from T1 to T2, reflective of an increase in psychosocial risk. However, as there were statistically significant differences between experimental conditions, H2 is accepted. Specifically, the change in scores across nine of 10 job resource scores was significantly less for participants receiving the psychosocial education intervention as compared to those who did not. The effect was significant for both fitness training and psychosocial education intervention programs on one job resource score: organizational culture, with the greatest discrepancy across scores between those receiving both intervention programs as compared to those in the control group.

Taking the outcomes of H1 and H2 together and considering the intervention effectiveness across both job demands and resources, participants receiving the psychosocial education intervention revealed statistically significant differences on 12 of 13 psychosocial risk factor scores across the wildland fire season. The psychosocial education intervention program contained two components: an educational workshop at the outset of the fire season and the weekly provision of a fact sheet throughout the

season on each of 13 psychosocial risk factors classified either as a job demand or resource. As a result, the evidence for the effectiveness of the psychosocial education intervention is strong for the mitigation of the psychosocial risk factors across the wildland fire season. The findings are in line with another resource-building intervention conducted with firefighters targeting psychological health through education sessions, where particular increases in job resources including social support were observed (Ângelo & Chambel, 2013).

One strength of the psychosocial education intervention was the direct link between the content of the educational material provided, the demands and resources experienced by the participating WFFs across a wildland fire season and the measurement tool for assessing psychosocial risk, Guarding Minds at Work. Guided by the suite of Guarding Minds at Work resources, the current research project was able to leverage the structure and information of the program to the context of wildland fire through a collaborative process between the research team, management and staff within the partnering organization. Through this process an emphasis was placed on the format in which the material was delivered and received. Tailoring of the material with examples and visuals from the field enhanced the relevance and facilitated the applicability of the topics into the working life of the participating WFFs. Moreover, having considered the high-demand occupation group, the provision of the material in small portions staggered across the wildland fire season allowed for workers to pick up material at the own availability (e.g., via email, or posted around their work location). This consideration has also been substantiated in other intervention research conducted in high-demand hospital contexts (Estabrook et al., 2012).

A second consideration for the effectiveness of the psychosocial education intervention is the unique blend of group and individual delivery methods. The initial workshop was delivered in a group setting, which previous research has established as having a positive effect on improving desirable work outcomes (Donaldson, Lee, & Donaldson, 2019; Knight, Patterson, & Dawson, 2017). An explanation of the mechanism at play with regard to the group setting delivery, relates particularly to the fostering positive interactions between colleagues and the development of a social support (Knight, Patterson, & Dawson, 2017). Subsequently, the delivery of the psychosocial education intervention material was delivered individually via email, a modality which has also proven particularly successful at decreasing undesirable work outcomes (Donaldson et al., 2019). As such, it is posited that delivering the material by group setting initially and reinforcing individually throughout the intervention period was one of the keys to the psychosocial education intervention program demonstrating effectiveness measures of job demands and resources. Indeed, many other resource building intervention programs scaffold opportunity for individual application and coaching following an initial group delivery or workshop (Ângelo & Chambel, 2013; Biggs et al., 2014; Wingerden et al., 2016).

H3: WFFs level of personal resources, including a) physical fitness and b) psychological capital, will be maintained across a wildland fire season for those receiving either or both intervention programs as compared to those who did not.

With regard to H3a, and considering all six measures of physical fitness simultaneously, there was a statistically significant effect for participation in the psychosocial education intervention group as compared to those who did not. Subsequent multilevel modeling

revealed a significant effect for only one measure of physical fitness: maximum power produced. Participants receiving both psychosocial education and fitness training interventions demonstrated the greatest decline in maximum power, whereas those in the control group increased their power across the wildland fire season.

In evaluating H3b, psychological capital across the wildland fire season, scores remained relatively constant, with slight declines overall on levels of Optimism, Hope and Efficacy and a slight increase on the Hope scale. A significant interaction effect between experimental conditions on all four measures of PsyCap indicated that participation in any intervention program had an effect on the change in scores across the wildland fire season. Subsequent multilevel modeling revealed a significant effect for participation in the fitness training intervention on the Hope scale, while participation in the psychosocial education intervention approached significance. The greatest difference within the four experimental groups on the Hope scale lie between the group receiving both intervention programs, which increased their score from T1 to T2, and the control group, which saw the greatest decline. These findings are in line with other resource-building intervention programs, which were able to demonstrate increases in PsyCap over a four-week intervention period through the utilization of exercises to support personal resource development (Wingerden et al., 2016).

Taken together, the results with respect to personal resources are not consistent with regard to Hypothesis 3. With regard to H3a, participation in the intervention programs had a negative impact on maximum power produced and would indicate a rejection, whereas with regard to H3b, participation in fitness training program had a positive impact on psychological capital's Hope scale which would indicate an acceptance. A

closer examination of the contextual influences of the current study offers a few plausible explanations for the lack of desired, measurable effects of the fitness training intervention and will be discussed in the subsequent section incorporating additional criteria of the RE-AIM Framework.

5.2.2 Secondary Outcomes

With regard to effectiveness criteria of evaluating the intervention on measures of secondary outcomes, the following was hypothesized:

H4: WFFs participating in any intervention program will demonstrate: a) significant increases in work engagement and b) lower job stress over the course of the fire season as compared to those WFFs in a control group not receiving any intervention programming.

Hypothesis 4a is rejected, as multilevel modeling did not reveal a statistically significant effect on work engagement across experimental groups. With regard to Hypothesis 4b, there was no statistically significant effect for the overall score, however, there were two differences that emerged when considering the subscales. First, participants in the fitness training intervention reported significantly higher levels of stress associated with the job itself (Job Pressure Index). While statistically significant, the scores for the Job Pressure Index for those participating in the fitness training intervention program still fall well within the moderate range of normative data and do not present an excessive risk. Secondly, participants receiving the psychosocial education intervention reported lower scores on the stress emerging from the organizational support frequency subscale as compared to those who did not. It is worth noting that the scores across all scales of

the JSS were in line with previously measured cross-sectional studies with WFFs in the same jurisdiction (Gordon & Lariviere, 2014; Mcgillis et al., 2017).

The small difference in scores may also be a reflection in the increased demand across the fire season for participants receiving the fitness interventions, especially as compared to the control group as they responded to a greater number of fires and worked more hours. However, it should be noted that elsewhere, in a resource-building intervention study that focused on the development of resource strategies also found mixed results, with no effect on work engagement across a nine-month period (Knight, Patterson, Dawson, et al., 2017). The full implications of the contextual influences remain to be discussed in a subsequent session on the adoption and implementation of intervention procedures.

5.2.3 Organizational Outcome

An overarching objective of the intervention programs was the reduction of injury incidence amongst WFFs. With regard to effectiveness criteria relative to this objective, the following was hypothesized:

H5: WFFs participating in the delivery of any intervention program will have a lower incidence rate of reported injuries over the course of the fire season as compared to those who did not participate, and as compared to the preceding five-year average within the organization.

The limited number of injuries reported across the fire season precluded a more direct comparison between experimental conditions. However, H5 is accepted, as WFFs

participating in any intervention program experienced a lower reported incidence of injury across the wildland fire season (9.9%) as compared to the yearly average over the five years previous to the study period (16.0%). More specifically, the reported injury incidence rates of WFFs receiving both intervention programs (1.5%) demonstrated the greatest difference from the five-year average.

While the examination of effectiveness across primary, secondary and broader organizational outcomes provides an evaluation of the overall impact of two intervention programs, it does little to provide insight into the contextual and procedural influences. Due to the unpredictable nature of a wildland fire season, consideration must be given to the contextual factors associated which may have influenced intervention delivery and effectiveness. Moreover, there remains an opportunity to consider the influence of personal and contextual characteristics (e.g., who was reached and adopted the intervention programs) and aspects of implementation process. The current project is unique in its extension of previous literature on WFFs to assess the change in characteristics across wildland fire season as opposed to cross-sectional research with a single measurement point in time, often at the mid- or post-season time points (Gordon & Lariviere, 2014; Sell & Livingston, 2012). In documenting the contextual demands of a particular fire season and monitoring hours of work over the season, the current project adds to our understanding of the dynamic changes that occur to subjective evaluations of job demands and resources, personal resources, work engagement and job stress across a wildland fire season.

5.2.4 Summary of Effectiveness

In summary, participation in the psychosocial education intervention program demonstrated a statistically significant difference in the change in scores on 12 of 13 psychosocial risk factors across a wildland fire season as compared to those who did not. Furthermore, there was limited evidence for the effectiveness of the fitness training intervention program as compared to those who did not receive it on aspects of job demands or resources, personal resources or work engagement. However, consideration of effectiveness outcomes alone does not provide adequate context and understanding of the impact of the interventions (Nielsen & Miraglia, 2017). As a result, a detailed examination of additional aspects of program reach, adoption, implementation and maintenance is required to further contextualize effectiveness findings and consolidate learning for both intervention research and the organization at large.

5.3 Reach and Adoption: Understanding Setting- and Individual-Level Influences

Imperative to the successful design and implementation of any applied organizational intervention is the consideration and understanding of the context in which it was received (Karanika-Murray & Biron, 2015b; Nielsen & Miraglia, 2017). As such, the secondary aim of the current research was to supplement the evaluation of intervention effectiveness with a more detailed examination of the setting- and individual-level influences across the delivery period. Leveraging aspects of the RE-AIM Framework's Reach and Adoption criteria, comparisons of contextual factors influencing both participation (who participated vs those who did not) in and adoption (who adopted) across the intervention programs are made possible. The provision of additional contextual information is key to identifying barriers and facilitators for the translation of research into subsequent practice (Antikainen & Ellis, 2011; Dubuy et al., 2013;

Glasgow, Klesges, Dzewaltowski, Bull, & Estabrooks, 2004). Individual and setting-level characteristics at both baseline and across a wildland fire season also illuminate and are imperative for understanding the effectiveness results (Hone et al., 2015).

5.3.1 Reach: Participation Rate

First, it should be noted that the current study is rare in providing evidence articulating participation at both the setting- and individual-levels. The participation rate at an absolute setting-level was high, with 57.1% of locations volunteering participation in the current intervention study. In practical terms and in a truer sense, the participation rate at the setting-level represented 100% capacity for the current researcher under the confines of a doctoral dissertation project.

At the individual-level, the participation rate was very high, with 87.3% offering to participate at T1. Elsewhere in JD-R intervention literature, reporting of the participation rate is also rare, and low when reported, ranging from 32.3% in an intervention with police officers (Biggs et al., 2014), 36.9% in nursing (Knight, Patterson, Dawson, et al., 2017), to 77.4% in the financial services sector (Van Steenbergen et al., 2018). In a review of positive psychology interventions, Hone et al. (2015) found that while less than half of their included studies reported participation rates, those that did were alarmingly low (overall average: 43%). Moreover, only two studies provided any reporting on the non-participants (Hone et al., 2015). The participation rates, where reported in other positive psychology and resource-building interventions utilizing the RE-AIM Framework, have also been markedly low, from 11% in the ICT sector (Fredrickson, Cohn, Coffey, Pek, & Finkel, 2008), to 14% within the insurance industry (Feicht et al., 2013), and 19% in the resource sector (Millear,

Liossis, Shochet, Biggs, & Donald, 2008). Similarly, an additional review of behavioural interventions found that the overall participation rate was 45% (Harden et al., 2015). Generally, recruitment and participation rates have been influenced by organization size, with larger recruitment pools inversely related to participation rate (Ryde, Gilson, Burton, & Brown, 2013; Welch et al., 2020). As such, the current study benefited from recruiting from each work location individually, allowing for members of the research team and organization to interact more directly with potential participants (Welch et al., 2020).

5.3.2 Contextual Influences: Setting-Level Characteristics

5.3.2.1 Fire Activity and Workload

In an effort to fully integrate the findings of the current study and consider their influence on both implementation, retention and outcomes, the contextual job demands specific to the wildland fire season under study must be fully considered. At the organization-level, the current study was completed across a relatively low-demand fire season compared to the 10-year average, as evidenced by both fire activity (636 vs. 957 fires) and number of hectares burned (83,009.5ha vs. 110,969ha). Consideration of the fire activity alone is not fully representative of the dynamic nature of the demands that each fire presents. Contextually, human-caused fires typically present more of a challenge to WFFs as they are more frequently located closer to the urban interface and involve greater risk to both people and property. The greater proportion of fires across the current fire season caused by humans (73.3%) but small proportion of hectares burned (7.3%) provides some evidence of the complex nature of the relationship. There was considerable variability across fire activity and hectares burned across the eight locations assigned to one of four experimental conditions in the current study. For

example, the locations in the control group responded to a total of 33 fires (42.1ha burned), whereas the locations in the fitness training intervention condition responded to 190 fires (761.2ha). While responding to just over half the number of fires, the locations receiving both intervention programs recorded over 2.5 times the number of hectares burned as compared to the locations receiving the fitness training intervention program only.

The subsequent impact of increased fire activity over the course of the season was evidenced by a significantly higher number of hours worked across the season for those in the intervention conditions as compared to the control group. Participants in any of the intervention experimental groups worked an average of 80-110 hours more over the same period of time. This represents roughly a cumulative addition of 2-3 typical workweeks over a four-month time period for those in any experimental condition as compared to the control group. While not linked directly, this increase in workload could have played an influence in the adoption and retention rates across experimental conditions, as the retention rate was lowest within the experimental group receiving both intervention programs (79%). Elsewhere, excessive work demands and a lack of time have been frequently cited as reasons for a lack of engagement with intervention material (Welch et al., 2020).

Taken together, the influence of fire activity and subsequent number of hours worked across the fire season, offer two insights into the lack of significant findings for the fitness training intervention program. First, participants receiving the fitness training intervention worked significantly more hours over the course of the fire season and responded to a greater number of fires as a whole. As a result, this limited the ability of

the participants to engage in the training program, as being deployed on an active fire precluded participation. Indeed, other intervention programs designed to support job resources also resulted in inadvertent significant increases in chronic job demands (Ângelo & Chambel, 2013).

Second, as members of the control group still had access to the core components of the existing 'Commit to be Fit' program, and given their low fire activity and hours worked, had additional opportunity to train physically across the wildland fire season. As a result, they successfully maintained or improved their level of fitness across all measures over the course of the season. However, the influence of fire activity and number of hours worked offers only a partial explanation for the lack of significant findings; further insight can be found when considering the fitness characteristics of the participants who reached and subsequently adopted the intervention programs.

5.3.3 Individual-Level Characteristics

Much cross-sectional research has been conducted globally to describe some of the unique challenges associated with wildland firefighting, including arduous physical and psychological demands, long working hours with poor opportunities for adequate sleep, unpredictable environmental factors (e.g., heat, weather, etc.) (Aisbett et al., 2012; Carballo-Leyenda et al., 2019; Cuddy et al., 2015; Gordon & Lariviere, 2014; Mcgillis et al., 2017; Robertson et al., 2017). Whereas the sole fitness requirement for securing employment as a wildland firefighter in Canada is successful completion of the WFX-FIT test evaluating aerobic capacity, previous literature has yet to comprehensively identify the baseline characteristics of WFFs as they enter a fire season. As such, the current study is the first to comprehensively document the baseline and changes over

the course of a wildland fire season of personal resources, including physical fitness and psychological capital, psychosocial factors classified as either job resources or job demands, work engagement and job stress. Informed by previous cross-sectional research and with input from the partnering organization, it was anticipated that at the outset of a fire season, evaluations of both job demands and resources via psychosocial risk factors, task-specific personal resources including physical fitness and psychological capital, and work engagement will be high as compared to the general population (Gordon & Lariviere, 2014; Robertson et al., 2017).

5.3.3.1 Workforce Characteristics

The demographic characteristics of the participating wildland firefighters was largely representative of wildland firefighting in Ontario. Roughly one in five participants were female which is reflective of the largely male-dominated field. Anecdotal evidence from personal conversations with wildland fire staff and management is that annual turnover for wildland firefighters from one season to the next is roughly 25%, so the current study's representation of 26.1% being new to wildland firefighting, or 'rookies', was as expected.

Given each crew of four is comprised of two crew members, one crew boss and one crew leader, the observed distribution across each type (members: 66.5%; bosses: 17.8%; leaders: 15.7) was satisfactory. As the level of training, responsibility and number of duties across a wildland fire season increases across each of these roles within the crew, it is not surprising that fewer than the representative proportion of more senior crew member roles opted to participate in the current study. As the proportion across WFF role within the crew choosing to participate was relatively close the same

across experimental groups, it is not likely that this had an influence on intervention effectiveness. However, it is worth noting that with regard to adoption, proportion of WFFs participating dropped as their level of seniority within the crew increased. This was not surprising as high levels of work demands has been found to negatively impact participation rates across other workplace intervention research (Welch et al., 2020).

5.3.3.2 Personal Resources: Physical Fitness

As a base level of aerobic fitness is established across all participants with the passing of the WFX-FIT test, four complementary measures of physical fitness were assessed: grip strength, flexibility, core strength and anaerobic capacity. Careful consideration of the values for each of these measures and in light of existing wildland fire research obtained by those whom the current study reached (at T1) and adopted the intervention programs (at T2) facilitates interpretation of intervention programs effectiveness outcomes.

Grip Strength

Assessing grip strength is a quick and reliable measure of overall muscular strength and predictive of several health outcomes over time and performance on firefighting related tasks such as hose pulls (Bohannon, 2008; Nazari, Macdermid, Sinden, & Overend, 2018; Wong, 2016). Normative data for the general population across the lifespan in Canada and allows for direct comparison. For Canadian males aged 20-24, the 50th percentile value for maximum grip strength (either hand) is 42.9kg, while for females in the same age group the value is 26.6kg (Wong, 2016). Given the nature of the extreme physical demands associated with wildland firefighting it was anticipated that participants would exhibit high levels of grip strength as compared to the general

population. Results from the current study determined that the mean right hand measurement was 60.05kg (*SD*=8.500) and the mean left hand measurement was 56.46kg (*SD*=7.951) among male participants, and 38.50kg (*SD*=4.974) and 35.77kg (*SD*=4.718) for both the right and left hand measurements respectively for female participants. Each of these values exceeds the 95th percentile for Canadians across every age group (Wong, 2016), confirming that the participating WFFs level of grip strength is high as compared to the general population.

Within the context of wildland fire research, Sell (2011) completed a comprehensive in-season assessment of an elite group of WFFs in the United States. Within an all-male group of 20 participants from a single Interagency Hotshot Crew (IHC), the average grip strength was 63.48 for the right hand and 58.71kg for the left hand (Sell, 2011; Sell & Livingston, 2012). While the current study documented measurements slightly below the measurements taken in the United States by Sell and Livingstone (2012), a few differences should be noted. First, the IHC Crews in the United States are elite level firefighters, responding on the national level to high-priority fires. Second, the smaller sample size limits transferability though the distribution of scores is comparable to the current study. Finally, the current study serves as a more representative sample of the broader wildland fire community as 21.5% of participating WFFs were female, offering a first glimpse into their level of grip strength at the outset of a wildland fire season.

Flexibility

Utilizing the sit and reach test as a measure of flexibility, the current study was able to assess the level of tightness of the lower back and hamstring muscles. Results from pre-season testing revealed that the results of 29.0cm (*SD*=8.28) and 36.2cm (*SD*=7.32) for

males and females respectively. Normative data based on the Canadian population aged 20-39 years found mean values of 25cm for males and 31cm for females, indicating an above average ranking for the current participants (Shields et al., 2010). Comparison to other sources of normative data utilizing the sit and reach test for flexibility requires careful examination of protocol and equipment used. For example, in a more recent compilation of Canadian normative data (Hoffmann et al., 2019), a toe touch was equal to a score of 26cm, whereas the protocol employed in the current study the same reference point was equal to a score of 23cm. As such, 50th percentile values of 24.6cm for males and 31.1 for females aged 20 to 24 represents a 1.4cm distance from being able to touch the toes for men, and an ability for females to extend beyond their toes by an average of 5.1cm. Applying the correction factor places the average score for both males and female participants in the current study around the 80th percentile (Hoffmann et al., 2019). The aforementioned in-season evaluation of IHCs in the United States had a toe touch reference point of 31cm, meaning the reported average of 47.9cm represents an ability to extend beyond the toes by 16.9cm and a difference of nearly 11cm over the male participants in the current study (Sell & Livingston, 2012). In summary, WFFs reached within the current study possess flexibility that is considered high compared to the general population.

Core Strength

In an effort to evaluate WFF core strength and endurance efficiently, the Core Muscle Strength and Stability test was used (Mackenzie, 2002; Quinn, 2019). With a maximum time of three minutes possible, male participants completed an average of 2 minutes, 40 seconds, while female participants completed 2 minutes, 31 seconds, representing 88.7% and 84.0% of max completion respectively. For context, in a pre-training

program evaluation of healthy male and female participants (average age 22.8 years) found an average of 1 minute, 58 seconds for females and 2 minutes, 10 seconds for males (Boguszewski et al., 2018). Using a modified protocol that allowed for the test to continue beyond the three-minute maximum time, (Yeung, 2011) reported an average of 2 minutes, 30 second for male undergraduate students. These direct comparisons of a similar demographic groups allow indicate that WFFs commenced their wildland fire season with elevated core strength and endurance as compared to the general population.

Anaerobic Capacity

Anaerobic capacity was assessed using the Running-based Anaerobic Sprint Test (RAST), yielding several measures previously undocumented amongst WFFs of individual power and capacity of the anaerobic energy system to generate and sustain activity (Draper & Whyte, 1997). As normative values for the general Canadian population are not available, comparisons with similar high-demand occupation groups or similarly aged athletes are offered. The average peak power produced by males was 682.3W and a relative peak power output of 8.3W per kg, while for females the values were 392.8W and 5.7W per kg. In a sample of collegiate-level soccer players in Ontario, Canada, males produced a slightly higher peak power of 758W, and a higher relative peak power output of 10.3W per kg (Keir, Thériault, & Serresse, 2013). Contextually, these athletes were tested in their off-season training period, at a time when they were focused on improving their overall fitness and training intensely a minimum of three times per week (Keir et al., 2013). These values are comparable to a similar study of military personnel, where an all-male participant group recorded peak power measurements of 751.0W and a relative peak power output of 10.4W per kg (Zagatto et

al., 2009). In a study of healthy adolescents, the relative peak power values for males and females was 6.5W per kg and 5.4W per kg (Bongers et al., 2015). Given the pre-season results for participants in the current study, and in comparison, to other elite-level athletes and specialized high-demand occupation groups, it can be concluded that WFFs reached possess high anaerobic capacity as compared to the general population.

In summary, the limited opportunity for participation in the fitness training activity, the increased opportunity for the control group to train and the high levels of fitness amongst all participants at the outset of the fire season, created an incredibly challenging conditions for the fitness training intervention program to show a statistically significant increases given the period of time allotted for follow-up between measurement points (Bickel et al., 2011; Fahey, Insel, Roth, & Wong, 2019).

5.3.3.3 Personal Resources: Psychological Capital

Scores on individual psychological capital for participants reached by the current study were consistently elevated across all four subscales, with the highest score on the Hope scale and lowest on Optimism. Scores were comparable to or higher than several other occupational groups and normative data sets evaluating PsyCap (Avey, Luthans, & Jensen, 2009; Avey, Reichard, Luthans, & Mhatre, 2011; Lorenz, Beer, Pütz, & Heinitz, 2016; Luthans, Avolio, et al., 2007). Scores within the current range in other research on psychological capital have demonstrated high levels of correlation with positive safety climate (Bergheim, Nielsen, Mearns, & Eid, 2015). Elsewhere, in a study of nearly 2000 army personnel, soldiers with higher levels of PsyCap prior to deployment, and similar to the levels observed in the current study, were buffered from the negative consequences of mental health problems and substance abuse post-deployment

(Krasikova, Lester, & Harms, 2015). The level of PsyCap at the outset of the fire season is then viewed as potentially buffering the impact of long deployments to fires in remote areas of the province or country.

5.3.3.4 Influence of Job Demands and Resources

Anecdotal evidence and conversations with the partnering organization suggested that at the outset of a wildland fire season the general disposition and morale across fire management headquarters is positive and brimming with anticipation about the potential of the fire season ahead. This renewed optimism is in part a product from the addition of new crew members (roughly 25% new WFFs annually), the assemblance of new crews and the prospect of earning significant income across the coming season. Assessments at T1 substantiate the anecdotal evidence, as scores across all participating WFFs on subjective ratings of the psychosocial risk associated with their job demands were positive as compared to the general population. As such, an objective on the part of the organization was to maintain levels of psychosocial risk associated with job demands and resources across a wildland fire season. The Guarding Minds at Work survey provides normative reference data across four categories of results allowing for a direct comparison. Whereas greater than half of all scores across all three measures of job demands fell into the 'relative strength' category in the current study, roughly a third of respondents in the normative data fall into that same category (Gilbert, M., Bilsker, Samra, & Shain, 2018; Samra et al., 2012a).

With regard to WFFs ratings of psychosocial risk associated with job resources, ten measures were taken to assess individual's appraisal at the outset of the fire season: psychological support, organizational culture, clear leadership and expectations, growth

and development, recognition and reward, involvement and influence, workload management, engagement, psychological protection and physical safety. The distribution of all scores were positively skewed, indicating an overwhelming majority of participants evaluating their levels of job resources as a relative strength, and thereby associating a low level of psychosocial risk emanating from this source. Indeed, the proportion of participants whose scores fell within the 'relative strength' category as compared to the normative data was high, ranging from 56.1% of respondents on the psychological support scale (vs. 29% of normative sample) to 90.1% on the engagement scale (vs. 48% of normative sample) (Gilbert, M. et al., 2018; Samra et al., 2012a).

Given both the anecdotal evidence provided through input from the partnering organization and the evidence of positive evaluations of psychosocial risk factors for both job demands and resources at the outset of the intervention period, the objective of the intervention programs was to maintain levels of psychosocial risk associated with job demands and resources across a wildland fire season. Indeed, the positive skew observed on assessments of psychosocial risk factors at T1 would have nearly precluded any statistically significant increases across the study period or as a result of an intervention program. Indeed, the observed effectiveness of the psychosocial intervention program was driven by the maintenance of scores across the wildland fire season and a marked decline across those participants who did not.

5.3.3.5 Secondary Outcome: Work Engagement

In comparison to normative data, scores for work engagement as measured by the UWES-17 were 'high' for the vigour and dedication scales, and at the upper edge of the 'average' range for the absorption scale and total score (Schaufeli & Bakker, 2003). In

the context of wildland fire, work engagement had been measured and was a significant correlate with three dimensions of leadership, however, mean scores were not presented within the study precluding direct comparison (Waldron et al., 2015). The scores of the current study are high as compared to other measures of work engagement amongst undergraduate students, who had an overall mean of 3.4 (*SD*=1.25) compared to 4.6 (*SD*=.66) (Carmona-Halty, Schaufeli, & Salanova, 2019). Relative to other firefighting and first responder population groups, the scores observed within the current population are within the broad range that is typically reported (Ângelo & Chambel, 2015; Sinval, Marques-Pinto, Queirós, & Marôco, 2018; Tuckey, Bakker, & Dollard, 2012).

5.3.4 Summary of Reach and Adoption

In summary, the current intervention demonstrated success with regard to aspects of reach and adoption of the intervention programs across setting and individual levels. A close consideration of those adopting the fitness training intervention program revealed high levels of fitness across all measures, indicating a ceiling effect with regard to training and offering insight into the lack in additional training benefits observed when evaluating intervention effectiveness. Moreover, the high scores on psychosocial risk factors associated with job demands and resources were also high at T1 across participants from all intervention groups, precluding further improvement, but shedding light on the decline that was observed among those not receiving the psychosocial education intervention.

5.4 Process Considerations: Implementation

Whereas reach and adoption aid in understanding contextual influences on effectiveness from a setting-level (fire activity) and for whom the intervention had an effect at the

individual-level (hours worked, T1 characteristics), consideration of implementation criteria strengthens our capacity to link elements of the interventions themselves with outcomes (Karanika-Murray & Biron, 2015b; Nielsen & Abildgaard, 2013; Nielsen & Miraglia, 2017). Moreover, opportunity for insight is made possible through an understanding of which aspects of the intervention were well received (fidelity and adherence) and which were in need of refinement (adaptations) (Glasgow et al., 2019; Harden et al., 2015; Harden et al., 2018). For simplicity, we will consider aspects of implementation for each intervention program individually.

5.4.1 Fitness Training Intervention

Fidelity and Adherence

The RE-AIM's implementation criteria of fidelity sheds light on the strengths and weaknesses of certain aspects of the intervention through a close examination of participant interaction with the components of the program (Glasgow et al., 2019). Generally, several previously recommended processes for intervention research were incorporated into the current study including using a group approach (Egan et al., 2007; Knight et al., 2017), targeting resources specific to the demands of the occupation (Gilbert, E. et al., 2018), leveraging and supporting resources that promote active engagement and uptake of existing wellness programs where possible (Nielsen et al., 2017), and maintaining contact with participants throughout the intervention through advances in technology (Heuvel et al., 2015).

For a more complete perspective of the impact of the fitness training intervention, several specific issues pertaining to process must be considered (Karanika-Murray & Biron, 2015b; Nielsen & Miraglia, 2017). Attendance at the initial workshop was 100%,

as all participating WFFs adopting the intervention program were present at T1 for the orientation and overview presentation of program materials.

Participants receiving the fitness training intervention recorded over 1100 workout training sessions, offering unique insight into the previously undocumented in-season training activity of WFFs. That being said, it is believed that the figure far underestimates the potential total number of workouts that were actually completed as only 11.0% of participated reported logging their activity ‘every time’ as compared to 26.3% of participants who stated they ‘rarely or never’ recorded their activity.

With regard to the effectiveness of the training schedule provided, insight can be gained by looking at the types of workouts completed. One of the primary objectives of the training schedule element of the fitness training intervention was to help diversify workout activity across the fire season to touch on various components of fitness. The distribution across cardiorespiratory endurance training (26.3%), muscular strength training (22.7%) and plyometrics (15.2%) denoted a positive and encouraging result, in particular to the partnering organization. With the majority (59.7%) of the workout activities logged lasting between 30-50 minutes, it confirmed that one-hour of time was sufficient and optimal for participation. The overwhelming majority (75.1%) reported ‘feeling great’ during their workout activity time.

A third element of the fitness training intervention program attempted to leverage participant attitudes towards the content area was the provision of a tailored feedback document (see Appendix 5) to each participating WFF about their pre-season fitness testing results. With 93.0% of participants finding the information in the document

useful and 80.3% discussing their results with their peers, both the organization and the researcher feel that the provision of the feedback document positively contributed to the culture of fitness that the 'Commit to be Fit' program is attempting to establish (Young, 2016). Further, the feedback surrounding the quality of the document was positive across elements of graphic design through to content.

Adaptations

There were several adaptations with regard to components of the fitness training intervention that were made over the course of the intervention period. First, there arose multiple technical and logistical issues relating to the technology associated with the logging application and tablet which was designed to foster accountability and ownership over participating in fitness training activities and via the logging of their workouts. While designed provide a constant source of power to the tablet, the tablet charging cord was accessible and frequently became a borrowed source of power for individuals to charge their own personal mobile devices while in the training room participating in a workout. Forgetting to plug the tablet back in at the conclusion would result in the tablet's battery dying and often not discovered until the following day, thereby missing the opportunity for individuals to log their workouts. One location in particular was hampered by an individual(s) who repeatedly attempted to hack the device which often left it locked out by its own security system. Finally, with only one tablet and several crews participating in a workout at the same time, there would often be a line to log the workouts resulting in participants opting to not log their activity for the sake of time. Though the provision of a paper logging option was provided at these locations, both of the aforementioned challenges caused interruptions that disrupted the routine and flow of recording training activity. In general, it is advised that future

intervention components featuring technological components consider their alternatives ahead of time should the use of the technology become compromised.

Additional Feedback

Overall, the feedback with regard to the fitness training intervention program was limited, with 45.8% of intervention participants providing a response. Qualitative content analyses revealed that the feedback that was received provided support for the program as 54.5% of responses were coded as positive. Participants affirmed several components of the intervention, including the provision of feedback with regard to their fitness levels and the visual appeal and graphic design. Challenges with the program were also identified and suggestions were given for overcoming them. These included difficulties monitoring their participation through logging activities and the unpredictable nature of the job, resulting in an inability to consistently incorporate a regular training regimen into their routine. The coding of the feedback received through this RE-AIM criteria has been instrumental in framing subsequent participatory sessions with WFFs across the organization to continue to refine the program over the fire seasons that followed the one under study.

5.4.2 Psychosocial Education Intervention

Adherence and Fidelity

As with the fitness training intervention, a closer examination of aspects of intervention process is essential. To begin, consideration of participant interaction with the components of the program sheds light on the strengths and weaknesses of certain aspects of the program and offer opportunities for revision and future implementation. All participating WFFs attended the initial workshop which provided an overview of

psychosocial risk factors in the context of wildland fire and foreshadowed the content of the material which was reinforced over the intervention period through weekly delivery of posters.

With regard to delivery method of material throughout the fire season, the majority of participants affirmed that sending material by email in addition to posting around their work location was an effective way to communicate the information with them. As WFFs are frequently away from their base for extended periods of time at unpredictable intervals, simply placing the material at the base and alternating each week would have been ineffective as many would have not had the opportunity to interact with the material. Indeed, in-season measures of fidelity indicated that active participation with the weekly emailed fact sheet throughout the fire season via replies was higher than anticipated with 55% of participants responding to the emailed fact sheets. Asked at the conclusion of the fire season whether they received the material by email, the response was 93% affirmative, meaning roughly 38% of participants stated that they had indeed received the emails but did not reply to confirm engaging with them in-season. At the completion of the intervention period 71.0% reported reading the fact sheets throughout the season either via email or in print around their work location.

Adaptations

The primary adaptation required over the course of psychosocial education intervention program delivery was in response to an oversight in understanding the context in which the intervention material would be received. Originally, the program called for a new poster with information pertaining to the psychosocial risk factor highlighted that week to be placed around the work location on a Wednesday, also known as a common day,

where all participating WFFs were scheduled to be working. However, as the fire season progressed and some WFFs were sent on longer deployments of up to 14 days off-location, it became clear that they would have missed the opportunity to view the poster around their work location. This became a concern, as WFFs on deployment away from base frequently have limited or no access to email and would therefore have not been receiving the intervention material via that medium either. As a result, it was decided that the posted material would remain for a period of at least three weeks.

Additional Feedback

With regard to the content of the material, there was near unanimous agreement (98.9%) from the participating WFFs on the relevance of the material to issues faced by them over the course of a fire season. Constructive feedback from participants encouraged future iterations of the material to be more inclusive of the dynamic relationship between that occurs between WFFs and members of staff and management across their work location. Moreover, this likely contributed in part to their willingness to talk about the material, with only 33.0% of participants discussing content with their colleagues over the fire season. In terms of transference of education material into behaviour change, it was found that the primary determinant among construction workers was whether or not they shared or discussed the material with other coworkers (Leduc, M., House, Eger, Thompson, & Holness, 2016). Together, this affirms the importance of creating opportunities for participants to integrate components of intervention programs into their regular workflow, including interactions with colleagues (Gordon et al., 2018).

Limited additional feedback from the open-ended question at the conclusion of the program served as the basis for a qualitative content analyses of responses, as only 22.6% of psychosocial education intervention participants provided a response. Notwithstanding, nearly two-thirds of the received responses were coded as positive, affirming relevance of the material content, manner of presentation and appreciated aspects of visual and graphic design as being inclusive and reflective of their workplace. The remaining comments received from participants pertaining to the challenges associated with the implementation of the psychosocial education intervention program served as the starting point for subsequent participatory sessions with wildland fire staff to refine the material for future fire seasons.

5.4.3 Additional Considerations of Simultaneous Delivery of Both Interventions

As the majority of the significant findings of intervention program effectiveness emerged from participation in either intervention program as compared to those who did not, additional consideration to aspects of implementation for the experimental condition which received both intervention programs. Whereas there were no unique adaptations made across the wildland fire season, and in the absence of any additional feedback that pertained to participating in both intervention programs simultaneously, consideration was given to the implementation criteria of fidelity and criteria for insight.

Fidelity and Adherence

Three plausible explanations are presented for the lack of cumulative impact of combining both intervention programs for achieving desired impacts. First, a difference emerged between experimental conditions on measures of fidelity throughout the fire season as participants in a single intervention group reported more engagement with

intervention material irrespective of intervention type as compared to the group receiving both simultaneously. For example, participants in the fitness training intervention group logged an average of seven more workouts over the course of the season as compared to those in the dual intervention experimental group. Further, nearly 25% more participants in the fitness training intervention group recorded at least one training session over the dual intervention group over the fire season. Similarly, participants in the psychosocial education intervention group reported engaging with an average of two more (out of 13) fact sheets and a 21.9% increase in response rate over the dual intervention group.

Second, intervention fidelity may have been influenced by the previously discussed setting- and individual-level characteristics of the participating locations and individuals across experimental conditions. The two locations comprising the experimental condition delivering both intervention programs faced different demands responding to fires that consumed 2.69 to 75 times more land area resulting in an increase in work hours by 30-40 hours over the single intervention groups.

Finally, it is worth noting that although not directly assessed, participation in both intervention programs simultaneously may have inadvertently created additional demands on the participating WFFs. The additional demand of participating in two programs may not been adequately resourced either through internal processes built-in to the interventions themselves or externally through managerial supports and workload restructuring. Evidence of this may also be found when looking at retention rate across experimental groups, as the experimental group receiving both intervention programs had the lowest retention rate across T1 and T2 measurement points (79.1% as compared

to 95.8%, 90.9%, and 94.4% for the control, psychosocial education only and fitness training only conditions respectively). In summary, participants in experimental groups receiving a single intervention program demonstrated greater participation in and engagement with program material over those receiving both interventions.

5.5 Maintenance of Intervention Programs

Though aspects of maintenance is rarely reported (Hone et al., 2015), it is important to note that although the confines of a doctoral dissertation precluded long-term, detailed follow-ups across multiple wildland fire seasons, that elements from both the fitness training and psychosocial education intervention programs have continued to embed themselves with partnering organization's policies and practices. Evidence from the reach, adoption, implementation and effectiveness evaluations have informed modifications to the program. For example, the Commit to be Fit program's mandate has been strengthened, with additional commitment and resources for structure for the program being added with regard to equipment and recommended training schedule and activities, including those in the control group and the additional locations not participating in the current study. Organizational policy has been developed internally to ensure sustainability and accountability of the program over the fire seasons to come. With regard to the psychosocial education program, the organization has continued to partner through additional collaborative research agreements to re-engage staff as it pertained to psychosocial education intervention material over the fire season that immediately followed, and the material was expanded to reach all staff within the organization, not only wildland firefighters. The education material has been expanded from the fact sheets presented in the current study to a number of other medium, including video clips, posters, and discussion cards.

CHAPTER 6. Conclusion

6.1 Summary of Contributions

Informed by the JD-R Theory, the current study is the first to document aspects of job demands and resources, personal resources including physical fitness and psychological capital, work engagement and job stress in a highly dynamic and safety-critical occupation group: wildland firefighters. The RE-AIM Framework provided the structure to guide the evaluation of both effectiveness and process considerations of two resource-building intervention programs delivered independently and simultaneously across experimental groups following a cluster-randomised controlled trial study design. Across a relatively low-demand fire season, notable declines were observed to psychosocial factors classified as either job demands or resources, components of psychological capital and work engagement, while measures of physical fitness remained constant or demonstrated marginal improvements in a control group of WFFs. Participation in a psychosocial education intervention program successfully mitigated the measured decline over the course of a fire season on 12 of 13 psychosocial factors classified as either job demands or resources, while improving on individual's level of hope. A fitness training intervention program showed limited potential above and beyond the existing fitness program housed within the partnering organization, with evidence pointing towards the usefulness of providing WFFs with feedback on objective evaluations of their fitness status and guiding them through a structured training program to ensure diversified and complete training program participation. Moreover, consideration and clearly articulated intervention development, delivery and evaluation processes offered insight into the challenges and opportunities for future intervention research. Participation in any intervention program resulted in fewer observed injuries as compared to the average incidence rate over the five-year period

preceding the current study. This first application of the JD-R Theory and RE-AIM Framework within wildland firefighting to document characteristics of the front-line responders, measure change over time and attempt to mitigate impact through applied participatory action intervention research serves as a positive foundation and example for subsequent research across high-demand occupation groups.

6.2 Strengths, Limitations and Future Research

6.2.1 Study Strengths

First, utilizing a cluster-randomized control trial methodology, the current study possessed the methodological rigour to evaluate the effectiveness of two intervention programs on primary, secondary and organizational outcomes. Employing the RE-AIM Framework allowed for the expansion of effectiveness findings to contextualize aspects of intervention participation, delivery and engagement, as often requested (Knight et al., 2019; Knight, Patterson, Dawson, et al., 2017; Nielsen & Abildgaard, 2013; Nielsen & Miraglia, 2017). Indeed, the current study documented participant uptake of the intervention material, through monitoring of engagement with the psychosocial education material and recording of fitness training activity as participants sought to reinforce their personal resources (Gordon et al., 2018).

Second, the study benefited from its participatory approach. As input was sought from members across all levels of the organization the research received meaningful organizational support from both senior and local levels of management and was advocated for within the wildland firefighters' population themselves. A testament to this is highlighted by the nearly 90% participation and adoption rate of participants across measurements points in the wildland fire season, nearly double the response and

retention rates of intervention research conducted with high demand or emergency response occupation groups (Biggs et al., 2014; Tuckey, Chrisopoulos, et al., 2012). The positive response rate, influenced by the participatory efforts ahead of the intervention period to allow for input from WFFs, staff and management also facilitated hitting the desired target sample size, an aspect of intervention rarely reported. (Nielsen & Randall, 2012; Wingerden, Bakker, et al., 2017a). Further, support mechanisms for participants across the intervention period were engaged, leveraging advances in technology, by providing intervention material (content and feedback) via email as recommended by Heuvel et al. (2015).

The participatory approach was also instrumental in the embedding of one of the two intervention programs alongside existing organizational programs, resources and structures, while establishing new procedures and processes for the second. As such and as the evidence mounted, the long-term sustainability and viability of the intervention programs were laid, and programs continue to be implemented and expanded on in subsequent wildland fire seasons. Of note, the programs including the fitness training intervention and the psychosocial education material have since been expanded and operate as established programs within the organization and are supported within their current operational structure, free of dependence on external researcher support for implementation and evaluation. Moreover, and within the context of wildland firefighting in Canada, several neighbouring jurisdictions have expressed interested in uniting alongside and are designing programs based on the efforts of the current project. Second, this research is the first to comprehensively measure psychosocial factors and the additional objective assessment of physical fitness in the high-demand occupation of wildland firefighting.

Finally, the current intervention research provides evidence for the thoughtful selection of both contextually relevant follow-up measurement tools and periods of time to evaluate desired effectiveness outcomes. The psychosocial education intervention was able to demonstrate effectiveness on primary outcome measures of psychosocial risk associated with both job demands and resources within a wildland fire season. Additionally, participation in any intervention program demonstrated a positive influence on dimensions of psychological capital and a lower reported incidence of injury across a wildland fire season.

6.2.2 Study Limitations and Opportunities for Future Research

Several limitations require acknowledgement. First, while objective measures were utilized where feasible and practical (e.g., objective job demands, anthropometric data) the current methodological approach relied heavily on self-report measures for evaluations of psychosocial factors, work engagement, psychological capital, and job stress, which can result in common method biases (Podsakoff et al., 2012). Measures of physical fitness also depended on participants exerting themselves to their greatest potential with several factors uncontrolled for which may have impacted performance, including time since previous training activity, rest and sleep, and nutrition and hydration. Future studies could look to record or control for these extraneous variables and look to corroborate self-report surveys through peer or objective observer ratings. Further, the limited collection of qualitative feedback in the current evaluation is acknowledged, a result in part of bounding the dissertation to a single fire season and the confines of a blended learning dissertation project and format. Subsequent research evaluating interventions delivered in the workplace would benefit from building in

capacity to conduct qualitative assessments of intervention implementation and effectiveness.

Second, the cluster-randomized control trial design and subsequent analyses are not without their shortcomings. Random assignment of participants to experimental condition by their work-location as opposed to individually was done in an effort to avoid contamination effects. While successful in recruiting eight locations from two geographic regions of the province to match one location from each region to each experimental condition, the possibility remains open that the differences in city or town characteristics may have also influenced any differences or predispositions among participants at the outset of the study. Indeed the potential for disparate groups at T1 or across the length of the study is acknowledged (Lipsey & Cordray, 2000), however, given the potential for extraneous factors to influence groups in the unpredictable occupational context of wildland firefighting and conducting applied organizational intervention research the choice is justified (Adkins & Weiss, 2003). Finally, across the utilisation of multiple MANOVA tests assessing the impact of the interventions on both primary and secondary outcomes, no adjustments were made for type I or type II errors. It is therefore acknowledged as a limitation, though there remains justification for the decision as the application of the MANOVA tests in the current context was driven by the testing of preplanned hypotheses (Armstrong, 2014).

Third, while participants were employed at one of eight different fire management headquarters spanning geographic distances ranging from 100-1500KM, all participants were wildland firefighters working under the auspices of one wildland fire and emergency response provincial ministry. To this end, the context and nature of wildland

firefighting is unpredictable and varies significantly across regions and over time. As such, it is difficult to conclude with absolute certainty that the intervention programs would yield the same benefits in a subsequent fire season or across a different geographic location. This restricts the generalizability of the study findings and future studies should attempt to replicate our approach among employees in other occupational groups. However, there are aspects of the intervention programs and their components that would be more readily transferred to other workplace populations and organizational contexts. For example, the mechanism of delivering psychosocial education material by email for working populations that are not always centrally located (e.g., construction or forestry workers) merits further exploration. Moreover, the approach to the fitness training intervention may be readily transferable to other physically demanding jobs that house fitness facilities with the opportunity for designated fitness time (e.g., first responders, structural firefighters) and should be investigated. There appears to be merit to the integration of fitness training and promotion at the employee level to meet the demands of their job in other workplace settings, irrespective of space and equipment restraints.

Fourth, the current study was limited by the time constraints of a wildland fire season, which runs annually from April to October in Ontario, Canada with the majority of wildland firefighters employed from May through September annually. All participants completed T1 testing within the first month of the wildland fire season and T2 testing within their last month of the wildland fire season. As the intervention period lasted a minimum of 13 weeks, this only allowed for a period of one to three weeks following the intervention delivery for the evaluation of intervention effectiveness to take place. As such, it is indeterminable whether the effects observed would be enduring or short-

lived and whether participants returning the following fire season will continue to benefit from their participation in the intervention programs. Future studies could take this into account in an effort to determine the viability of the program at influencing retention, and whether a cumulative benefit exists for improving fitness and psychosocial climate across fire seasons or whether the programs are investment that need to be made annually to positively impact outcomes during each individual fire season.

Finally, the current study utilized a broad framework (RE-AIM Framework) to evaluate the effect of the two separate intervention programs. Moreover, it is acknowledged that a certain depth of quantitative data analyses is not possible within the current blended learning dissertation format, while still addressing other aspects of intervention development, reach, adoption, implementation and maintenance. Further, the current approach also limited the ability to definitively conclude which aspects of each intervention were linked more strongly with the observed outcomes. For instance, the fitness training intervention had five components: workshop, tailored feedback, individual training program and support, wearable activity monitor and a training log, whereas the psychosocial education intervention had an initial workshop and was supported by weekly engagement by email and posting of material around each work location. Future research could employ a mixed methodology approach in order to further explore which components were most influential on employee behaviours and attitudes through semi-structured interviews, open-ended questionnaires or focus group discussions. To this end, it is also acknowledged that the two resources the current study sought to build (e.g., physical fitness and psychosocial education) were selected primarily out of practical importance and agreed upon through input from the partnering

organization and their staff. Future studies may strive to include other job resources and demands that can influence or may impacted by participation in resource-building intervention programs.

6.3 Advancing Research, Practice and Theory

6.3.1 Advancing Intervention Research

Several contributions to advancing intervention research bear mentioning. First, the project lends credence to the importance of adopting a participatory approach throughout the entirety of the research process (Daniels, Gedikli, Watson, Semkina, & Vaughn, 2017; Giga et al., 2003; Nielsen, 2013; Nielsen & Randall, 2012). This approach is critical for the long-term sustainability of the intervention programs as it successfully aligned with existing programs and did not create processes that were not sustainable in the absence of subsequent researcher involvement or facilitation. Second, a thorough understanding and level of embeddedness within the culture and context of the workplace is key to both designing intervention program material, but also in creating and selecting evaluation measures and processes that are meaningful to both the organization and academic communities (Karanika-Murray & Biron, 2015b; Nielsen & Miraglia, 2017; Vignoli, Nielsen, Guglielmi, Tabanelli, & Violante, 2017). Third, there are challenges associated with taking a quantitative approach and experimental design to 'real-world' contexts, and in particular high-demand and unpredictable occupation groups that are largely metric-driven (Nielsen & Miraglia, 2017). The present study affirms the importance of a mixed-methods approach, allowing for the incorporation of qualitative methods to understand both how and why certain outcomes were observed (Glasgow et al., 2019; Nielsen & Miraglia, 2017).

6.3.2 Applicability for Practice

The current research provided a solid foundation of evidence for the continuation and renewed commitment to the mandate of the organization's 'Commit to be Fit' program (Young, 2016). The ability of participants across all experimental groups to maintain their level of task-specific fitness was viewed as a testament to the investment made into the program in the years leading up to the current study. The results from the current study have strengthened the organizational commitment for the 'Commit to be Fit' program, exemplified through adequate and on-going resources, including staff to coordinate delivery and provision of equipment and facilities across all locations. Elsewhere, organizations requiring a high level of physical fitness of their employees are encouraged to consider being active partners with their employees in the development of a task-specific training program that is adequately resourced within the constructs of a typical workday and space.

The psychosocial education intervention represented the organization's first approach to addressing psychosocial risk factors in their workplace and demonstrative of the strides that can be made by beginning a dialogue around psychological health and safety in the workplace. Several aspects of the program that have been adopted beyond the confines of the current research are transferrable to other organizations, including ongoing monitoring through formal and informal mechanisms, fully considering and contextualizing delivery of material, and gaining user-involvement from all levels of staff into the design process to name a few. Moreover, the partnering organization has refined the program material and has successfully and adequately resourced expanded implementation across all locations and staff.

6.3.3 Contributing to Theory

The current research offered a first and robust application of the RE-AIM Framework in the context of wildland firefighting. In applying 19 of 31 (61.2%) of RE-AIM criteria with representativeness across all dimensions, the current study sits comfortably within the range of previous intervention studies adopting the RE-AIM Framework (45-78%) (Kessler et al., 2012). Indeed, the present application of the RE-AIM Framework provides further evidence for its feasibility and structure to guide the evaluation of intervention effectiveness and aspects of process and implementation in a workplace setting (Harden et al., 2018).

Further, the current study provides evidence for the flexibility of the JD-R Theory to adapt and be applied in novel and dynamic workplace settings and support the development of intervention programs. Indeed, this project represents the first application of the JD-R Theory as the basis for intervention program development in wildland firefighting. Several aspects of the JD-R Theory contributed in this regard. For example, the current project took an expanded view of personal resources to include both physical and psychological capacities as they related to the context of wildland firefighting. The JD-R Theory's ability to comprehensively classify work characteristics, psychosocial factors and desired outcomes into its individual components and corresponding processes facilitates dialogue between researcher and members of partnering organizations in a way that is easily understood. Moreover, the current research also highlights that it is possible to target interventions at specific constructs within the JD-R Theory (e.g., personal resources), and achieve desired outcomes while operating within highly dynamic and heavily context-driven workplaces. Future research would be well positioned to explore the mechanisms of

action in this regard, supplementing the current work by including additional measures of job crafting or self-undermining and allowing for a more complete testing of the JD-R Theory as a whole.

6.4 Final Reflection and Positionality

The current research builds upon nearly a decade of collaborative research between the organization and the research centre where the researcher is located. Having been involved in the collaboration since 2011, the researcher gained an extensive familiarity with the operational personnel and processes of a complex wildland fire organization. Participation in cross-sectional research projects in supportive capacities provided an intimate knowledge and experience of the requirements and context of wildland firefighting. This familiarity expedited the participatory action processes employed for the development, implementation and evaluation of the two intervention programs utilized in the current study. Moreover, the productive relationship between the researcher and members of the partnering organization was the product of reciprocal trust forged over time and through consistent and respectful delivery of mutually agreed outcomes and products. Indeed, the strength and success of the current intervention study is tied to the productive and cohesive relationship between the researcher and participants, other members of the organization and the Health and Wellness Specialist who coordinated all research activity. Notwithstanding the extensive input from all stakeholders, the current dissertation research remains the intellectual property of the researcher, solely responsible for project conceptualization and all aspects of study design, intervention material development, implementation and evaluation, data collection, entry, analysis, dissemination and knowledge exchange.

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APPENDICES

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Appendix 1: Summary of JD-R Theory components and current evidence

JD-R Theory: Defining Demands and Resources

The initial proposition of the JD-R model is that all working conditions and characteristics can be placed into one of two broad headings, job demands and job resources, which are related to organizational outcomes including employee well-being and performance through two unique processes (Bakker & Demerouti, 2007; Demerouti, Bakker, Nachreiner, & Schaufeli, 2001; Lesener, Gusy, & Wolter, 2019).

Job Demands

Job demands have been described as "physical, social or organizational aspects of the job that require sustained physical or mental effort and are therefore associated with certain physiological and psychological costs" (Demerouti et al., 2001, p. 501). Common examples of job demands include time and work pressure, workload, complex tasks and conflicts within the workplace (Demerouti et al., 2001).

Job Resources

Generally, job resources is the umbrella term used to describe constructs which serve three primary purposes: "(a) are functional in achieving goals, (b) protect from threats and the associated physical and psychological costs, and (c) stimulate personal growth and development" (Xanthopoulou, Bakker, Demerouti, & Schaufeli, 2009a, p. 236). Universally within JD-R Theory, job resources refer to the aspects of a job, whether physical, psychological, social or organizational, that are functional and supportive of employee efforts toward achieving work-related goals, reducing the physical or psychological costs of job demands or facilitating personal growth and development (Bakker, 2011; Bakker & Demerouti, 2007; Demerouti et al., 2001). Examples of job

resources include autonomy, organizational and supervisor support, performance feedback and opportunity for learning and growth.

Dual Processes of JD-R Theory

Consistent from the initial JD-R model is the assertion of two separate and causal processes that are initiated by job demands and resources (Demerouti et al., 2001). Job demands initiate a health impairment process and are uniquely predictive of exhaustion; whereas job resources initiate a motivational process predictive of work engagement, both of which are discussed in greater detail below (Bakker, Demerouti, & Sanz-Vergel, 2014; Crawford, Lepine, & Rich, 2010; Demerouti et al., 2001).

Burnout: Health Impairment Process

Within the initial JD-R model, the central pathogenic indicator is burnout, also referred by its energetic expression, exhaustion (Demerouti et al., 2001). Exhaustion has been defined as the consequence of extended exposure to job demands, such as intense physical, affective, or emotional strain (Demerouti, Bakker, Vardakou, & Kantas, 2003).

The health impairment process of the JD-R model posits that higher levels of job demands are associated with increased risk of burnout, exhaustion or strain and result in a number of negative outcomes (Crawford et al., 2010; Demerouti et al., 2001). Examples of negative outcomes resulting from high job demands through strain include prolonged absence duration, physical and psychological health complaints not limited to depression, and heightened turnover intentions (Bakker, Demerouti, De Boer, & Shaufeli, 2003; Hakanen, Schaufeli, & Ahola, 2008).

Work Engagement: Motivational Process

As a positive health indicator, work engagement was introduced, emphasizing a positive, fulfilling and work-related state of mind (Schaufeli, 2002). Work engagement has three core characteristics: vigour (employees feel full of energy), dedication (employees are enthusiastic about the content of their work), and absorption (employees are immersed in their work activities and time seems to fly) (Schaufeli, 2002). The motivational process of the JD-R is initiated by sufficient levels of job resources positively impacting work engagement and resulting in positive outcomes at both the individual level through improved well-being and organizational outcomes via improved job performance (Bakker et al., 2003; Nielsen et al., 2017).

While job demands and resources each initiate separate processes, evidence of a cross-over, or mitigating effect exists (Bakker & Demerouti, 2017). Job resources have been shown to mitigate the impact of job demands on strain (Bakker & Demerouti, 2017; Bakker, Van Veldhoven, & Xanthopoulou, 2010; Tadić, Bakker, & Oerlemans, 2015). For instance, resources such as autonomy, social support and performance feedback were found to mitigate the strength of the relationship between job demands, such as physical demands, workload, and emotional demands, and burnout across a number of settings (Bakker et al., 2010; Xanthopoulou et al., 2007). Moreover, the ability for job resources to mitigate the negative impact of demands on burnout and facilitate work engagement appear to be enhanced when demands are high (Bakker, Hakanen, Demerouti, & Xanthopoulou, 2007; Hakanen, Bakker, & Demerouti, 2005). Finally, the influence of job demands on work engagement have been shown to be highly dependent on an individual's appraisal or understanding of the demand. Building on the work of Cavanaugh, Boswell, Roehling, and Boudreau (2000) which categorized demands by

their appraisal as either a challenge or hindrance to well-being and performance, Crawford et al. (2010) established their unique relationship with burnout and engagement. Challenge demands appraised as stressful but with the "potential to promote mastery, personal growth, or future gains" (Crawford et al., 2010, p. 836) have been found to be positively associated with both burnout and work engagement. Examples include high workload and high levels of job responsibility. On the contrary, hindrance demands with the "potential to thwart personal growth, learning and goal attainment" (Crawford et al., 2010, p. 836) were negatively associated with work engagement, while maintaining a positive relationship with burnout. Examples of hindrance demands include role conflict or ambiguity, organizational politics or overload.

Outcomes

A primary outcome measure within JD-R Theory research for both motivational and health impairment processes is job performance (Bakker & Demerouti, 2017). Within the health impairment process, job performance is consistently and negatively predicted by higher levels of burnout or exhaustion (Bakker, Van Emmerik, & Van Riet, 2008; Taris, 2006). On the contrary, work engagement within the motivational process has been consistently associated with increases in objective individual and organizational performance (Hopstaken, Linden, Bakker, & Kompier, 2015; Hopstaken, Van Der Linden, Bakker, Kompier, & Leung, 2016; Xanthopoulou, Bakker, Demerouti, & Schaufeli, 2009b).

Mediating Relationships within JD-R Theory

Personal Resources

Similar to job resources, an individual's personal resources serve as a catalyst in the motivational process through a direct and positive relationship with work engagement. Personal resources have been defined as the "beliefs people hold regarding how much control they have over their environment" (Bakker & Demerouti, 2017, p. 275). Elsewhere, a broader perspective of personal resources has differentiated between three distinct categories of personal resources: psychological, cognitive or physiological (Rich, Lepine, & Crawford, 2010). The most common psychological resource construct has emerged from positive psychology literature, namely psychological capital (PsyCap) (Avey, Reichard, Luthans, & Mhatre, 2011; Luthans, Avolio, Avey, & Norman, 2007; Luthans, Luthans, & Luthans, 2004). Psychological capital is a higher-order, state-like construct that has been characterized by the following four dimensions: self-efficacy, optimism, hope and resiliency (Luthans, Youssef, & Avolio, 2007). Self-efficacy is a reflection of an individual's confidence to successfully meet the demands of challenging tasks (Luthans, Youssef, et al., 2007). Optimism is an indication of the positive attributions that individuals make about their likelihood of succeeding both in the present and future contexts (Luthans, Youssef, et al., 2007). The ability of an individual to direct themselves towards a set goal in a manner likely to succeed is a reflection of hope (Luthans, Youssef, et al., 2007). Finally, resiliency is a measure of an individual's ability to sustain effort, persevere and succeed when confronted with challenges or adversity (Luthans, Youssef, et al., 2007).

Individuals with higher levels of psychological capital have been consistently linked with positive organizational outcomes, including commitment and performance,

decreased experience of workplace stress, and well-being (Avey, Luthans, & Jensen, 2009; Avey, Luthans, Smith, & Palmer, 2010; Avey et al., 2011; Avey, Wernsing, & Luthans, 2008; Peterson, Luthans, Avolio, Walumbwa, & Zhang, 2011; Walumbwa, Peterson, Avolio, & Hartnell, 2010). The conditions wherein personal resources are best leveraged to mitigate within the JD-R Theory's health impairment process and facilitate the motivational process remain inconclusive (Bakker & Sanz-Vergel, 2013; Xanthopoulou, Bakker, & Fischbach, 2013).

Job Crafting

As the JD-R Theory matured and evidence mounted for the reciprocal relationships that exist within both motivational and health impairment processes, researchers began to examine the ways in which employees became active agents in the construction of their work (Bakker & Demerouti, 2014; Bakker et al., 2014). Initially, job crafting referred to the proactive changes employees take with regards to their work tasks, context and relationships (Wrzesniewski & Dutton, 2001). In the context of JD-R Theory research, job crafting has been defined as the "changes that employees may make to balance their job demands and job resources with their personal abilities and needs" (Tims, Bakker, & Derks, 2012, p. 174). This positive, reciprocal relationship within the motivational process has also been referred to as a 'gain spiral', wherein employees with high levels of work engagement are more effective at leveraging resources to meet demands (Demerouti, 2014; Rudolph, Katz, Lavigne, & Zacher, 2017; Tims et al., 2012; Tims, Bakker, & Derks, 2013; Tims, Derks, & Bakker, 2016).

Self-Undermining

Within the health impairment process of the JD-R Theory, a reciprocal relationship exists between job demands, strain and negative outcomes, a process referred to as self-undermining, or a 'loss spiral' (Bakker & Demerouti, 2017). Over time, employees experiencing strain as a result of high job demands perceive their work environment as more challenging, leading to further increases in job demands and strain (Bakker & Costa, 2014).

Meta-Analytic and Systematic Review Evidence for JD-R Theory

Since the initial inception of the JD-R model an extensive amount of literature, narrative reviews and subsequently systematic reviews and meta-analyses have examined and established each of the aforementioned JD-R components and their corresponding relationships (Bakker & Demerouti, 2014, 2017; Schaufeli & Taris, 2014). However, much of this research has relied heavily on cross sectional and longitudinal research designs, often focusing on single constructs within the JD-R Theory and the influence of one or two other constructs depending on context (Alarcon, 2011; Christian, Garza, & Slaughter, 2011; Crawford et al., 2010; Halbesleben, 2010; Lesener et al., 2019; Maricuțoiu, Sulea, & Iancu, 2017; Mauno, Kinnunen, Mäkikangas, & Feldt, 2010; Nahrgang, Morgeson, & Hofmann, 2011; Nielsen et al., 2017). For instance, both Crawford et al. (2010) and Halbesleben (2010) in their meta-analyses firmly established the positive relationship between job resources, including autonomy, feedback, opportunities for development, support and job variety as examples, with work engagement. In a qualitative review that contrasted evidence from cross sectional and longitudinal studies, both autonomy and social support emerged as salient resources associated with work engagement over time (Mauno et al., 2010). In a more recent

review, Nielsen et al. (2017) identified 84 cross-sectional or longitudinal studies in their examination of the relationship between resources and employee well-being and performance. They concluded that a positive relationship exists across four levels of resources (individual, group, leader and organization) with improved well-being and performance, suggesting interventions may be effective targeting any level (Nielsen et al., 2017). Areas of promise for further research included supporting resources that promote job crafting, social support and cohesion between leaders and employees (Nielsen et al., 2017).

While the majority of aforementioned reviews and meta-analyses included results from cross-sectional study designs, they have fallen short of providing evidence for reverse and reciprocal causal relationships within the JD-R Theory. As a result, Lesener et al. (2019) aggregated and appraised for methodological quality, data from 74 longitudinal studies of the JD-R Theory. The meta-analytic evidence provided support for the core assumptions of the JD-R Theory, indicating its efficacy for serving as a theoretical basis to assess employee well-being (Lesener et al., 2019). Outstanding in their evaluation of the JD-R Theory evidence base is the inability to differentiate the divergent effects of challenge and hindrance demands on work engagement and the reciprocal relationship between well-being and job characteristics (e.g., potentially through job crafting) (Lesener et al., 2019). Quality appraisal of included studies consisted of five components: study design, number and interval of measurements, psychometric quality of the measures, nonresponse analysis, and method of analysis (Lesener et al., 2019). While 39% of studies were classified as high-quality studies, it is worth noting that nearly one in four studies were deemed to suffer from serious methodological shortcomings (Lesener et al., 2019).

Despite their unique contributions, each of the reviews are not without their shortcomings, the majority of which are common to the bulk of JD-R Theory research. As a result, an acknowledgement of the JD-R Theory's limitations and unresolved issues must be made. To begin, a reliance on self-report measures of job characteristics and well-being carries potential to be problematic (Podsakoff, Mackenzie, Lee, & Podsakoff, 2003). Moreover, a limitation of the previously mentioned meta-analyses that only one (Lesener et al., 2019) documented their evaluations of methodological quality of included studies, and as a result, can be prone to biased results. Finally, while each of the reviews provided support for the dual processes that exist within the JD-R Theory, there continues to be an inability to differentiate between job demands and resources despite repeated and substantiated calls for inclusion (e.g., challenge vs. hindrance demands as posited by Crawford et al. (2010) and renewed by Lesener et al. (2019)). In reality, it appears that as each study leverages a strength of the JD-R Theory to classify job characteristics as either a job demand or resource as a function of their application and individual research context, it also creates a limitation. Few authors have proposed lists of characteristics by JD-R Theory component, though agreement within the literature remains elusive (Schaufeli, 2017; Schaufeli & Taris, 2014). Further, as the JD-R Theory is a broad and open model, its effectiveness lies in the ability to discern what characteristics are associated with specific outcomes and psychological states but falls short in explaining the underlying mechanism as to why this relationship may exist (Schaufeli & Taris, 2014).

More generally, a level of ambiguity has emerged when attempting to distinguish between health impairment and motivational processes posited within the JD-R Theory

(Schaufeli & Taris, 2014). Given the moderating effect of resources on the health impairment process and the potential mitigating effect of demands on the motivational process, calls have emerged for both processes to be evaluated simultaneously (Bakker & Demerouti, 2017; Schaufeli & Taris, 2014). Moreover, this cross-over effect has brought into question the distinctiveness of the dual processes across all contexts (Schaufeli & Taris, 2014).

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Appendix 2: Quality Assessment Tool for Studies with Diverse Designs (QATSDD) from Sirriyeh et al. (2012) with two criteria excluded based on methodological design

Table 1 Quality assessment tool and scoring guidance notes

Criteria	0 = Not at all	1 = Very slightly	2 = Moderately	3 = Complete
Explicit theoretical framework	No mention at all.	Reference to broad theoretical basis.	Reference to a specific theoretical basis.	Explicit statement of theoretical framework and/or constructs applied to the research.
Statement of aims/objectives in main body of report	No mention at all.	General reference to aim/objective at some point in the report including abstract.	Reference to broad aims/objectives in main body of report.	Explicit statement of aims/objectives in main body of report.
Clear description of research setting	No mention at all.	General description of research area and background, e.g. 'in primary care'.	General description of research problem in the target population, e.g. 'among GPs in primary care'.	Specific description of the research problem and target population in the context of the study, e.g. nurses and doctors from GP practices in the east midlands.
Evidence of sample size considered in terms of analysis	No mention at all.	Basic explanation for choice of sample size. Evidence that size of the sample has been considered in study design.	Evidence of consideration of sample size in terms of saturation/information redundancy or to fit generic analytical requirements.	Explicit statement of data being gathered until information redundancy/saturation was reached or to fit exact calculations for analytical requirements.
Representative sample of target group of a reasonable size	No statement of target group.	Sample is limited but represents some of the target group or representative but very small.	Sample is somewhat diverse but not entirely representative, e.g. inclusive of all age groups, experience but only one workplace. Requires discussion of target population to determine what sample is required to be representative.	Sample includes individuals to represent a cross section of the target population, considering factors such as experience, age and workplace.
Description of procedure for data collection	No mention at all.	Very basic and brief outline of data collection procedure, e.g. 'using a questionnaire distributed to staff'.	States each stage of data collection procedure but with limited detail, or states some stages in details but omits others.	Detailed description of each stage of the data collection procedure, including when, where and how data were gathered.
Rationale for choice of data collection tool(s)	No mention at all.	Very limited explanation for choice of data collection tool(s).	Basic explanation of rationale for choice of data collection tool(s), e.g. based on use in a prior similar study.	Detailed explanation of rationale for choice of data collection tool(s), e.g. relevance to the study aims and assessments of tool quality either statistically, e.g. for reliability & validity, or relevant qualitative assessment.
Detailed recruitment data	No mention at all.	Minimal recruitment data, e.g. no. of questionnaire sent and no. returned.	Some recruitment information but not complete account of the recruitment process, e.g. recruitment figures but no information on strategy used.	Complete data regarding no. approached, no. recruited, attrition data where relevant, method of recruitment.
Statistical assessment of reliability and validity of measurement tool(s) (Quantitative only)	No mention at all.	Reliability and validity of measurement tool(s) discussed, but not statistically assessed.	Some attempt to assess reliability and validity of measurement tool(s) but insufficient, e.g. attempt to establish test–retest reliability is unsuccessful but no action is taken.	Suitable and thorough statistical assessment of reliability and validity of measurement tool(s) with reference to the quality of evidence as a result of the measures used.
Fit between stated research question and method of data collection (Quantitative)	No research question stated.	Method of data collection can only address some aspects of the research question.	Method of data collection can address the research question but there is a more suitable alternative that could have been used or used in addition.	Method of data collection selected is the most suitable approach to attempt answer the research question
Fit between stated research question and format and content of data collection tool, e.g. interview schedule (Qualitative)	No research question stated.	Structure and/or content only suitable to address the research question in some aspects or superficially.	Structure & content allows for data to be gathered broadly addressing the stated research question(s) but could benefit from greater detail.	Structure & content allows for detailed data to be gathered around all relevant issues required to address the stated research question(s).
Fit between research question and method of analysis	No mention at all.	Method of analysis can only address the research question basically or broadly.	Method of analysis can address the research question but there is a more suitable alternative that could have been used or used in addition to offer greater detail.	Method of analysis selected is the most suitable approach to attempt answer the research question in detail, e.g. for qualitative IPA preferable for experiences vs. content analysis to elicit frequency of occurrence of events, etc.
Good justification for analytical method selected	No mention at all.	Basic explanation for choice of analytical method	Fairly detailed explanation of choice of analytical method.	Detailed explanation for choice of analytical method based on nature of research question(s).
Assessment of reliability of analytical process (Qualitative only)	No mention at all.	More than one researcher involved in the analytical process but no further reliability assessment.	Limited attempt to assess reliability, e.g. reliance on one method.	Use of a range of methods to assess reliability, e.g. triangulation, multiple researchers, varying research backgrounds.
Evidence of user involvement in design	No mention at all.	Use of pilot study but no involvement in planning stages of study design.	Pilot study with feedback from users informing changes to the design.	Explicit consultation with steering group or statement or formal consultation with users in planning of study design.
Strengths and limitations critically discussed	No mention at all.	Very limited mention of strengths and limitations with omissions of many key issues.	Discussion of some of the key strengths and weaknesses of the study but not complete.	Discussion of strengths and limitations of all aspects of study including design, measures, procedure, sample & analysis.

Appendix 3: Outcome measures utilized across 11 included studies by component of JD-R Theory

Author (Date)	Personal Resources	Job Resources	Job Demands	Motivation	Exhaustion/Strain	Job Crafting	Performance	Additional Measures
Ângelo and Chambel (2013)	-	*Social Support*: Karasek's Job Content Instrument	Professional Demands Scale	9-item Utrecht Work Engagement Scale	Maslach Burnout Inventory	-	-	-
Biggs et al. (2014)	-	4-item measures of Work-Culture Support and Leadership (Gracia, 2007)	9-item Job Demands Measure (Wall, Jackson, and Mullarkey, 1995)	9-item Utrecht Work Engagement Scale	12-item General Health Questionnaire	-	-	4-items assessing strategic alignment; 15-item measure of Job Satisfaction (Warr, Cook and Wall, 1979); 3-item measure of Turnover Intention (Brough and Frame, 2004)
Gordon et al. (2018)	-	-	-	9-item Utrecht Work Engagement Scale	Oldenburg Burnout Inventory	Job Crafting Scale (Petrou et al., 2012)	4-item Subjective Measure (Metselaar, 1997); 6-item scale of subjective task	1-item from SF-36 Health Survey

							performance; 14-item task performance scale, measure of objective performance	
Heuvel et al. (2015)	4-items of Generalized Self-Efficacy Scale (Schwarzer and Jerusalem, 1995)	*Professional Development:* 3-items; *Leader-Member Exchange:* 5-item	-	-	-	Job Crafting Scale (Petrou et al., 2012)	-	Job Affective Well-Being Scale
Knight, Patterson, Dawson, et al. (2017)	-	*Social Support:* 4-item Scale *Influence in Decision-Making:* 4-item measure	4-item measure (Patterson et al., 2011)	9-item Utrecht Work Engagement Scale	-	-	-	Work-Related Basic Needs Scale
Sakuraya et al. (2016)	-	-	-	9-item Utrecht Work Engagement Scale	Brief Job Stress Questionnaire	12-item Job Crafting Scale (Sekiguchi et al., 2014)	-	-

Van Steenbergen et al. (2018)	Psychological Capital Questionnaire	*Autonomy:* 3-items, *Coworker Support:* 3-item measure; *Supervisor Support:* 3-items; *Professional Development:* 4-items	*Mental Demands:* 4-item measure (Veldhoven and Meijman, 1994); *Workload:* 3-item Karasek's Job Content Instrument; *Task Ambiguity:* 4-item measure	6-items from Utrecht Work Engagement Scale	-	-	-	-
Wingerden et al. (2016)	Psychological Capital Questionnaire	-	-	9-item Utrecht Work Engagement Scale	-	3 subscales of Job Crafting Scale (Tims et al., 2012)	In-Role Performance Scale	-
Wingerden, Bakker, et al. (2017a)	-	-	-	9-item Utrecht Work Engagement Scale	-	3 subscales of Job Crafting Scale (Tims et al., 2012)	-	Work-Related Basic Need Scale

Wingerden, Derks, et al. (2017)	Psychological Capital Questionnaire	-	-	9-item Utrecht Work Engagement Scale	-	3 subscales of Job Crafting Scale (Tims et al., 2012)	In-Role Performance Scale	Structured Interviews
Wingerden, Bakker, et al. (2017b)	*Resilience*: 5-item scale *Self-efficacy*: 4-item scale	*Performance Feedback:* 3-item scale *Professional Development:* 3-item scale	*Workload:* 3-item Karasek's Job Content Instrument *Emotional Demands:* 3-itemVan Veldhoven and Meijman (1994) scale	9-item Utrecht Work Engagement Scale	-	Job Crafting Scale (Tims et al., 2012)	In-Role Performance Scale	-

Appendix 4: Quality assessment scores by appraisal item

Author (Date)	**Item 1** Theor-etical Frame work	**Item 2** Aims	**Item 3** Resear-ch Setting	**Item 4** Sample Size	**Item 5** Target Sample	**Item 6** Data Collec-tion Proce-dure	**Item 7** Data Collec-tion Tools	**Item 8** Recrui-tment Data	**Item 9** Assess-ment of Tools	**Item 10** Fit: Quest-ion and Meth-od	**Item 11** Fit: Quest-ion and Analy-sis	**Item 12** Justifi-cation of Analy-sis	**Item 13** User Involv-ement	**Item 14** Streng-ths and Limita-tions	**Total /42**
Ângelo and Chambel (2013)	3	3	3	2	1	2	2	1	2	2	2	1	0	2	**26**
Biggs et al. (2014)	3	3	3	1	2	2	3	3	3	2	2	1	2	3	**33**
Gordon et al. (2018)	3	3	3	0	1	2	3	2	3	3	3	2	2	3	**33**
Heuvel et al. (2015)	3	3	2	1	1	3	2	3	2	2	3	3	3	2	**33**
Knight, Patterson, Dawson, et al. (2017)	2	3	3	0	1	3	3	3	1	3	2	3	3	3	**33**
Sakuraya et al. (2016)	1	3	2	3	1	2	2	3	0	1	3	3	0	3	**27**
Van Steenbergen et al. (2018)	3	3	3	1	2	2	2	2	3	3	2	3	2	2	**33**
Wingerden et al. (2016)	3	3	2	0	2	3	2	3	3	1	3	2	0	2	**29**
Wingerden, Bakker, et al. (2017a)	3	3	3	0	2	3	2	2	3	1	3	2	0	2	**29**

Wingerden, Derks, et al. (2017)	3	3	3	0	1	2	3	2	3	3	3	3	0	3	**32**
Wingerden, Bakker, et al. (2017b)	3	3	3	0	2	3	2	3	3	3	3	3	0	2	**33**
Mean	**2.7**	**3.0**	**2.7**	**0.7**	**1.5**	**2.5**	**2.4**	**2.5**	**2.4**	**2.2**	**2.6**	**2.4**	**1.1**	**2.5**	**31**

Appendix 5: Fitness Intervention Materials

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centre for research in occupational safety and health at Laurentian University | centre de recherche sur la santé et sécurité au travail à l'Université Laurentienne

PHYSICAL FITNESS & WILDLAND FIREFIGHTING

Sudbury FMH

Caleb Leduc, PhD Student
Michelle Young, Health & Wellness Specialist

Overview

3

- FireRangers = Occupational Athletes
- Commit To Be Fit
  - Maintain fitness
  - Injury reduction
  - Mental health and wellness
- Schedule
  - Prevents training the same way
  - Balance anaerobic and aerobic training
  - Decrease congestion in workout areas

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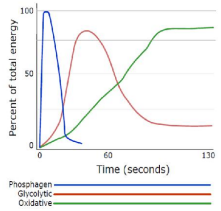
Aerobic and Anaerobic?

- Anaerobic – absence of oxygen
  - 10 secs to several minutes
  - High to medium powered activites
- Aerobic – oxygen present
  - Low powered activities – long duration

Examples: long distance run, interval training

starting a pump, laying hose, handtooling



	Increases power, speed , and strength	Improves cardiovas-cular health	Burns body fat	Burns Muscle	Builds Muscle	Aids in all sports	Develops aerobic capacity	Develops anaerobic capacity
Anaerobics	•	•	•		•	•	•	•
Aerobics		•	•	•			•	

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You are here: OP Spedia > AFFES > AFFES Health and Safety > Commit To Be Fit – FireRanger Fitness

Director's Blog

Visit the Director's Blog

Our Branch

AFFES Health and Safety

Our Branch, Our Future

AFFES Branch Management Team Key Initiatives

AFFES Policy and Policy Framework

Aviation Services

Business Management

Integrated Services

Response and Operations

Where Do I Find...

Information Management

Application Support

Publications

Provincial Bulletin Board

Training Repository

Briefing Material Templates

Commit To Be Fit - FireRanger Fitness

The term 'occupational athlete' was created from the realization that physically demanding occupations face similar physical challenges faced by athletes. For AFFES, the development of the new WFX-Fit test in 2012 shed light on the physical demands of Fire Rangers. The identification of Fire Rangers as 'occupational athletes' lead to the creation of the Fitness Task Team and the development of the Commit To Be Fit program in 2013. Fire Rangers need a combination of strength, flexibility and endurance to perform their job safely and effectively. The Commit To Be Fit Program was created to provide Fire Rangers the opportunity to maintain their fitness throughout the fire season, reduce injuries and improve overall mental health and wellness.

This site will be the source of all information relating to the Commit To Be Fit program. If you have any questions, please contact one of the task team members listed below:

2016 Implementation Guidelines
CTBF Newsletters
Exercise Fitness Library
Fitness Equipment Guidelines SOP
Fitness Leads

Hazard Assessments
NER Equipment Inventory
NER Exercise Schedule
NWR Equipment Inventory
NWR Exercise Schedule
Terms of Reference

Fitness Task Team Members

Sponsor – **Sandra Byers**, Provincial Safety and Training Coordinator, Sudbury
Lead – **Michelle Young**, Health and Wellness Specialist, Sault Ste. Marie
NWR Rep. – **John Mash**, Fire Operations Supervisor, Kenora
NWR Rep. – **Ian Monteith**, Fire Operations Technician, Thunder Bay
NER Rep. – **Al Winters**, Fire Operations Supervisor, Hearst
NER Rep. – **Trevor Marshall**, Fire Operations Technician, Haliburton

Updated: April 26, 2016

Workout Schedule NWR

	F	S	SU	M	T	W	TH	F	S	SU	M	T	W	TH	F	S	SU	M	T	W	TH	F	S	SU	M	T	W	TH	F	S
April	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Schedule 1	W	X	X	CB	C	CW	CBW	AR	X	X	B	WC	BWC	WC	C	X	X	X	W	CB	WCB	AR	C	BW	CBW	AR	X	X	B		
Schedule 2	C	X	X	BW	B	WC	BWC	AR	X	X	W	CB	WCB	X	X	C	BW	CBW	AR	B	WC	BWC	X	X	X	X	W	CB	WCB	AR	
Schedule 3	B	X	X	WC	W	CB	WCB	AR	X	X	X	C	BW	CBW	AR	B	WC	BWC	AR	X	X	W	CB	WCB	AR	C	BW	CBW	X		

	SU	M	T	W	TH	F	S	SU	M	T	W	TH	F	S	SU	M	T	W	TH	F	S	SU	M	T	W	TH	F	S	SU	M	T
May	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Schedule 1	X	B	WC	BWC	WC	C	X	X	CBW	AR	B	WC	BWC	X	X	X	X	W	CB	WCB	AR	C	H	BW	CBW	X	X	B	WC	BWC	AR
Schedule 2	X	W	CB	WCB	WB	B	X	X	CB	WCB	AR	X	X	C	BW	CBW	AR	B	WC	WC	X	X	H	X	X	CB	WCB	AR	C	BW	CBW
Schedule 3	X	C	BW	CBW	CB	W	X	X	X	X	C	BW	CBW	AR	B	WC	BWC	AR	X	X	W	CB	H	AR	C	BW	CBW	X	X	X	

	W	TH	F	S	SU	M	T	W	TH	F	S	SU	M	T	W	TH	F	S	SU	M	T	W	TH	F	S	SU	M	T	W	TH
June	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
Schedule 1	W	CB	WCB	X	X	X	X	C	BW	CBW	AR	B	WC	BWC	AR	X	X	W	CB	WCB	AR	C	BW	CBW	X	X	X	X	B	WC	
Schedule 2	AR	X	X	B	WC	BWC	AR	W	CB	WCB	X	X	X	X	C	BW	CBW	AR	B	WC	BWC	AR	W	CB	X	X	C	BW	CBW	AR	
Schedule 3	B	WC	BWC	AR	W	CB	WCB	AR	X	X	X	C	BW	CBW	AR	B	WC	BWC	X	X	X	X	W	CB	WCB	AR	C	BW	CBW	X	X

	F	S	SU	M	T	W	TH	F	S	SU	M	T	W	TH	F	S	SU	M	T	W	TH	F	S	SU	M	T	W	TH	F	S	SU
July	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Schedule 1	H		B	BW	CBW	AR	W	CB	X	X	X	C	BW	CBW	AR	B	WC	BWC	AR	X	X	W	CB	WCB	AR	C	BW	CBW	X	X	
Schedule 2	H	BWC	AR	W	CB	WCB	X	X	C	BW	CBW	AR	B	WC	BWC	X	X	X	X	W	CB	WCB	AR	C	BW	CBW	AR	X	X	B	WC
Schedule 3	H	X	X	X	X	B	WC	BWC	AR	W	CB	WCB	AR	X	X	C	BW	CBW	AR	B	WC	BWC	X	X	X	X	W	CB	WCB	AR	C

	M	T	W	T	F	S	SU	M	T	W	TH	F	S	SU	M	T	W	TH	F	S	SU	M	T	W
August	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Schedule 1	H	W	CB	WCB	AR	X	X	X	C	BW	CBW	AR	B	WC	BWC	AR	X	X	W	CB	WCB	AR	C	BW
Schedule 2	H	BW	CBW	X	X	B	WC	BWC	AR	W	CB	WCB	X	X	X	C	BW	CBW	AR	B	WC	BWC	X	X
Schedule 3	H	X	X	X	B	WC	BWC	AR	X	X	C	BW	CBW	AR	B	WC	BWC	X	X	X	W	CB	WCB	AR

	TH	F	S	SU	M	T	W	TH	F	S	SU	M	T	W	TH	F	S	SU	M	T	W	TH	F
September	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Schedule 1	WC	BWC	AR	W	H	CB	WCB	X	X	C	BW	CBW	AR	B	WC	BWC	X	X	X	X	W	CB	WCB
Schedule 2	BW	X	X	X	H	X	B	WC	BWC	AR	W	CB	WCB	AR	X	X	C	BW	CBW	AR	B	WC	BWC
Schedule 3	X	X	B	WC	H	WCB	AR	C	BW	X	X	X	C	BW	CBW	AR	B	WC	BWC	AR	X	X	W

B = bodyweight W = weights C = cardio AR = active rest day

Workout Schedule NER

	F	S	SU	M	T	W	TH	F	S	SU	M	T	W	TH	F	S	SU	M	T	W	TH	F	S	SU	M	T	W	TH	F	S	SU
April	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
Schedule 1	W	X	X	CB	C	CW	CBW	AR	X	X	B	WC	BWC	WC	C	X	X	X	W	CB	WCB	AR	C	BW	CBW	AR	X	X	B		
Schedule 2	C	X	X	BW	B	WC	BWC	AR	X	X	W	CB	WCB	X	X	C	BW	CBW	AR	B	WC	BWC	X	X	X	X	W	CB	WCB	AR	
Schedule 3	B	X	X	WC	W	CB	WCB	AR	X	X	X	C	BW	CBW	AR	B	WC	BWC	AR	X	X	W	CB	WCB	AR	C	BW	CBW	X		

	SU	M	T	W	TH	F	S	SU	M	T	W	TH	F	S	SU	M	T	W	TH	F	S	SU	M	T	W	TH	F	S	SU	M	T
May	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Schedule 1	WC	BWC	AR	W	CB	WCB	X	X	X	C	BW	CBW	AR	B	WC	BWC	AR	X	X	W	CB	H	AR	C	BW	CBW	X	X	X		
Schedule 2	C	BW	AR	CBW	X	X	B	WC	BWC	AR	W	CB	WCB	X	X	X	W	CB	WCB	AR	C	H	BW	CBW	X	X	B	WC	BWC	AR	
Schedule 3	X	X	X	B	WC	WCB	AR	CB	WCB	AR	C	X	X	C	BW	CBW	AR	B	WC	WC	X	X	H	X	X	CB	WCB	AR	C	BW	CBW

	W	TH	F	S	SU	M	T	W	TH	F	S	SU	M	T	W	TH	F	S	SU	M	T	W	TH	F	S	SU	M	T	W	TH
June	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
Schedule 1	B	WC	BWC	AR	W	CB	WCB	AR	X	X	C	BW	CBW	AR	B	WC	BWC	X	X	X	W	CB	WCB	AR	C	BW	CBW	X	X		
Schedule 2	W	CB	WCB	X	X	X	X	C	BW	CBW	AR	B	WC	BWC	AR	X	X	W	CB	WCB	AR	C	BW	CBW	X	X	X	X	B	WC	
Schedule 3	AR	X	X	B	WC	BWC	AR	W	CB	WCB	X	X	X	X	C	BW	CBW	AR	B	WC	BWC	AR	X	X	C	BW	CBW	AR			

	F	S	SU	M	T	W	TH	F	S	SU	M	T	W	TH	F	S	SU	M	T	W	TH	F	S	SU	M	T	W	TH	F	S	SU
July	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Schedule 1	H		B	BW	CBW	AR	W	CB	X	X	X	C	BW	CBW	AR	B	WC	BWC	AR	X	X	W	CB	WCB	AR	C	BW	CBW	X	X	
Schedule 2	H	BWC	AR	W	CB	WCB	X	X	C	BW	CBW	AR	B	WC	BWC	X	X	X	X	W	CB	WCB	AR	C	BW	CBW	AR	X	X	B	WC
Schedule 3	H	X	X	X	X	B	WC	BWC	AR	W	CB	WCB	AR	X	X	C	BW	CBW	AR	B	WC	BWC	X	X	X	X	W	CB	WCB	AR	C

	M	T	W	T	F	S	SU	M	T	W	TH	F	S	SU	M	T	W	TH	F	S	SU	M	T	W
August	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Schedule 1	H	W	CB	WCB	AR	X	X	X	C	BW	CBW	AR	B	WC	BWC	AR	X	X	W	CB	WCB	AR	C	BW
Schedule 2	H	BW	CBW	X	X	B	WC	BWC	AR	W	CB	WCB	X	X	X	C	BW	CBW	AR	B	WC	BWC	X	X
Schedule 3	H	X	X	X	B	WC	BWC	AR	X	X	C	BW	CBW	AR	B	WC	BWC	X	X	X	W	CB	WCB	AR

	TH	F	S	SU	M	T	W	TH	F	S	SU	M	T	W	TH	F	S	SU	M	T	W	TH	F
September	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Schedule 1	X	X	B	WC	H	WCB	AR	C	BW	X	X	X	C	BW	CBW	AR	B	WC	BWC	AR	X	X	W
Schedule 2	WC	BWC	AR	W	H	CB	WCB	X	X	C	BW	CBW	AR	B	WC	BWC	X	X	X	X	W	CB	WCB
Schedule 3	BW	X	X	X	H	X	B	WC	BWC	AR	W	CB	WCB	AR	X	X	C	BW	CBW	AR	B	WC	BWC

B = bodyweight W = weights C = cardio AR = active rest day

NER Sample Time Period

8

	SU	M	T	W	TH	F	S	SU	M	T	W	TH	F	S	SU	M	T	W	TH	F
May	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Schedule 1	WC	BWC	AR	W	CB	WCB	X	X	X	C	BW	CBW	AR	B	WC	BWC	AR	X	X	X
Schedule 2	C	BW	AR	CBW	X	X	B	WC	BWC	AR	W	CB	WCB	X	X	X	X	W	CB	WCB
Schedule 3	X	X	X	B	WC	WCB	AR	CB	WCB	AR	C	X	X	C	BW	CBW	AR	B	WC	WC

B = bodyweight **W** = weights **C** = cardio **AR** = active rest day

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NWR Sample Time Period

9

	SU	M	T	W	TH	F	S	SU	M	T	W	TH	F	S	SU
May	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Schedule 1	X	B	WC	BWC	WC	C	X	X	CBW	AR	B	WC	BWC	X	X
Schedule 2	X	W	CB	WCB	WB	B	X	X	CB	WCB	AR	X	X	C	BW
Schedule 3	X	C	BW	CBW	CB	W	X	X	X	X	C	BW	CBW	AR	B

B = bodyweight **W** = weights **C** = cardio **AR** = active rest day

Cardio	Bodyweight	Weight
Running	**Upper Body**	**Upper Body**
Pack walk	Pushups	Shoulder press
Sprints	Dips	Mace swings
Rowing	Pullups	Dumbbell row
Rowing sprints	**Lower Body**	**Lower Body**
Sled pulls	Air squat	Weighted squat
Battle ropes	Lunge	Weighted lunge
	Pistol (one leg squat)	Deadlift
	Core	**Core**
	Situps	Kettlebell swings
	Plank	Ball slams
	Spidermans	Woodchoppers

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Cardio

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- Running
- Pack Walk
- Interval Training
- Rowing
- Sled Pushes/Pulls
- Skipping
- Battle Ropes
- Mountain Climbers
- High knee Skips
- Hiking

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Body Weight

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Upper Body
- Pushups
- Dips
- Pullups
- Burpees
- Planks

Lower Body
- Squats
- Lunges
- Pistols
- Step ups
- Jump squats

Core
- Situps
- Planks
- Side Planks
- Supermans
- Inchworms

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Weights

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Upper Body
- Shoulder Press
- Mace Swings
- Dumbbell Row
- Sled Pull
- Bench Press
- TRX Bands

Lower Body
- Weighted Squats
- Weighted Lunges
- Medicine Ball
- Tire Flips
- Sled Drags

Core
- Kettlebell Swings
- Ball Slams
- Russian Twists

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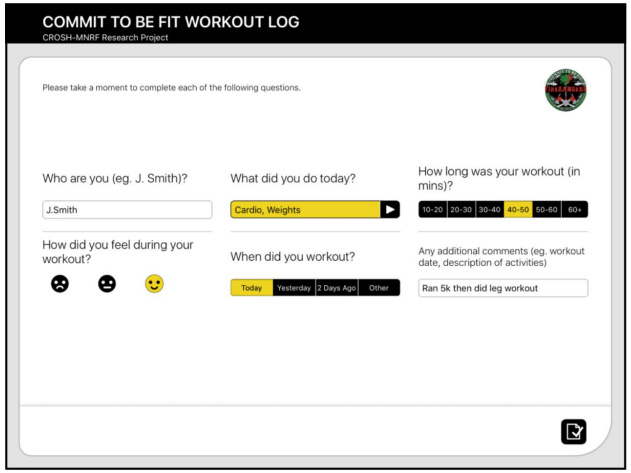
CROSH CRSST


COMMIT TO BE FIT
FIRERANGERS
ONTARIO
CROSH
CRSST
centre for research in occupational safety and health at Laurentian University
centre de recherche sur la santé et sécurité au travail à l'Université Laurentienne
Ontario


COMMIT TO BE FIT WORKOUT LOG
CROSH-MNRF Research Project
Please take a moment to complete each of the following questions.
Who are you (eg. J. Smith)?
J.Smith
What did you do today?
Cardio, Weights
How long was your workout (in mins)?
10-20
20-30
30-40
40-50
50-60
60+
How did you feel during your workout?
When did you workout?
Today
Yesterday
2 Days Ago
Other
Any additional comments (eg. workout date, description of activities)
Ran 5k then did leg workout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MISFIT
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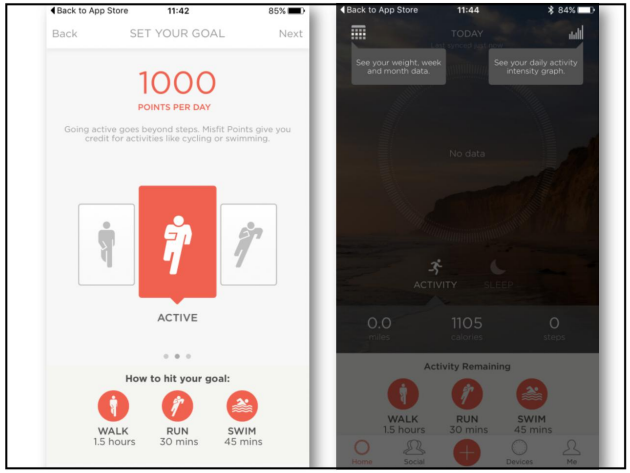
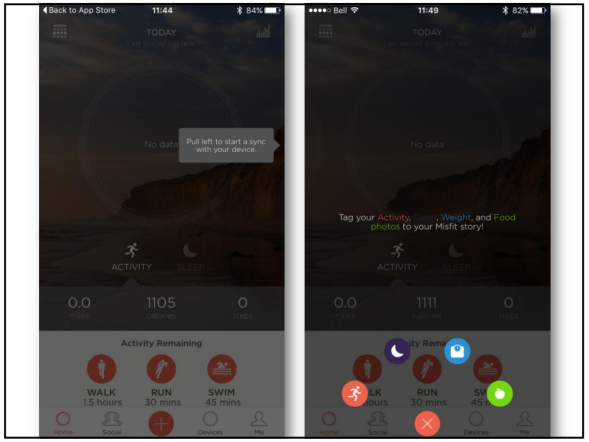
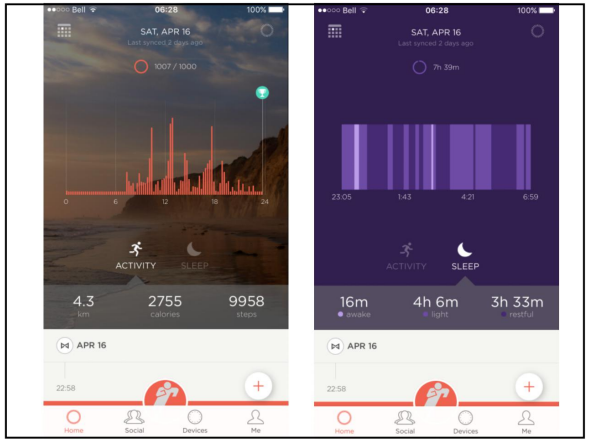
CRSST


Back to App Store
11:42
85%
Back
SET YOUR GOAL
Next
1000
POINTS PER DAY
Going active goes beyond steps. Misfit Points give you credit for activities like cycling or swimming.
ACTIVE
How to hit your goal:
WALK
1.5 hours
RUN
30 mins
SWIM
45 mins
Back to App Store
11:44
84%
TODAY
See your weight, week and month data.
See your daily activity intensity graph.
No data
ACTIVITY
SLEEP
0.0
1105
0
Activity Remaining
WALK
1.5 hours
RUN
30 mins
SWIM
45 mins
Home
Social
Devices
Me





Questions?

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Lancaster University

CROSH CRSST

Workout Schedule NER

	F	S	SU	M	T	W	TH	F	S	SU	M	T	W	TH	F	S	SU	M	T	W	TH	F	S	SU	M	T	W	TH	F	S
April	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Schedule 1	W	X	X	CB	C	CW	CBW	AR	X	X	B	WC	BWC	WC	C	X	X	X	X	W	CB	WCB	AR	C	BW	CBW	AR	X	X	B
Schedule 2	C	X	X	BW	B	WC	BWC	AR	X	X	W	CB	WCB	X	X	C	BW	CBW	AR	B	WC	BWC	X	X	X	X	W	CB	WCB	AR
Schedule 3	B	X	X	WC	W	CB	WCB	AR	X	X	X	X	C	BW	CBW	AR	B	WC	BWC	AR	X	X	W	CB	WCB	AR	C	BW	CBW	X

	SU	M	T	W	TH	F	S	SU	M	T	W	TH	F	S	SU	M	T	W	TH	F	S	SU	M	T	W	TH	F	S	SU	M	T
May	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Schedule 1	WC	BWC	AR	W	CB	WCB	X	X	X	X	C	BW	CBW	AR	B	WC	BWC	AR	X	X	W	CB	H	AR	C	BW	CBW	X	X	X	X
Schedule 2	C	BW	AR	CBW	X	X	B	WC	BWC	AR	W	CB	WCB	X	X	X	X	W	CB	WCB	AR	C	H	BW	CBW	X	X	B	WC	BWC	AR
Schedule 3	X	X	X	B	WC	WCB	AR	CB	WCB	AR	C	X	X	C	BW	CBW	AR	B	WC	WC	X	X	H	X	X	CB	WCB	AR	C	BW	CBW

	W	TH	F	S	SU	M	T	W	TH	F	S	SU	M	T	W	TH	F	S	SU	M	T	W	TH	F	S	SU	M	T	W	TH
June	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Schedule 1	B	WC	BWC	AR	W	CB	WCB	AR	X	X	C	BW	CBW	AR	B	WC	BWC	X	X	X	X	W	CB	WCB	AR	C	BW	CBW	X	X
Schedule 2	W	CB	WCB	X	X	X	X	C	BW	CBW	AR	B	WC	BWC	AR	X	X	W	CB	WCB	AR	C	BW	CBW	X	X	X	X	B	WC
Schedule 3	AR	X	X	B	WC	BWC	AR	W	CB	WCB	X	X	X	X	C	BW	CBW	AR	B	WC	BWC	AR	W	CB	X	X	C	BW	CBW	AR

	F	S	SU	M	T	W	TH	F	S	SU	M	T	W	TH	F	S	SU	M	T	W	TH	F	S	SU	M	T	W	TH	F	S	SU
July	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Schedule 1	H		B	BW	CBW	AR	W	CB	X	X	X	X	C	BW	CBW	AR	B	WC	BWC	AR	X	X	W	CB	WCB	AR	C	BW	CBW	X	X
Schedule 2	H	BWC	AR	W	CB	WCB	X	X	C	BW	CBW	AR	B	WC	BWC	X	X	X	X	W	CB	WCB	AR	C	BW	CBW	AR	X	X	B	WC
Schedule 3	H	X	X	X	X	B	WC	BWC	AR	W	CB	WCB	AR	X	X	C	BW	CBW	AR	B	WC	BWC	X	X	X	X	W	CB	WCB	AR	C

	M	T	W	T	F	S	SU	M	T	W	TH	F	S	SU	M	T	W	TH	F	S	SU	M	T	W	TH	F	S	SU	M	T	W
August	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Schedule 1	H	X	X	B	WC	BWC	AR	W	CB	WCB	X	X	C	BW	CBW	AR	B	WC	BWC	X	X	X	X	W	CB	WCB	AR	C	BW	CBW	AR
Schedule 2	H	W	CB	WCB	AR	X	X	X	X	C	BW	CBW	AR	B	WC	BWC	AR	X	X	W	CB	WCB	AR	C	BW	CBW	X	X	X	X	B
Schedule 3	H	BW	CBW	X	X	B	WC	BWC	AR	W	CB	WCB	X	X	X	X	C	BW	CBW	AR	B	WC	BWC	AR	X	X	W	CB	WCB	AR	C

	TH	F	S	SU	M	T	W	TH	F	S	SU	M	T	W	TH	F	S	SU	M	T	W	TH	F	S	SU	M	T	W	TH	F
September	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Schedule 1	X	X	B	WC	H	WCB	AR	C	BW	X	X	X	X	C	BW	CBW	AR	B	WC	BWC	AR	X	X	W	CB	WCB	AR	C	BW	CBW
Schedule 2	WC	BWC	AR	W	H	CB	WCB	X	X	C	BW	CBW	AR	B	WC	BWC	X	X	X	X	W	CB	WCB	AR	C	BW	CBW	AR	B	WC
Schedule 3	BW	X	X	X	H	X	B	WC	BWC	AR	W	CB	WCB	AR	X	X	C	BW	CBW	AR	B	WC	BWC	X	X	W	CB	WCB	AR	C

B = bodyweight W = weights C = cardio AR = active rest day

Workout Schedule NWR

	F	S	SU	M	T	W	TH	F	S	SU	M	T	W	TH	F	S	SU	M	T	W	TH	F	S	SU	M	T	W	TH	F	S
April	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Schedule 1	W	X	X	CB	C	CW	CBW	AR	X	X	B	WC	BWC	WC	C	X	X	W	CB	WCB	WB	B	X	X	C	CW	CBW	CB	W	X
Schedule 2	C	X	X	BW	B	WC	BWC	AR	X	X	W	CB	WCB	WB	B	X	X	C	BW	CBW	CB	W	X	X	B	WC	BWC	WC	C	X
Schedule 3	B	X	X	WC	W	CB	WCB	AR	X	X	C	BW	CBW	CB	W	X	X	B	WC	BWC	WC	C	X	X	W	CB	WCB	WB	B	X

	SU	M	T	W	TH	F	S	SU	M	T	W	TH	F	S	SU	M	T	W	TH	F	S	SU	M	T	W	TH	F	S	SU	M	T
May	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Schedule 1	X	B	WC	BWC	WC	C	X	X	CBW	AR	B	WC	BWC	X	X	X	X	W	CB	WCB	AR	C	H	BW	CBW	X	X	B	WC	BWC	AR
Schedule 2	X	W	CB	WCB	WB	B	X	X	CB	WCB	AR	X	X	C	BW	CBW	AR	B	WC	WC	X	X	H	X	X	CB	WCB	AR	C	BW	CBW
Schedule 3	X	C	BW	CBW	CB	W	X	X	X	X	C	BW	CBW	AR	B	WC	BWC	AR	X	X	W	CB	H	AR	C	BW	CBW	X	X	X	X

	W	TH	F	S	SU	M	T	W	TH	F	S	SU	M	T	W	TH	F	S	SU	M	T	W	TH	F	S	SU	M	T	W	TH
June	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Schedule 1	W	CB	WCB	X	X	X	X	C	BW	CBW	AR	B	WC	BWC	AR	X	X	W	CB	WCB	AR	C	BW	CBW	X	X	X	X	B	WC
Schedule 2	AR	X	X	B	WC	BWC	AR	W	CB	WCB	X	X	X	X	C	BW	CBW	AR	B	WC	BWC	AR	W	CB	X	X	C	BW	CBW	AR
Schedule 3	B	WC	BWC	AR	W	CB	WCB	AR	X	X	C	BW	CBW	AR	B	WC	BWC	X	X	X	X	W	CB	WCB	AR	C	BW	CBW	X	X

	F	S	SU	M	T	W	TH	F	S	SU	M	T	W	TH	F	S	SU	M	T	W	TH	F	S	SU	M	T	W	TH	F	S	SU
July	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Schedule 1	H	BWC	AR	W	CB	WCB	X	X	C	BW	CBW	AR	B	WC	BWC	X	X	X	X	W	CB	WCB	AR	C	BW	CBW	AR	X	X	B	WC
Schedule 2	H	X	X	X	X	B	WC	BWC	AR	W	CB	WCB	AR	X	X	C	BW	CBW	AR	B	WC	BWC	X	X	X	X	W	CB	WCB	AR	C
Schedule 3	H		B	BW	CBW	AR	W	CB	X	X	X	X	C	BW	CBW	AR	B	WC	BWC	AR	X	X	W	CB	WCB	AR	C	BW	CBW	X	X

	M	T	W	T	F	S	SU	M	T	W	TH	F	S	SU	M	T	W	TH	F	S	SU	M	T	W	TH	F	S	SU	M	T	W
August	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Schedule 1	H	W	CB	WCB	AR	X	X	X	X	C	BW	CBW	AR	B	WC	BWC	AR	X	X	W	CB	WCB	AR	C	BW	CBW	X	X	X	X	B
Schedule 2	H	BW	CBW	X	X	B	WC	BWC	AR	W	CB	WCB	X	X	X	X	C	BW	CBW	AR	B	WC	BWC	AR	X	X	W	CB	WCB	AR	C
Schedule 3	H	X	X	B	WC	BWC	AR	W	CB	WCB	X	X	C	BW	CBW	AR	B	WC	BWC	X	X	X	X	W	CB	WCB	AR	C	BW	CBW	AR

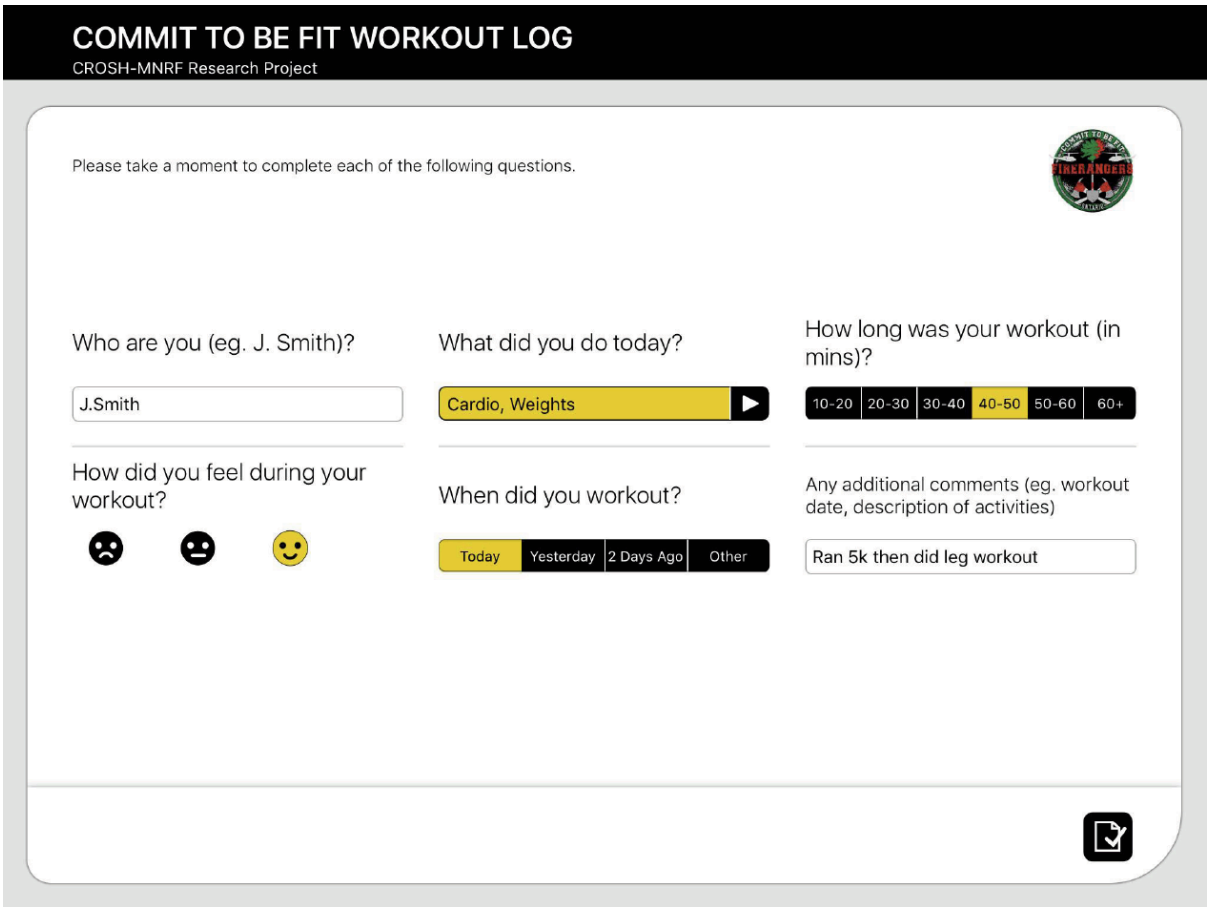
	TH	F	S	SU	M	T	W	TH	F	S	SU	M	T	W	TH	F	S	SU	M	T	W	TH	F	S	SU	M	T	W	TH	F
September	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Schedule 1	WC	BWC	AR	W	H	CB	WCB	X	X	C	BW	CBW	AR	B	WC	BWC	X	X	X	X	W	CB	WCB	AR	C	BW	CBW	AR	B	WC
Schedule 2	BW	X	X	X	H	X	B	WC	BWC	AR	W	CB	WCB	AR	X	X	C	BW	CBW	AR	B	WC	BWC	X	X	W	CB	WCB	AR	C
Schedule 3	X	X	B	WC	H	WCB	AR	C	BW	X	X	X	X	C	BW	CBW	AR	B	WC	BWC	AR	X	X	W	CB	WCB	AR	C	BW	CBW

B = bodyweight W = weights C = cardio AR = active rest day

Cardio	Bodyweight	Weight
Running (400m, 5km)	**Upper Body**	**Upper Body**
Pack walk	Pushups (variations)	Shoulder press
Sprint	Dips	Mace swings
Rowing	Pullups	Dumbbell row
Rowing sprints	Ring rows	Sled pull
Sled push (light)	Burpees	Serratus punch
Sled drag (light)	Plank ups	Bench press
Skipping	Lateral plank walk	Banded external rotation
Battle ropes	**Lower Body**	**Lower Body**
Mountain climbers	Air squat	Weighted squat
Burpees	Lunge	Weighted lunge
High knee skips	Pistol (one leg squat)	Deadlift
	Step ups	Medicine Ball Clean
	Jump squats	Tire Flip
	Single leg deadlift	Thruster
	Glute bridge	Wall ball
	Good morning	Weighted sled drag
	Clams	Weighted sled push
	Core	**Core**
	Situps	Kettlebell swings
	Planks	Ball slams
	Spidermans	Woodchoppers
	Knees to elbows	Russian twist
	Toes to bar	Farmer's carry
	Birddog	Kettlebell windmill
	Alternating supermans	Overhead lunge
	Sideplank	Turkish Get-ups
	Stir the pot	Dumbbell sidebend
	Deadbugs	Weighted single leg deadlift


FLASH

Screenshot of electronic logging application:



Paper logging:

COMMIT TO BE FIT WORKOUT LOG

1. WHO ARE YOU (e.g., J.Smith)?

_____

2. WHAT DID YOU DO (check all that apply)?

☐ CARDIO ☐ WEIGHTS ☐ BODYWEIGHTS

3. HOW LONG WAS YOUR WORKOUT (in mins)?

10-20 | 20-30 | 30-40 | 40-50 | 50-60 | 60+

4. HOW DID YOU FEEL (only circle one)?

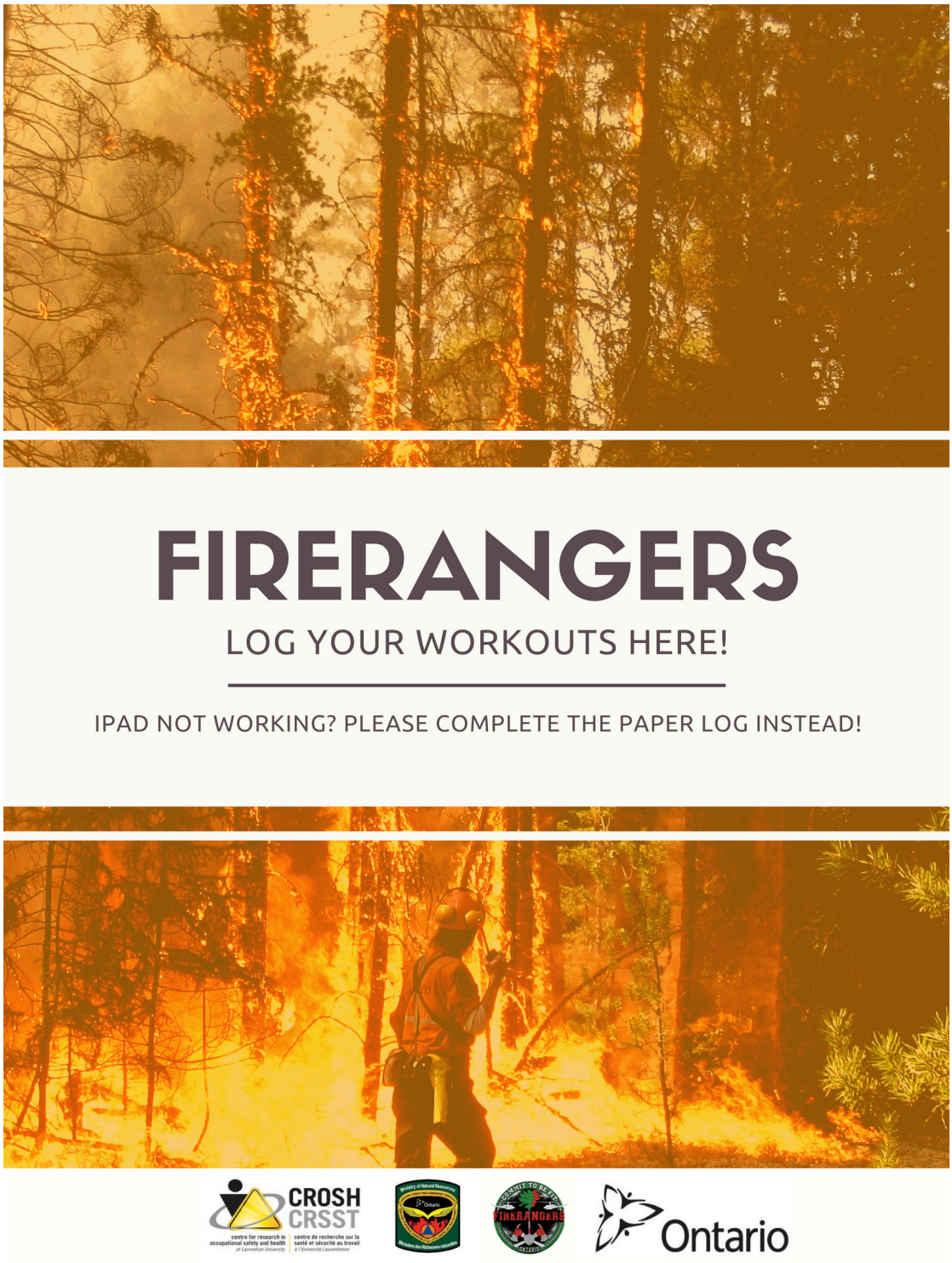
☹ 😐 ☺

5. WHEN DID YOU WORK OUT (date)?

_____

6. ANY ADDITIONAL COMMENTS?

Fitness Intervention Exercise Logging Reminder Poster:



Fitness Intervention Logging Stations at various locations:


NO EXCUSES!
The 100 Workout


OMNR

Sample male and female fitness results feedback as part of fitness intervention

PRE-SEASON FITNESS

FEEDBACK

Female FireRanger Provincial Average

May 2016

ANTHROPOMETRICS 01

Height: 166.4cm
Weight: 155.0lbs
Body Mass Index (BMI): 25.4

General Population:

Classification	BMI Category (kg/m²)
Underweight	< 18.5
Normal Weight	18.5-24.9
Overweight	25.0-29.9
Obese I	30.0-34.9
Obese II	35.0-39.9

FEMALE FIRERANGERS BMI
MIN: 20.1 MAX: 33.3
STD DEV: 3.20

NCAA FEMALE ATHLETE AVERAGE
22.5

02 FLEXIBILITY

Best Attempt: 36.2cm
Rating: Good

General Population:

WOMEN	Needs Improvement	Fair	Good	Very Good	Excellent
Age: 15-19	<28	29-33	34-37	38-42	>43
20-29	<27	28-32	33-36	37-40	>41
30-39	<26	27-31	32-35	36-40	>41
40-49	<24	25-29	30-33	34-37	>38
50-59	<24	25-29	30-32	33-38	>39

FEMALE FIRERANGERS
MIN: 12.5CM MAX: 50CM
STD DEV: 7.32CM

OLYMPIC TRIATHLETES
AVG = 41CM

GRIP STRENGTH 03

Best Right Hand: 38.5kg
Best Left Hand: 35.8kg
Total Grip Strength: 74.3kg

General Population:

WOMEN	Needs Improvement	Fair	Good	Very Good	Excellent
Age: 15-19	<47	48-52	53-59	60-67	>68
20-29	<51	52-57	58-62	63-69	>70
30-39	<50	51-57	58-62	63-70	>71
40-49	<48	49-53	54-60	61-68	>69
50-59	<44	45-48	49-53	54-60	>61

FEMALE FIRERANGER TOTAL GRIP STRENGTH
MIN: 59.1KG MAX: 96.9KG
STD DEV: 9.11KG

NCAA Female Athletes
90.8kg

04 CORE STRENGTH

Time Completed: 2:31:00
Stage Completed: 7

FEMALE FIRERANGERS
STD DEV: 40.0seconds

Completion Rate: 55%

ANAEROBIC CAPACITY

Fastest 35m: 6.08seconds
MAX Power: 392.8watts
AVG Power: 304.7watts
Fatigue Index: 3.9watts/second

05

FEMALE FIRERANGER TOP SCORES
FASTEST 35M: 5.34sec
MAX Power: 609.1 watts
AVG Power: 467.8 watts
Fatigue Index STD DEV: 1.6 W/sec

General Population:

%ile Rank	Male MAX Power (watts)	Female MAX Power (watts)
90th	822	560
70th	757	505
50th	689	449
30th	656	399
10th	570	353

NCAA Athletes:

Rating	Men	Women
Very Good	<4.80	<5.30
Good	4.80-5.09	5.30-5.59
Average	5.10-5.29	5.60-5.89
Fair	5.30-5.60	5.90-6.20
Poor	>5.60	>6.20

CROSH CRSST

PRE-SEASON FITNESS

FEEDBACK

Male FireRanger Provincial Average

May 2016

ANTHROPOMETRICS 01

Height: 179.7cm
Weight: 183.0lbs
Body Mass Index (BMI): 25.7

General Population:

Classification	BMI Category (kg/m²)
Underweight	< 18.5
Normal Weight	18.5-24.9
Overweight	25.0-29.9
Obese I	30.0-34.9
Obese II	35.0-39.9

MALE FIRERANGERS BMI
MIN: 18.2 MAX: 38.9
STD DEV: 3.65

NFL AVERAGES
DEFENSIVE TACKLE = 38.2
RUNNING BACK = 31.0
QUARTERBACK = 27.8

02 FLEXIBILITY

Best Attempt: 28.8cm
Rating: Fair

General Population:

MEN	Needs Improvement	Fair	Good	Very Good	Excellent
Age: 15-19	<23	24-28	29-33	34-38	>39
20-29	<24	25-29	30-33	34-39	>40
30-39	<22	23-27	28-32	33-37	>38
40-49	<17	18-23	24-28	29-34	>35
50-59	<15	16-23	24-27	28-34	>35

MALE FIRERANGERS
MIN: 0.0CM MAX: 60.0CM
STD DEV: 8.62CM

OLYMPIC SPRINTERS
AVG = 38CM

GRIP STRENGTH 03

Best Right Hand: 60.18kg
Best Left Hand: 56.55kg
Total Grip Strength: 116.7kg

General Population:

MEN	Needs Improvement	Fair	Good	Very Good	Excellent
Age: 15-19	<78	79-89	90-97	98-107	>108
20-29	<83	84-94	95-103	104-114	>115
30-39	<83	84-94	95-103	104-114	>115
40-49	<79	80-87	88-96	97-107	>108
50-59	<75	76-83	84-91	92-100	>101

MALE FIRERANGERS TOTAL GRIP STRENGTH
MIN: 67.9KG MAX: 177.6KG
STD DEV: 15.93KG

TOP PLAYER AT 2016 NHL COMBINE
159.5KG
OVERALL AVG
116.0KG

04 CORE STRENGTH

Time Completed: 2:40:00
Stage Completed: 7

MALE FIRERANGERS
STD DEV: 34.32secs

Completion Rate: 68%

ANAEROBIC CAPACITY

Fastest 35m: 5.35seconds
MAX Power: 674.2watts
AVG Power: 515.6watts
Fatigue Index: 8.24watts/second

05

MALE FIRERANGERS TOP SCORES
FASTEST 35M: 4.63sec
MAX Power: 1120.4 watts
AVG Power: 787.0 watts
Fatigue Index STD DEV: 3.21W/sec

General Population:

%ile Rank	Male MAX Power (watts)	Female MAX Power (watts)
90th	822	560
70th	757	505
50th	689	449
30th	656	399
10th	570	353

NCAA Athletes:

Rating	Men	Women
Very Good	<4.80	<5.30
Good	4.80-5.09	5.30-5.59
Average	5.10-5.29	5.60-5.89
Fair	5.30-5.60	5.90-6.20
Poor	>5.60	>6.20

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PSYCHOSOCIAL FACTORS & WILDLAND FIREFIGHTING

Timmins FMH

Caleb Leduc, PhD Student

Overview

3

- What are psychosocial risk factors?
- 13 psychosocial factors at work

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Psychosocial Factors

4

- Anything that can impact a FireRanger's psychological response to work and work conditions
- Psychosocial factors include the way work is carried out (workload, work methods) and the context in which the work occurs (including all relationships and interactions)

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Psychosocial Factors

5

Psychological Support

6

- A work environment where co-workers and supervisors are supportive of FireRangers' psychological and mental health concerns, and respond appropriately as needed

Psychological Support at Work?

7

- Improved overall psychological health of employees
- Successful/sustainable return to work
- Reasonable workplace support during times of emotional distress, crisis or upset
- Understanding and awareness of mental health

Organizational Culture

8

- A work environment characterized by trust, honesty and fairness

Organizational Culture at Work?

9

- Greater teamwork
- Higher job satisfaction and morale
- Enhanced retention and recruitment
- A positive public and community image

Clear Leadership & Expectations

10

- A work environment where there is effective leadership and support that helps FireRangers know what they need to do, how their work contributes to the organization, and whether there are impending changes

Leadership & Expectations at Work

11

- FireRangers have clear expectations regarding job responsibilities and roles
- FireRangers can trust their supervisors and those in management
- Less FireRanger frustration or conflict
- FireRanger morale is positive and resiliency is high even during times of stress and change

Civility & Respect

12

- A work environment where FireRangers are respectful and considerate in their interactions with one another, as well as with other members of staff, outside agencies and the public

Civility & Respect at Work

13

- Reduced conflict among FireRangers
- Effective teamwork with positive morale
- Effective resolution of conflicts that do arise
- Respectful leadership at all levels (e.g., within crews and between crews and management)

Psychological Job Demands

14

- A work environment where there is a good fit between an FireRanger's interpersonal and emotional competencies and the requirements of being a FireRanger

Psychological Job Demands at Work

15

- Enhanced job performance and overall productivity
- Greater job satisfaction
- Increased retention of skilled staff
- Enhanced recruitment

Growth & Development

16

- A work environment where FireRangers receive encouragement and support in the development of their interpersonal, emotional and job specific skills

Growth & Development at Work

17

- Increased employee competency
- Retention of skilled staff
- Effective succession planning/internal promotions

Recognition & Reward

18

- A work environment where there is appropriate acknowledgement and appreciation of FireRangers' efforts in a fair and timely manner

Recognition & Reward at Work

19

- Enhanced FireRanger satisfaction, motivation and loyalty
- Improved teamwork and positive morale within crews
- Increased retention and recruitment of skilled FireRangers

Involvement & Influence

20

- A work environment where FireRangers are included in discussions about how their work is done and how important decisions are made

Involvement & Influence at Work

21

- FireRangers take an active role in addressing challenges that arise at base and while on deployment
- Greater FireRanger satisfaction and motivation

Workload Management

22

- A work environment where tasks and responsibilities can be accomplished successfully within the time available

Workload Management at Work

23

- Reduced FireRanger stress and/or burnout
- Fewer job-related errors, incidents, accidents or injuries
- Increased FireRanger retention

Engagement

24

- A work environment where FireRangers feel connected to their work and are motivated to do their job well

Engagement at Work

25

- High FireRanger morale and motivation
- Improved interactions within crews and between FireRangers and staff and the public
- Enhanced recruitment of skilled FireRangers

Work-Life Balance

26

- A work environment where there is a recognition of the need for balance between the demands of work, family, and personal life

Balance at Work

27

- Reduced FireRanger stress and burnout
- Reduced FireRanger absenteeism
- Greater FireRanger satisfaction and improved morale

Psychological Protection

28

- A work environment where FireRangers feel able to put themselves on the line, ask questions, seek feedback, report mistakes and problems or propose a new idea without fearing negative consequences to themselves, their job or their career

Psychological Protection at Work

29

- Reduced conflict
- Fewer job-related errors, incidents, accidents and injuries
- Enhanced compliance with legal and regulatory requirements
- Elimination of bullying and harassment

Physical Safety

30

- A work environment where management at all levels takes appropriate action to protect the physical safety of FireRangers

Physical Safety at Work

31

- Appropriate actions may include:
  - Policies to protect FireRangers physical safety
  - Training in safety-related protocols
  - Rapid and appropriate response to physical accidents or situations with heightened alert
  - Clearly demonstrated concern for FireRangers' physical safety

Going Forward

32

- Weekly email from croshmnrf@gmail.com on Wednesdays over next 13 weeks featuring one psychosocial factor
- **Expectation:** Reply to confirm receipt

Psychosocial fact sheets 1 through 13 as part of psychosocial intervention materials.

PSYCHOSOCIAL FACTOR #1
PSYCHOLOGICAL SUPPORT

What is PSYCHOLOGICAL SUPPORT?

Psychological Support is present in a work environment where FireRangers and supervisors are supportive of FireRangers' psychological and mental health concerns, and respond appropriately as needed. When FireRangers perceive organizational support, it means they believe the MNRF-AFFES values their contributions, is committed to ensuring their psychological well-being and provides meaningful supports if this well-being is compromised.

Why is PSYCHOLOGICAL SUPPORT important?

The more FireRangers feel they have psychological support, the greater their job commitment, satisfaction, and performance. When adequate psychological support is present, FireRangers experiencing psychological distress in the workplace will be more likely to seek, and receive, appropriate help. They will be better equipped to stay safe and productive at work while they recover, and, if work absence is required, will be more likely to have a quicker and more sustainable work return. There are two programs FireRangers can access that provide psychological support; the Employee Assistance Program (EAP) available at 1-800-268-5211 and the Peer Support Program available at 1-888-311-9770.

What are PSYCHOSOCIAL FACTORS?

Psychosocial factors are elements that impact FireRangers' psychological responses to work and work conditions, potentially causing psychological health problems. Psychosocial factors include the way work is carried out (deadlines, workload, work methods) and the context in which work occurs (including relationships and interactions with crew bosses/leaders and supervisors, colleagues and coworkers, and with the public).

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PSYCHOSOCIAL FACTOR #2
ORGANIZATIONAL CULTURE

What is ORGANIZATIONAL CULTURE?

Organizational culture is defined as the degree to which your workplace environment is characterized by trust, honesty, and fairness. In general, within your crew and between crews at your base, **organizational culture is a set of unwritten rules** that guide how FireRangers conduct themselves at work. These can include the values, beliefs, meanings and expectations that FireRangers hold in common and that they use to work together.

Why is ORGANIZATIONAL CULTURE important?

Organizational culture is important because when workers believe that they can trust their organization and that everyone is treated fairly and honestly, they work better as a group and their individual health and safety is improved. Being able to trust each other within a crew and others at AFFES contributes to a better environment for everyone and creates feelings of commitment and loyalty, both of which help keep and attract FireRangers to the job. FireRangers will feel better about coming to work and take satisfaction from working together. As a FireRanger, **you impact your workplace culture**. You can have a positive impact by providing an encouraging, social environment for other FireRangers.

What are PSYCHOSOCIAL FACTORS?

Psychosocial factors are issues that change your mental state and can affect the way you do your work or your feelings about your workplace. Repeated exposure to these factors can cause you to have mental or physical health problems. Psychosocial factors include the way work is carried out (deadlines, workload, work methods) and the context in which work occurs (including relationships and interactions with crew bosses/leaders and supervisors, colleagues and coworkers, and with the public).

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PSYCHOSOCIAL FACTOR #3

LEADERSHIP & EXPECTATIONS

What is meant by

LEADERSHIP AND EXPECTATIONS?

Clear leadership and expectations are present in a workplace where FireRangers know: what they need to do, how their work contributes to the goals of AFFES, and whether there will be impending changes. There are many types of leadership styles, each of which impact psychosocial health and safety in different ways. One type, called **Transformational Leadership**, is considered the most powerful because these leaders guide by focusing on the **'big picture'**, communicating a sense of purpose to others in the organization, motivating others to understand what is expected of them, therefore accomplishing more within the group. Transformational leaders give individualized consideration to their crew-members, stimulate intellectual capabilities in others and inspire co-workers to do their best.

Why are

LEADERSHIP AND EXPECTATIONS

important?

Leadership and clear communication of expectations at work are crucial for overall work-related-health and well-being. A good team leader provides leadership by communicating expectations on the fireline. When everyone knows what their role or job is, and what needs to be accomplished, the crew works best as a team.

Effective leadership can increase FireRanger morale, resiliency and trust, and decrease frustration and conflict within your crew. Good leadership results in workers reporting higher personal well-being, a reduction in sick leave time and better worker retention. All members of a crew can be a leader by showing a commitment to maintaining his or her own physical and mental health, which can influence the health of co-workers (sickness, presenteeism, absenteeism) as well as the health of the organization as a whole (vigour, vitality, productivity).

What are

PSYCHOSOCIAL FACTORS?

Psychosocial factors are issues that change your mental state and can affect the way you do your work or your feelings about your workplace. Repeated exposure to these factors can cause you to have mental or physical health problems. Psychosocial factors include the way work is carried out (deadlines, workload, work methods) and the context in which work occurs (including relationships and interactions with crew bosses/leaders and supervisors, colleagues and coworkers, and with the public).

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PSYCHOSOCIAL FACTOR #4
CIVILITY AND RESPECT

What are
CIVILITY AND RESPECT?

Civility and respect are present in a work environment where FireRangers are respectful to coworkers and considerate in their interactions to others within their crew, on their base, with AFFES staff and in public interactions. **Civility and respect are based on showing appreciation, care and consideration for others, and acknowledging their dignity.** FireRangers should work to make their crews an inclusive work environment by recognizing and respecting individual differences and qualities.

Why are
CIVILITY AND RESPECT
important?

A civil and respectful workplace is related to greater job satisfaction, greater perceptions of fairness, a more positive attitude, improved morale, and better teamwork. Crews that have civility and respect for each other, create a positive atmosphere marked by high spirits and work satisfaction. This allows people to enjoy their work, whether they are AFFES staff, staff from other fire agencies or the public. **As a FireRanger, it is important for you to consider the impact of your words and actions on others before acting.** You can also promote a culture of civility and respect by speaking out when you feel others have crossed-the-line or when you see potential bullying or harassment taking place.

What are
PSYCHOSOCIAL FACTORS?

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PSYCHOSOCIAL FACTOR #5
PSYCHOLOGICAL JOB DEMANDS

What are PSYCHOLOGICAL JOB DEMANDS?

Job demands include the physical, social, and organizational components of work. **Psychological Job Demands** refer, specifically, to the social and emotional skills required by wildland firefighters to do their job. This means that competent FireRangers not only possess the technical skills and knowledge needed to fight fire, but they also have **social skills and emotional intelligence** to do the job. Emotional intelligence includes: self-awareness, impulse control, perseverance, understanding, and self-motivation, as well as the ability to get along with your crew and co-workers. Workers who exhibit the best psychological competency at their job are people who feel that they 'fit their job.' Another way of saying this is that they feel their personality matches the job demands of their workplace.

Why are PSYCHOLOGICAL JOB DEMANDS important?

When a FireRanger's psychological competencies are a good fit for the job requirements of wildland firefighting, they have: improved mental health, lower levels of depression, greater self-esteem, and a more positive view of him/herself . In addition, if you are able to meet the psychological demands of your job, you are more likely to be satisfied at work and perform better.

What are PSYCHOSOCIAL FACTORS?

Psychosocial factors are issues that change your mental state and can affect the way you do your work or your feelings about your workplace. Repeated exposure to these factors can cause you to have mental or physical health problems. Psychosocial factors include the way work is carried out (deadlines, workload, work methods) and the context in which work occurs (including relationships and interactions with crew bosses/leaders and supervisors, colleagues and coworkers, and with the public).

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PSYCHOSOCIAL FACTOR #6
GROWTH & DEVELOPMENT

What is GROWTH & DEVELOPMENT?

Growth and Development exist in worksites where FireRangers receive encouragement and support to develop their **social-, emotional-, and technical-job skills**. Workplaces with optimal growth and development offer a variety of opportunities to workers, including opportunities within crews, at FMH, and within AFFES itself, so that FireRangers can build their repertoire of competencies. This will help FireRangers perform at their best in their current job, and will prepare them for possible future positions.

FireRangers who are not challenged by their work will grow bored, their well-being will suffer, and their performance will drop. In addition, without opportunities to learn and improve interpersonal and psychological skills, workplaces see increases in conflicts, disengagement and distress.

Why is GROWTH & DEVELOPMENT important?

When FireRangers are provided opportunities for growth and development they are more likely: to be satisfied in their role within their crew; to be committed to AFFES; and to feel better at work. FireRangers feel that coworkers, management and/or AFFES care, when they support their personal growth and development, by either providing them with opportunity or encouraging and supporting their efforts to improve their skills and therefore gain additional competencies within their crew, their FMH and/or within AFFES. For optimal Growth and Development within an organization, it is important that opportunities extend beyond learning specific technical skills necessary for fighting fire, including opportunities to learn personal and social skills that are critical to successfully caring for oneself and relating to others.

What are PSYCHOSOCIAL FACTORS?

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PSYCHOSOCIAL FACTOR #7
RECOGNITION & REWARD

What is
RECOGNITION & REWARD?

Recognition and reward is present in a work environment where there is appropriate acknowledgement and appreciation of FireRangers' efforts in a fair and timely manner. This can be done formally, through crew or base celebrations, recognition of years served, and/or milestones reached. You can also accomplish this informally, by expressing appreciation of your fellow crew members and acknowledging their contributions to the crew.

Why is
RECOGNITION & REWARD
important?

Recognizing and rewarding FireRangers motivates them, **fuels their desire to excel**, builds their self-esteem, encourages them to exceed expectations and enhances the success of the whole crew. This, in turn, provides FireRangers with more energy and enthusiasm and a greater sense of pride and participation in their work. In addition, FireRangers who receive recognition are more likely to treat their fellow crew members, people in other fire agencies, and the public with courtesy, respect and understanding.

What are
PSYCHOSOCIAL FACTORS?

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PSYCHOSOCIAL FACTOR #8
INVOLVEMENT & INFLUENCE

What is INVOLVEMENT & INFLUENCE?

Involvement & Influence at work refers to a work environment where FireRangers are **included** in discussions about how their work is done and how important decisions are made. Examples of involvement can include opportunities for a FireRanger to contribute ideas about: individual tasks, the activities of their crew or base, or issues involving the organization as a whole.

Why is INVOLVEMENT & INFLUENCE important?

When FireRangers feel they have meaningful input into their work they are more likely to be engaged, have higher morale, and take pride in working for the MNRF-AFFES. This in turn, increases their willingness to make extra effort when required. Job involvement is associated with increased psychological well-being, enhanced innovation and organizational commitment.

What are PSYCHOSOCIAL FACTORS?

Psychosocial factors are issues that change your mental state and can affect the way you do your work or your feelings about your workplace. Repeated exposure to these factors can cause you to have mental or physical health problems. Psychosocial factors include the way work is carried out (deadlines, workload, work methods) and the context in which work occurs (including relationships and interactions with crew bosses/leaders and supervisors, colleagues and coworkers, and with the public).

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PSYCHOSOCIAL FACTOR #9
WORKLOAD MANAGEMENT

What is WORKLOAD MANAGEMENT?

Workload Management refers to your ability as a FireRanger to successfully complete all of your tasks and responsibilities within the time given. Many Canadians identify this psychosocial factor as being their biggest workplace stressor (i.e., having too much to do and not enough time to do it). However, it is important to note that it is not just the amount of work, but also the extent to which FireRangers have the **resources and tools** (equipment, support) to perform the job well.

Why is WORKLOAD MANAGEMENT important?

Most FireRangers are not only willing to work hard, but find putting in a 'good day's work' fulfilling and rewarding. Workload management is important because there is a unique relationship between the demands of your job, your ability to **manage the flow of work**, and how satisfied you are with it. Too many demands reduces job satisfaction, but having the ability to control the pace of work can actually increase your job satisfaction. Even when there are high demands, if FireRangers also have high decision-making ability, they will be able to thrive. Having high decision-making latitude also allows for positive coping behaviours to be learned and experienced and can lead to increased FireRanger performance while fighting fire.

What are PSYCHOSOCIAL FACTORS?

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PSYCHOSOCIAL FACTOR #10

ENGAGEMENT

What is ENGAGEMENT?

Engagement is present in a work environment where FireRangers feel connected to their work and are motivated to do their job well. **Employee engagement can be physical, emotional, and/or cognitive**. Physically-engaged FireRangers see work as a source of energy. Emotionally-engaged FireRangers feel good about fighting fire and are passionate about their work. Cognitively-engaged FireRangers devote more attention to their work tasks and are absorbed in their job. Regardless of the source of engagement, engaged FireRangers are connected to their work and are committed to the overall success and mission of their crew, base, and organization.

Why is ENGAGEMENT important?

Engagement is important for your job satisfaction and psychological health, but it also has positive outcomes for your crew and the organization. Engagement is related to an **improved ability** to fight fire, higher morale, and greater motivation. It is also positively connected to increased camaraderie within crews and bases. This is because engaged FireRangers are more likely to behave in ways that are beneficial to everyone, by choice, rather than prioritizing themselves.

What are PSYCHOSOCIAL FACTORS?

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PSYCHOSOCIAL FACTOR #11

WORK-LIFE BALANCE

What is WORK-LIFE BALANCE?

Balanced workplaces recognize that FireRanger's must manage multiple factors in their lives. Specifically **FireRangers must balance the workplace demands of fighting fire, with their individual demands** from family and their personal life. This psychosocial factor reflects the reality that everyone has multiple roles in life, such as: FireRangers, students, partners, children, parents, friends, etc. When balance is achieved, FireRangers are able to show their true strengths and abilities at work, because they do not feel conflicted while performing work tasks.

Why is WORK-LIFE BALANCE important?

FireRangers feel valued, in workplaces where management recognizes the importance of work-life balance. Acknowledging the multiple demands placed on FireRangers contributes to their personal happiness, both at work and at home. An awareness of work-life balance not only helps to reduce the stress an individual FireRanger may be facing, but can also reduce the risk of home issues spilling over into the workplace and vice versa. **Balance allows FireRangers to maintain their concentration, confidence, responsibility, and sense of control at work.** Organizationally, this translates into enhanced FireRanger commitment, job satisfaction, job performance, and organizational citizenship behaviours (behaviour choices by FireRangers, which are not mandatory, but are beneficial to the organization). Balance is associated with heightened well-being and reduced stress. Over time, these effects show a direct causal relationship to higher physical and psychological health.

What are PSYCHOSOCIAL FACTORS?

Psychosocial factors are issues that change your mental state and can affect the way you do your work or your feelings about your workplace. Repeated exposure to these factors can cause you to have mental or physical health problems. Psychosocial factors include the way work is carried out (deadlines, workload, work methods) and the context in which work occurs (including relationships and interactions with crew bosses/leaders and supervisors, colleagues and coworkers, and with the public).

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PSYCHOSOCIAL FACTOR #12
PSYCHOLOGICAL PROTECTION

What is PSYCHOLOGICAL PROTECTION?

Psychological Protection is when FireRangers feel safe expressing themselves honestly in the workplace. Workplace psychological safety is demonstrated when FireRangers feel confident to ask questions, seek feedback, report mistakes and problems, or propose a new idea without fearing negative consequences to themselves, their job or their place in the organization. A psychologically healthy and safe organization is one that promotes FireRangers' psychological well-being and works to prevent harm to FireRanger psychological health, which includes creating an approachable and supportive environment.

Why is PSYCHOLOGICAL PROTECTION important?

When FireRangers are psychologically protected they demonstrate greater job satisfaction, enhanced team learning, and perform better as a crew. Protected FireRangers are also more likely to speak up and become involved with the Organization. They show increased morale and engagement, are less likely to experience stress-related illness and have fewer conflicts. When FireRangers are not psychologically safe they can feel demoralized, threatened and disengaged. **Within your crew, you have a role to play in creating a psychologically safe culture, by listening to your fellow FireRangers and by being receptive to their concerns and opinions.**

What are PSYCHOSOCIAL FACTORS?

Psychosocial factors are issues that change your mental state and can affect the way you do your work or your feelings about your workplace. Repeated exposure to these factors can cause you to have mental or physical health problems. Psychosocial factors include the way work is carried out (deadlines, workload, work methods) and the context in which work occurs (including relationships and interactions with crew bosses/leaders and supervisors, colleagues and coworkers, and with the public).

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PSYCHOSOCIAL FACTOR #13

PHYSICAL SAFETY

What is

PHYSICAL SAFETY?

Protection of Physical Safety is present in a workplace where management and supervisors take appropriate action to protect the physical safety of FireRangers. Examples include: implementing policies designed to protect FireRangers' physical safety; ensuring appropriate training in safety-related protocols (e.g., LACES); responding rapidly and appropriately to workplace accidents or near misses; clearly demonstrating concern for FireRangers' physical safety; and leading by example.

Why is

PHYSICAL SAFETY important?

FireRangers who perceive their workplace to be protective of physical safety will feel more secure and engaged at work. When FireRangers feel confident in the safety protection provided, they experience lower rates of mental distress and mental health problems. **Your sense of physical safety protection can be enhanced by:** participating in physical safety training, trusting that your crew leaders and management are working towards minimizing physical threats, ensuring that you respond to safety incidents quickly; and that you report all safety incidents, including near-misses at work.

What are

PSYCHOSOCIAL FACTORS?

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PREVENTION THROUGH RESEARCH

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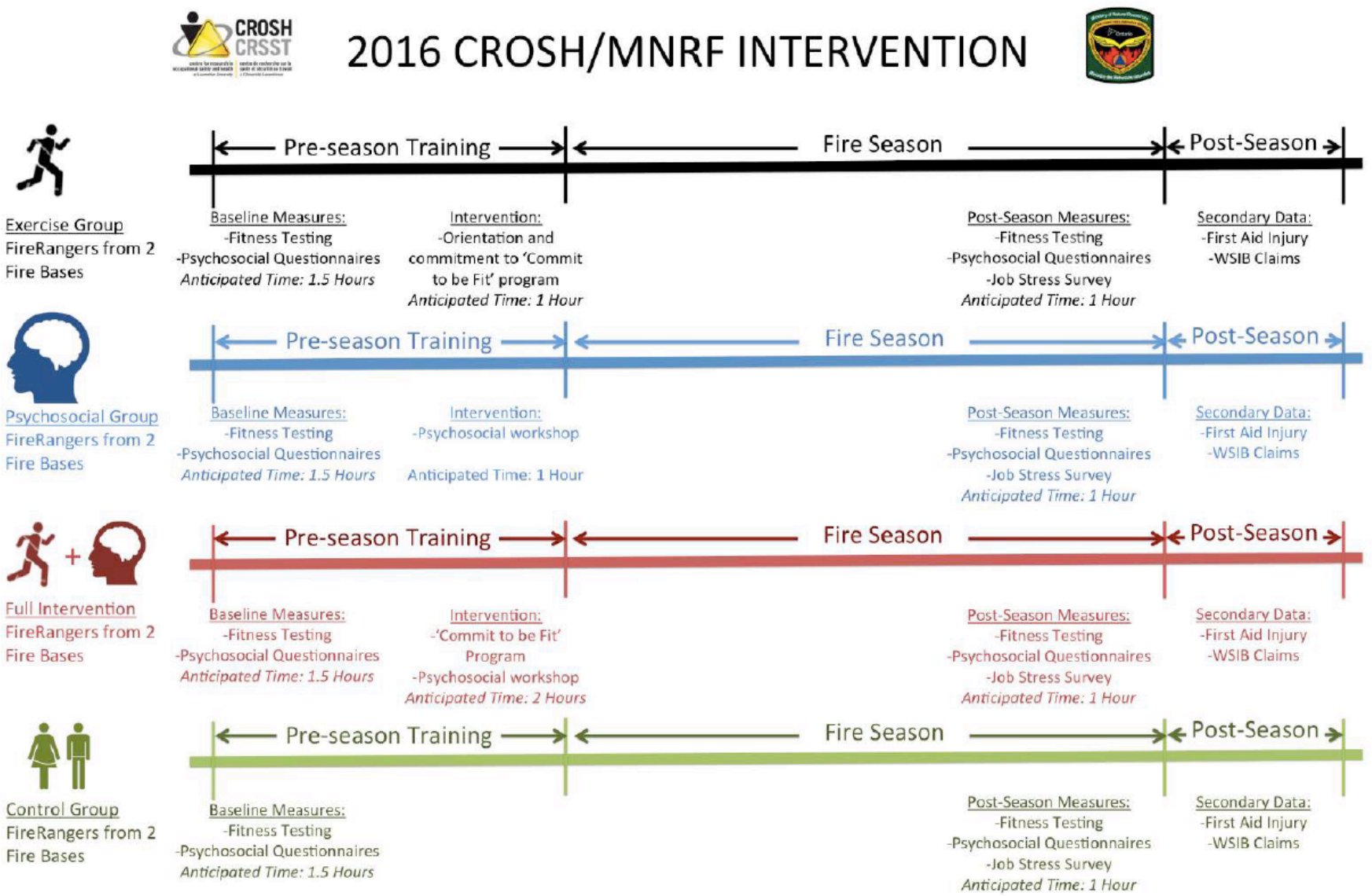
centre for research in occupational safety and health at Laurentian University | centre de recherche sur la santé et sécurité au travail à l'Université Laurentienne

Ontario

Psychosocial intervention materials posted around work locations


PSYCHOSOCIAL FACTOR #4
CIVILITY AND RESPECT
CIVILITY AND RESPECT?
CIVILITY AND RESPECT
Important?
PSYCHOSOCIAL FACTORS?
FIT TO FIGHT
PREVENTION THROUGH RESEARCH
CROSH CROST
Ontario
PSYCHOSOCIAL FACTOR #7
RECOGNITION & REWARD
RECOGNITION & REWARD?
RECOGNITION & REWARD
PSYCHOSOCIAL FACTORS?
FIT TO FIGHT
PREVENTION THROUGH RESEARCH
What you need to know
Employers are prohibited from penalizing employees in any way for exercising ESA rights.
Contact the Ministry of Labour for more information.
Ontario
In Case of Injury at Work
1
Get first aid immediately, if needed
2
Worker: Tell your employer about the injury
3
Employer: Arrange and pay for transportation to get medical care, if needed
4
Employer: Pay worker's wages for day of injury
Employer: Report injury to WSIB within 3 days if it involves:
wsib
cspaat
Questions? Call 1-800-387-0750
SHARING THE ROAD WITH CYCLISTS
The number of cyclists seriously injured by motor vehicles has increased in recent years, faster than the increase in cyclists out on the roads. Here are a few driver and cyclist safety tips as we head into cycling season:
TIPS FOR DRIVERS
TIPS FOR CYCLISTS
LET'S LOOK OUT FOR EACH OTHER
Did you know that carbohydrates...
Daily AFFES FireRanger Carbohydrate Consumption
Best Practices:
FIRERANGERS ARE OCCUPATIONAL ATHLETES
Flying Commercial or Charter?
Before you hit the runway...
Don't Forget The Checklist
Passport or Driver's License
Health Card/Government I.D.
Knives and Multitools in checked baggage
No Propane
No Lithium Radio Batteries
FIP 58 lbs (ON) or 65 lbs (OOP)
Camp Bag 90 lbs (ON) includes grill/stove/food
Crew Shelter 20 lbs (ON)
E-cigarettes carried on person


CROSH
CRSST
2016 CROSH/MNRF INTERVENTION
Pre-season Training
Fire Season
Post-Season
Exercise Group
FireRangers from 2 Fire Bases
Baseline Measures:
-Fitness Testing
-Psychosocial Questionnaires
Anticipated Time: 1.5 Hours
Intervention:
-Orientation and commitment to 'Commit to be Fit' program
Anticipated Time: 1 Hour
Post-Season Measures:
-Fitness Testing
-Psychosocial Questionnaires
-Job Stress Survey
Anticipated Time: 1 Hour
Secondary Data:
-First Aid Injury
-WSIB Claims
Psychosocial Group
FireRangers from 2 Fire Bases
Baseline Measures:
-Fitness Testing
-Psychosocial Questionnaires
Anticipated Time: 1.5 Hours
Intervention:
-Psychosocial workshop
Anticipated Time: 1 Hour
Post-Season Measures:
-Fitness Testing
-Psychosocial Questionnaires
-Job Stress Survey
Anticipated Time: 1 Hour
Secondary Data:
-First Aid Injury
-WSIB Claims
Full Intervention
FireRangers from 2 Fire Bases
Baseline Measures:
-Fitness Testing
-Psychosocial Questionnaires
Anticipated Time: 1.5 Hours
Intervention:
-'Commit to be Fit' Program
-Psychosocial workshop
Anticipated Time: 2 Hours
Post-Season Measures:
-Fitness Testing
-Psychosocial Questionnaires
-Job Stress Survey
Anticipated Time: 1 Hour
Secondary Data:
-First Aid Injury
-WSIB Claims
Control Group
FireRangers from 2 Fire Bases
Baseline Measures:
-Fitness Testing
-Psychosocial Questionnaires
Anticipated Time: 1.5 Hours
Post-Season Measures:
-Fitness Testing
-Psychosocial Questionnaires
-Job Stress Survey
Anticipated Time: 1 Hour
Secondary Data:
-First Aid Injury
-WSIB Claims

Appendix 8: Typical Information Session Set-up

Appendix 9: Letter of Information

Letter of Information

Title of Study: Evaluating the efficacy of a psychosocial and fitness intervention in wildland FireRangers

Principal Investigators: Caleb Leduc, MHK, PhD Student at Lancaster University
Sandra Dorman BSc, PhD, Centre for Research in Occupational Safety and Health, Laurentian University

Wildland firefighters have higher-than-average physical and psychological workplace demands at work, due to rough environmental conditions and irregular/extended hours of work. These demands increase your risk for fatigue, which may also increase your risk of having an accident or injury. With this in mind, the present study was designed to evaluate whether an intervention program, designed to 1) improve your fitness for specific job tasks; and 2) help you manage and reduce your job stress, is able to reduce the number of injuries your base may experience over a fire season.

To test whether this intervention works, we need at least eight bases in Ontario to participate. These bases will be divided into 4 groups, with some bases implementing all aspects of the intervention, some bases implementing part of the intervention and some bases to act as control bases, that is to NOT implement the program.

The 4 Groups are:
Group 1: Control group – this group will not have the intervention program at their base; therefore these FireRangers will carry-on as they would normally during a fire season.
Group 2: Complete Intervention – this group will have a modified fitness program introduced at their base as well as an educational session about job stress at the beginning of the fire season and will receive information about stress reduction over the entire season, in the form of posters and/or emails.
Group 3: Fitness Intervention-Only – this group will have a modified fitness program introduced at their base over the fire season.
Group 4: Job Stress Intervention-Only – this group will receive an education session about job stress at the beginning of the fire season and receive information about stress reduction over the entire fire season, in the form of posters and/or emails.

You have been asked to participate in this study, because you work at one of the eight bases that have been selected to assist us with this research. If you agree to take part in this study you will be asked to meet with researchers on at least two occasions at your base, once prior to the start of the fire season and near the end of the fire season (August). Both visits will occur during times when you are scheduled to be at the base, so you do not need to commit extra time from your personal schedule to participate. If you are in Group 2, 3 or 4 above, you will also be asked to participate in the programs described and available at your base.

Visit 1 (pre-season): This visit will take about 2 hours – during this time we will measure your height, weight, ask you to fill out 3 paper questionnaires and we will measure your current physical fitness, using 4 tests. The fitness tests are: a running-sprint test, grip strength, core strength test, and a balance test. The sprint test will make you winded and you need to be wearing comfortable clothing to perform all tests. Before doing the fitness tests, we will ask some questions about your health to ensure that it is safe for you to do these tasks. If the test indicates that it may be unsafe for you to do the fitness tests, you will be unable to participate in this study.

Visit 2 (post-season): This visit will also take about two hours – during this time, we will repeat all of the same fitness tests and another 3 paper questionnaires. Two of these questionnaires will be the same, one will be different.

Following the fire season, the MNRF-AFFES will provide the research team with any first aid or WSIB injury data you generate over the course of the season. This data will be anonymized and never shared individually.

Your participation in this study is completely voluntary and you can quit at any time for any reason, without any repercussions, from your workplace or other. Your decision to participate in the study does not impact your ability to participate in the MNRF-AFFES' Commit to be Fit program. The MNRF-AFFES will not know who is participating in the study and there will be no repercussions should you choose to not participate.

All of the information you provide is confidential and the information you provide us is coded such that your name is never attached to the data. The data collected for this study will be stored securely and only the researchers conducting this study will have access to this data. Hard copies of the coded questionnaires will be kept in a locked cabinet and stored for a period of 7 years before being destroyed. Computer files will be encrypted. All of your personal data is confidential and individual results will NOT be shared with the MNRF-AFFES.

If you are willing to participate in this study, please read and sign the attached, informed consent and return it to the researcher by placing it in the provided envelope and either returning it to the designated team leader or by depositing it in the designated lock box at your fire base. You may tear off and keep this information sheet. If you do not want to participate, you can return the consent unsigned, in the envelope provided.

Appendix 10: Consent Form

Consent Form

Title of Study: Evaluating the efficacy of a psychosocial and fitness intervention in wildland FireRangers

Principal Investigators: Caleb Leduc, MHK, PhD Candidate, Lancaster University;
Sandra Dorman BSc, Phd, Centre for Research in Occupational Safety and Health, Laurentian University

I understand that:

1. The purpose of this study is to evaluate the impact of an Intervention program on my physical and psychological health to help develop ways to prevent fatigue, enhance recovery during a wildfire deployment and over the course of a fire season and therefore reduce my risk of injury.
2. This study is being primarily conducted by Caleb Leduc, and under the guidance of Dr. Sandra Dorman, PhD.
3. Data collected as a result of this study will be compiled, analyzed and disseminated by Caleb Leduc as a part of his degree requirements in the PhD in Organizational Health and Well Being program at Lancaster University, where his work is supervised by Dr. Sabir Giga, PhD.
4. During the study, I will be asked to meet with researcher twice; once prior to the commencement of the fire season and again near the end of the fire season. At each meeting I will be asked to complete 4 physical fitness evaluation tests, including the running-based anaerobic sprint test, a grip strength test, a core strength and stability test and a balance test; in addition to 3 pen-and-paper questionnaires. These meetings will take about 2 hours each and will occur at the base where I work, during work hours.
5. There is no direct benefit to me from participating in this study, although it may help me better understand my physical fitness and psychological health and well-being.
6. I am aware that I have the option to be provided summary reports on my own personal data collected from fitness tests, upon request.
7. That I will not be allowed to participate in this study if I fail to pass the PAR-Q+ test, a survey that confirms that I am fit-enough to perform the fitness testing.
8. That, although it is unlikely there is a small chance that I will feel dizzy during or after I complete the physical fitness tests, and that I will be provided with support from the research team should this occur.
9. First aid and WSIB injury data will be shared with the research group after the fire season; but all data will be presented as group, data, not individual data.
10. My participation is voluntary and I am free to withdraw from the study at any time, for any reason, and without penalty. I can withdraw by contacting any of

the researchers or supervisors, who will inform the researchers of my withdrawal on my behalf.

11. Regardless of participation in the study, I am free to participate in the Commit to be Fit program led by the MNRF-AFFES.
12. Potential benefits from participating in the study can be anticipated to include increases in physical fitness in addition to knowledge and awareness of psychosocial factors in the workplace.
13. Results from this study may be combined with data collected from future deployments or seasons, if this study were to extend over multiple fire seasons.
14. All information will be coded and presented in such a way that my identity will never be revealed in any reports or publications that may be issued as a result of this study.
15. Data collected will be kept in a locked office at the Centre for Research in Occupational Safety and Health at Laurentian University in Sudbury and disposed of seven years after the results of the study have been published.
16. My personal data will not be shared with anyone, including my employer or anyone at the Ministry of Natural Resources.
17. The Laurentian University Research Ethics Board had approved this study; this group is responsible for ensuring the rights of human subjects are protected through the study design.
18. I have been given the opportunity to ask questions about this study.
19. Results of this study will be made available to me upon request.

If you have any questions regarding your rights as a research participant, you may contact the Research Officer, with the Research Ethics Board at Laurentian University:

Research Officer: Toll Free: 1-800-461-4030
Tel: 705-675-1151, ext.3213
Email: ethics@laurentian.ca

If you have any questions or concerns about the study or your participation, please contact:

Caleb Leduc Toll Free: 1-800-461-4030
Tel: 705-675-1151, ext.1019
Email: cr_leduc@laurentian.ca

Dr. Sandra Dorman Toll Free: 1-800-461-4030
Tel: 705-675-1151, ext.1015
Email: sdorman@laurentian.ca

I have read the letter of information and consent form and I _____ _____ consent to participate in this study. (name of participant)

_____ _____
Signature of Participant Date

I would like a copy of my personal fitness results sent to me (please circle): YES/NO
Please send them to: _____ (email address)

Appendix 11: Research Ethics Board Approval Certificates

APPROVAL FOR CONDUCTING RESEARCH INVOLVING HUMAN SUBJECTS
Research Ethics Board – Laurentian University

This letter confirms that the research project identified below has successfully passed the ethics review by the Laurentian University Research Ethics Board (REB). Your ethics approval date, other milestone dates, and any special conditions for your project are indicated below.

TYPE OF APPROVAL / New X / Modifications to project / Time extension	
Name of Principal Investigator and school/department	Caleb Leduc, PHD candidate, Human Kinetics, supervisor, Sandra Dorman, Human Kinetics
Title of Project	Evaluating the efficacy of a psychosocial and fitness intervention in wildland FireRangers
REB file number	2015-12-18
Date of original approval of project	April 04, 2016
Date of approval of project modifications or extension *(if applicable)*	
Final/Interim report due on: *(You may request an extension)*	April, 2017
Conditions placed on project	

During the course of your research, no deviations from, or changes to, the protocol, recruitment or consent forms may be initiated without prior written approval from the REB. If you wish to modify your research project, please refer to the Research Ethics website to complete the appropriate REB form.

All projects must submit a report to REB at least once per year. If involvement with human participants continues for longer than one year (e.g. you have not completed the objectives of the study and have not yet terminated contact with the participants, except for feedback of final results to participants), you must request an extension using the appropriate LU REB form. In all cases, please ensure that your research complies with Tri-Council Policy Statement (TCPS). Also please quote your REB file number on all future correspondence with the REB office.

Congratulations and best wishes in conducting your research.

Rosanna Langer, PHD, Chair, *Laurentian University Research Ethics Board*

Applicant: Caleb Leduc
Supervisor: Sabir Giga
Department: Health Research
FHMREC Reference: FHMREC15075

25 April 2016

Dear Caleb

Re: Evaluating the efficacy of a psychosocial and fitness intervention in wildland FireRangers.

Thank you for submitting your research ethics application for the above project for review by the Faculty of Health and Medicine Research Ethics Committee (FHMREC). The application was recommended for approval by FHMREC, and on behalf of the Chair of the University Research Ethics Committee (UREC), I can confirm that approval has been granted for this research project.

As principal investigator your responsibilities include:

- ensuring that (where applicable) all the necessary legal and regulatory requirements in order to conduct the research are met, and the necessary licenses and approvals have been obtained;
- reporting any ethics-related issues that occur during the course of the research or arising from the research to the Research Ethics Officer (e.g. unforeseen ethical issues, complaints about the conduct of the research, adverse reactions such as extreme distress);
- submitting details of proposed substantive amendments to the protocol to the Research Ethics Officer for approval.

Please contact the Diane Hopkins (01542 592838 fhmresearchsupport@lancaster.ac.uk) if you have any queries or require further information.

Yours sincerely,

Dr Diane Hopkins
Research Development Officer

CC Ethics@Lancaster; Professor Roger Pickup (Chair, FHMREC)

Appendix 12: Screening questionnaire, surveys and fitness testing protocols

Physical Activity Readiness Questionnaire Plus (PAR-Q+)

CSEP approved Sept 12 2011 version

PAR-Q+

The Physical Activity Readiness Questionnaire for Everyone

Regular physical activity is fun and healthy, and more people should become more physically active every day of the week. Being more physically active is very safe for MOST people. This questionnaire will tell you whether it is necessary for you to seek further advice from your doctor OR a qualified exercise professional before becoming more physically active.

SECTION 1 - GENERAL HEALTH

	Please read the 7 questions below carefully and answer each one honestly: check YES or NO.	YES	NO
1.	Has your doctor ever said that you have a heart condition OR high blood pressure?	☐	☐
2.	Do you feel pain in your chest at rest, during your daily activities of living, OR when you do physical activity?	☐	☐
3.	Do you lose balance because of dizziness OR have you lost consciousness in the last 12 months? Please answer NO if your dizziness was associated with over-breathing (including during vigorous exercise).	☐	☐
4.	Have you ever been diagnosed with another chronic medical condition (other than heart disease or high blood pressure)?	☐	☐
5.	Are you currently taking prescribed medications for a chronic medical condition?	☐	☐
6.	Do you have a bone or joint problem that could be made worse by becoming more physically active? Please answer NO if you had a joint problem in the past, but it does not limit your current ability to be physically active. For example, knee, ankle, shoulder or other.	☐	☐
7.	Has your doctor ever said that you should only do medically supervised physical activity?	☐	☐

If you answered NO to all of the questions above, you are cleared for physical activity.

Go to Section 3 to sign the form. You do not need to complete Section 2.

- Start becoming much more physically active – start slowly and build up gradually.
- Follow the Canadian Physical Activity Guidelines for your age (www.csep.ca/guidelines).
- You may take part in a health and fitness appraisal.
- If you have any further questions, contact a qualified exercise professional such as a CSEP Certified Exercise Physiologist® (CSEP-CEP) or CSEP Certified Personal Trainer® (CSEP-CPT).
- If you are over the age of 45 yrs. and NOT accustomed to regular vigorous physical activity, please consult a qualified exercise professional (CSEP-CEP) before engaging in maximal effort exercise.

If you answered YES to one or more of the questions above, please GO TO SECTION 2.

Delay becoming more active if:

- You are not feeling well because of a temporary illness such as a cold or fever – wait until you feel better
- You are pregnant – talk to your health care practitioner, your physician, a qualified exercise professional, and/or complete the PARmed-X for Pregnancy before becoming more physically active OR
- Your health changes – please answer the questions on Section 2 of this document and/or talk to your doctor or qualified exercise professional (CSEP-CEP or CSEP-CPT) before continuing with any physical activity programme.

CSEP | SCPE
THE GOLD STANDARD IN EXERCISE SCIENCE AND PERSONAL TRAINING

SECTION 2 - CHRONIC MEDICAL CONDITIONS

Please read the questions below carefully and answer each one honestly: check YES or NO.			YES	NO
1.	Do you have Arthritis, Osteoporosis, or Back Problems?		☐ If yes, answer questions 1a-1c	☐ If no, go to question 2
	1a.	Do you have difficulty controlling your condition with medications or other physician-prescribed therapies? (Answer NO if you are not currently taking medications or other treatments)	☐	☐
	1b.	Do you have joint problems causing pain, a recent fracture or fracture caused by osteoporosis or cancer, displaced vertebra (e.g., spondylolisthesis), and/or spondylolysis/pars defect (a crack in the bony ring on the back of the spinal column)?	☐	☐
	1c.	Have you had steroid injections or taken steroid tablets regularly for more than 3 months?	☐	☐
2.	Do you have Cancer of any kind?		☐ If yes, answer questions 2a-2b	☐ If no, go to question 3
	2a.	Does your cancer diagnosis include any of the following types: lung/bronchogenic, multiple myeloma (cancer of plasma cells), head, and neck?	☐	☐
	2b.	Are you currently receiving cancer therapy (such as chemotherapy or radiotherapy)?	☐	☐
3.	Do you have Heart Disease or Cardiovascular Disease? This includes Coronary Artery Disease, High Blood Pressure, Heart Failure, Diagnosed Abnormality of Heart Rhythm		☐ If yes, answer questions 3a-3e	☐ If no, go to question 4
	3a.	Do you have difficulty controlling your condition with medications or other physician-prescribed therapies? (Answer NO if you are not currently taking medications or other treatments)	☐	☐
	3b.	Do you have an irregular heart beat that requires medical management? (e.g. atrial fibrillation, premature ventricular contraction)	☐	☐
	3c.	Do you have chronic heart failure?	☐	☐
	3d.	Do you have a resting blood pressure equal to or greater than 160/90 mmHg with or without medication? (Answer YES if you do not know your resting blood pressure)	☐	☐
	3e.	Do you have diagnosed coronary artery (cardiovascular) disease and have not participated in regular physical activity in the last 2 months?	☐	☐
4.	Do you have any Metabolic Conditions? This includes Type 1 Diabetes, Type 2 Diabetes, Pre-Diabetes		☐ If yes, answer questions 4a-4c	☐ If no, go to question 5
	4a.	Is your blood sugar often above 13.0 mmol/L? (Answer YES if you are not sure)	☐	☐
	4b.	Do you have any signs or symptoms of diabetes complications such as heart or vascular disease and/or complications affecting your eyes, kidneys, and the sensation in your toes and feet?	☐	☐
	4c.	Do you have other metabolic conditions (such as thyroid disorders, pregnancy-related diabetes, chronic kidney disease, liver problems)?	☐	☐
5.	Do you have any Mental Health Problems or Learning Difficulties? This includes Alzheimer's, Dementia, Depression, Anxiety Disorder, Eating Disorder, Psychotic Disorder, Intellectual Disability, Down Syndrome)		☐ If yes, answer questions 5a-5b	☐ If no, go to question 6
	5a.	Do you have difficulty controlling your condition with medications or other physician-prescribed therapies? (Answer NO if you are not currently taking medications or other treatments)	☐	☐
	5b.	Do you also have back problems affecting nerves or muscles?	☐	☐

Please read the questions below carefully and answer each one honestly: check YES or NO.			YES	NO
6.	Do you have a Respiratory Disease? This includes Chronic Obstructive Pulmonary Disease, Asthma, Pulmonary High Blood Pressure		☐ If yes, answer questions 6a-6d	☐ If no, go to question 7
	6a.	Do you have difficulty controlling your condition with medications or other physician-prescribed therapies? (Answer NO if you are not currently taking medications or other treatments)	☐	☐
	6b.	Has your doctor ever said your blood oxygen level is low at rest or during exercise and/or that you require supplemental oxygen therapy?	☐	☐
	6c.	If asthmatic, do you currently have symptoms of chest tightness, wheezing, laboured breathing, consistent cough (more than 2 days/week), or have you used your rescue medication more than twice in the last week?	☐	☐
	6d.	Has your doctor ever said you have high blood pressure in the blood vessels of your lungs?	☐	☐
7.	Do you have a Spinal Cord Injury? This includes Tetraplegia and Paraplegia		☐ If yes, answer questions 7a-7c	☐ If no, go to question 8
	7a.	Do you have difficulty controlling your condition with medications or other physician-prescribed therapies? (Answer NO if you are not currently taking medications or other treatments)	☐	☐
	7b.	Do you commonly exhibit low resting blood pressure significant enough to cause dizziness, light-headedness, and/or fainting?	☐	☐
	7c.	Has your physician indicated that you exhibit sudden bouts of high blood pressure (known as Autonomic Dysreflexia)?	☐	☐
8.	Have you had a Stroke? This includes Transient Ischemic Attack (TIA) or Cerebrovascular Event		☐ If yes, answer questions 8a-c	☐ If no, go to question 9
	8a.	Do you have difficulty controlling your condition with medications or other physician-prescribed therapies? (Answer NO if you are not currently taking medications or other treatments)	☐	☐
	8b.	Do you have any impairment in walking or mobility?	☐	☐
	8c.	Have you experienced a stroke or impairment in nerves or muscles in the past 6 months?	☐	☐
9.	Do you have any other medical condition not listed above or do you live with two chronic conditions?		☐ If yes, answer questions 9a-c	☐ If no, read the advice on page 4
	9a.	Have you experienced a blackout, fainted, or lost consciousness as a result of a head injury within the last 12 months OR have you had a diagnosed concussion within the last 12 months?	☐	☐
	9b.	Do you have a medical condition that is not listed (such as epilepsy, neurological conditions, kidney problems)?	☐	☐
	9c.	Do you currently live with two chronic conditions?	☐	☐

Please proceed to Page 4 for recommendations for your current medical condition and sign this document.

PAR-Q+

If you answered NO to all of the follow-up questions about your medical condition, you are ready to become more physically active:

- It is advised that you consult a qualified exercise professional (e.g., a CSEP-CEP or CSEP-CPT) to help you develop a safe and effective physical activity plan to meet your health needs.
- You are encouraged to start slowly and build up gradually – 20-60 min. of low- to moderate-intensity exercise, 3-5 days per week including aerobic and muscle strengthening exercises.
- As you progress, you should aim to accumulate 150 minutes or more of moderate-intensity physical activity per week.
- If you are over the age of 45 yrs. and NOT accustomed to regular vigorous physical activity, please consult a qualified exercise professional (CSEP-CEP) before engaging in maximal effort exercise.

If you answered YES to one or more of the follow-up questions about your medical condition:

- You should seek further information from a licensed health care professional before becoming more physically active or engaging in a fitness appraisal and/or visit a or qualified exercise professional (CSEP-CEP) for further information.

Delay becoming more active if:

- You are not feeling well because of a temporary illness such as a cold or fever – wait until you feel better
- You are pregnant - talk to your health care practitioner, your physician, a qualified exercise profesional, and/or complete the PARmed-X for Pregnancy before becoming more physically active OR
- Your health changes - please talk to your doctor or qualified exercise professional (CSEP-CEP) before continuing with any physical activity programme.

SECTION 3 - DECLARATION

- You are encouraged to photocopy the PAR-Q+. You must use the entire questionnaire and NO changes are permitted.
- The Canadian Society for Exercise Physiology, the PAR-Q+ Collaboration, and their agents assume no liability for persons who undertake physical activity. If in doubt after completing the questionnaire, consult your doctor prior to physical activity.
- If you are less than the legal age required for consent or require the assent of a care provider, your parent, guardian or care provider must also sign this form.
- Please read and sign the declaration below:

I, the undersigned, have read, understood to my full satisfaction and completed this questionnaire. I acknowledge that this physical activity clearance is valid for a maximum of 12 months from the date it is completed and becomes invalid if my condition changes. I also acknowledge that a Trustee (such as my employer, community/fitness centre, health care provider, or other designate) may retain a copy of this form for their records. In these instances, the Trustee will be required to adhere to local, national, and international guidelines regarding the storage of personal health information ensuring that they maintain the privacy of the information and do not misuse or wrongfully disclose such information.

NAME _____ DATE _____

SIGNATURE _____ WITNESS _____

SIGNATURE OF PARENT/GUARDIAN/CARE PROVIDER _____

For more information, please contact:
Canadian Society for Exercise Physiology
www.csep.ca

KEY REFERENCES
1. Jamnik VJ, Warburton DER, Makarski J, McKenzie DC, Shephard RJ, Stone J, and Gledhill N. Enhancing the cectiveness of clearance for physical activity participation; background and overall process. APNM 36(S1):S3-S13, 2011.
2. Warburton DER, Gledhill N, Jamnik VK, Bredin SSD, McKenzie DC, Stone J, Charlesworth S, and Shephard RJ. Evidence-based risk assessment and recommendations for physical activity clearance; Consensus Document. APNM 36(S1):S266-s298, 2011.

The PAR-Q+ was created using the evidence-based AGREE process (1) by the PAR-Q+Collaboration chaired by Dr. Darren E. R. Warburton with Dr. Norman Gledhill, Dr. Veronica Jamnik, and Dr. Donald C. McKenzie (2). Production of this document has been made possible through financial contributions from the Public Health Agency of Canada and the BC Ministry of Health Services. The views expressed herein do not necessarily represent the views of the Public Health Agency of Canada or BC Ministry of Health Services.

CSEP approved Sept 12 2011 version

GuardingMinds @ WORK

Please note: Your answers are anonymous and individual responses will be kept confidential.
This questionnaire takes 10 to 15 minutes to complete.

	Strongly Agree	Somewhat Agree	Somewhat Disagree	Strongly Disagree
1. My employer offers services or benefits that adequately address my psychological and mental health.	4	3	2	1
2. All people in our workplace are held accountable for their actions.	4	3	2	1
3. In my job, I know what I am expected to do.	4	3	2	1
4. People treat each other with respect and consideration in our workplace.	4	3	2	1
5. Hiring/promotion decisions consider the "people skills" necessary for specific positions.	4	3	2	1
6. I receive feedback at work that helps me grow and develop.	4	3	2	1
7. My immediate supervisor appreciates my work.	4	3	2	1
8. I am able to talk to my immediate supervisor about how I do my work.	4	3	2	1
9. The amount of work I am expected to do is reasonable for my position.	4	3	2	1
10. I enjoy my work.	4	3	2	1
11. My employer encourages me to take my entitled breaks (e.g., lunchtime, sick time, vacation time, earned days off, parental leave).	4	3	2	1
12. My employer is committed to minimizing unnecessary stress at work.	4	3	2	1
13. Management takes appropriate action to protect my physical safety at work.	4	3	2	1
14. My supervisor would say or do something helpful if I looked distressed while at work.	4	3	2	1
15. People at work show sincere respect for others' ideas, values and beliefs.	4	3	2	1
16. Leadership in my workplace is effective.	4	3	2	1
17. Our workplace effectively handles "people problems" that exist between staff.	4	3	2	1
18. My company hires people who fit well within the organization.	4	3	2	1
19. My supervisor is open to my ideas for taking on new opportunities and challenges.	4	3	2	1
20. I am paid fairly for the work I do.	4	3	2	1
21. I have some control over how I organize my work.	4	3	2	1
22. I can talk to my supervisor about the amount of work I have to do.	4	3	2	1
23. I am willing to give extra effort at work if needed.	4	3	2	1
24. I am able to reasonably balance the demands of work and personal life.	4	3	2	1

GuardingMinds @ WORK

25.	My immediate supervisor cares about my emotional well-being.	4	3	2	1
26.	My employer offers sufficient training to help protect my physical safety at work (emergency preparedness, safe lifting, violence prevention).	4	3	2	1
27.	I feel supported in my workplace when I am dealing with personal or family issues.	4	3	2	1
28.	Difficult situations at work are addressed effectively.	4	3	2	1
29.	I am informed about important changes at work in a timely manner.	4	3	2	1
30.	People from all backgrounds are treated fairly in our workplace.	4	3	2	1
31.	I have the social and emotional skills needed to do my job well.	4	3	2	1
32.	I have the opportunity to advance within my organization.	4	3	2	1
33.	My company appreciates extra effort made by employees.	4	3	2	1
34.	My opinions and suggestions are considered at work.	4	3	2	1
35.	I have the equipment and resources needed to do my job well.	4	3	2	1
36.	My work is an important part of who I am.	4	3	2	1
37.	My employer promotes work-life balance.	4	3	2	1
38.	My employer makes efforts to prevent harm to employees from harassment, discrimination or violence.	4	3	2	1
39.	When physical accidents occur or physical risks are identified, my employer responds effectively.	4	3	2	1
40.	My workplace supports employees who are returning to work after time off due to a mental health condition.	4	3	2	1
41.	I feel that I am part of a community at work.	4	3	2	1
42.	My supervisor provides helpful feedback on my performance.	4	3	2	1
43.	Unnecessary conflict is kept to a minimum in our workplace.	4	3	2	1
44.	My supervisor believes that social skills are as valuable as other skills.	4	3	2	1
45.	My company values employees' ongoing growth and development.	4	3	2	1
46.	Our organization celebrates our shared accomplishments.	4	3	2	1
47.	I am informed of important changes that may impact how my work is done.	4	3	2	1
48.	My work is free from unnecessary interruptions and disruptions.	4	3	2	1
49.	I am committed to the success of my organization.	4	3	2	1

50.	I can talk to my supervisor when I am having trouble maintaining work-life balance.	4	3	2	1
51.	I would describe my workplace as being psychologically healthy.	4	3	2	1
52.	I have the equipment and tools I need to do my job in a physically safe way (protective clothing, adequate lighting, ergonomic seating).	4	3	2	1
53.	People in my workplace have a good understanding of the importance of employee mental health.	4	3	2	1
54.	Employees and management trust one another.	4	3	2	1
55.	My organization provides clear, effective communication.	4	3	2	1
56.	My workplace has effective ways of addressing inappropriate behaviour by customers or clients.	4	3	2	1
57.	My position makes good use of my personal strengths.	4	3	2	1
58.	I have the opportunity to develop my "people skills" at work.	4	3	2	1
59.	My employer values my commitment and passion for my work.	4	3	2	1
60.	My employer encourages input from all staff on important issues related to their work.	4	3	2	1
61.	I have control over prioritizing tasks and responsibilities when facing multiple demands at work.	4	3	2	1
62.	I am proud of the work I do.	4	3	2	1
63.	I have energy left at the end of most workdays for my personal life.	4	3	2	1
64.	My employer deals effectively with situations that may threaten or harm employees (e.g., harassment, discrimination, violence).	4	3	2	1
65.	My employer responds appropriately when workers raise concerns about physical safety.	4	3	2	1

Specific Areas of Concern:

1) In my workplace, I am experiencing discrimination because of my cultural/ethnic background, disability, sexual orientation, gender or age.
   ☐ Yes ☐ No

2) In my workplace, I am being bullied or harassed, either verbally, physically or sexually.
   ☐ Yes ☐ No

3) In my workplace, I am being treated unfairly because I have a mental illness.
   ☐ Yes ☐ No

Utrecht Work Engagement Scale

Work & Well-being Survey (UWES) ©

The following 17 statements are about how you feel at work. Please read each statement carefully and decide if you ever feel this way about your job. If you have never had this feeling, cross the '0' (zero) in the space after the statement. If you have had this feeling, indicate how often you feel it by crossing the number (from 1 to 6) that best describes how frequently you feel that way.

	Almost never	Rarely	Sometimes	Often	Very often	Always
0	1	2	3	4	5	6
Never	A few times a year or less	Once a month or less	A few times a month	Once a week	A few times a week	Every day

1. _____ At my work, I feel bursting with energy* *(VI1)*
2. _____ I find the work that I do full of meaning and purpose *(DE1)*
3. _____ Time flies when I'm working *(AB1)*
4. _____ At my job, I feel strong and vigorous *(VI2)**
5. _____ I am enthusiastic about my job *(DE2)**
6. _____ When I am working, I forget everything else around me *(AB2)*
7. _____ My job inspires me *(DE3)**
8. _____ When I get up in the morning, I feel like going to work *(VI3)**
9. _____ I feel happy when I am working intensely *(AB3)**
10. _____ I am proud on the work that I do *(DE4)**
11. _____ I am immersed in my work *(AB4)**
12. _____ I can continue working for very long periods at a time *(VI4)*
13. _____ To me, my job is challenging *(DE5)*
14. _____ I get carried away when I'm working *(AB5)**
15. _____ At my job, I am very resilient, mentally *(VI5)*
16. _____ It is difficult to detach myself from my job *(AB6)*
17. _____ At my work I always persevere, even when things do not go well *(VI6)*

Psychological Capital (PsyCap) Questionnaire (PCQ)
Self-Rater Version

Name: _____ Date: _____

Organization ID #: _____ Person ID #: _____

Instructions: Below are statements that describe how you may think about yourself **right now**. Use the following scale to indicate your level of agreement or disagreement with each statement.

Strongly Disagree	Disagree	Somewhat Disagree	Somewhat Agree	Agree	Strongly Agree
1	2	3	4	5	6

1.	I feel confident analyzing a long-term problem to find a solution.	1	2	3	4	5	6
2.	I feel confident in representing my work area in meetings with management.	1	2	3	4	5	6
3.	I feel confident contributing to discussions about the organization's strategy.	1	2	3	4	5	6
4.	I feel confident helping to set targets/goals in my work area.	1	2	3	4	5	6
5.	I feel confident contacting people outside the organization (e.g., suppliers, customers) to discuss problems.	1	2	3	4	5	6
6.	I feel confident presenting information to a group of colleagues.	1	2	3	4	5	6
7.	If I should find myself in a jam at work, I could think of many ways to get out of it.	1	2	3	4	5	6
8.	At the present time, I am energetically pursuing my work goals.	1	2	3	4	5	6
9.	There are lots of ways around any problem.	1	2	3	4	5	6
10.	Right now I see myself as being pretty successful at work.	1	2	3	4	5	6
11.	I can think of many ways to reach my current work goals.	1	2	3	4	5	6
12.	At this time, I am meeting the work goals that I have set for myself.	1	2	3	4	5	6
13.	When I have a setback at work, I have trouble recovering from it, moving on.	1	2	3	4	5	6
14.	I usually manage difficulties one way or another at work.	1	2	3	4	5	6
15.	I can be "on my own," so to speak, at work if I have to.	1	2	3	4	5	6
16.	I usually take stressful things at work in stride.	1	2	3	4	5	6
17.	I can get through difficult times at work because I've experienced difficulty before.	1	2	3	4	5	6
18.	I feel I can handle many things at a time at this job.	1	2	3	4	5	6
19.	When things are uncertain for me at work, I usually expect the best.	1	2	3	4	5	6
20.	If something can go wrong for me work-wise, it will.	1	2	3	4	5	6
21.	I always look on the bright side of things regarding my job.	1	2	3	4	5	6
22.	I'm optimistic about what will happen to me in the future as it pertains to work.	1	2	3	4	5	6
23.	In this job, things never work out the way I want them to.	1	2	3	4	5	6
24.	I approach this job as if "every cloud has a silver lining."	1	2	3	4	5	6

Typical Survey Completion Setting

Anthropometric Measurement Setting

Core Muscle Strength and Stability Test

The objective of the Core Muscle Strength & Stability Test is to monitor the development of an individual's abdominal and lower back muscles.

Equipment

- Flat non-slip surface
- Mat
- Stopwatch
-

The evaluator is responsible for instructing the participant as to the position to assume at the appropriate stage. Throughout the test the back, neck and head should be maintained in the posture as per figure below. If you are unable to hold the position then the test is to be stopped.

Stage 1

- The athlete warms up for 10 minutes
- The athlete, using the mat to support their elbows and arms, assumes the **Start Position**
- Once the athlete is in the correct position the assistant starts the stopwatch
- The athlete is to hold this position for 60 seconds

Stage 2

- The athlete lifts their right arm off the ground and extends it out in front of them parallel with the ground
- The athlete is to hold this position for 15 seconds

Stage 3

- The athlete returns to the **Start Position**, lifts the left arm off the ground and extends it out in front of them parallel with the ground
- The athlete is to hold this position for 15 seconds

Stage 4

- The athlete returns to the **Start Position**, lifts the right leg off the ground and extends it out behind them parallel with the ground
- The athlete is to hold this position for 15 seconds

Stage 5

- The athlete returns to the **Start Position**, lifts the left leg off the ground and extends it out behind them parallel with the ground
- The athlete is to hold this position for 15 seconds

Stage 6

- The athlete returns to the **Start Position**, lifts the left leg and right arm off the ground and extends them out parallel with the ground
- The athlete is to hold this position for 15 seconds

Stage 7

- The athlete returns to the **Start Position**, lifts the right leg and left arm off the ground and extends them out parallel with the ground
- The athlete is to hold this position for 15 seconds

Stage 8

- The athlete returns to the **Start Position**
- The athlete is to hold this position for 30 seconds

Stage 9

- End of test

Typical Core Strength Testing Procedures

Example of Participant on Stage 7 of core strength testing

Grip Strength Test

Participant squeezes dynamometer as hard as they can.

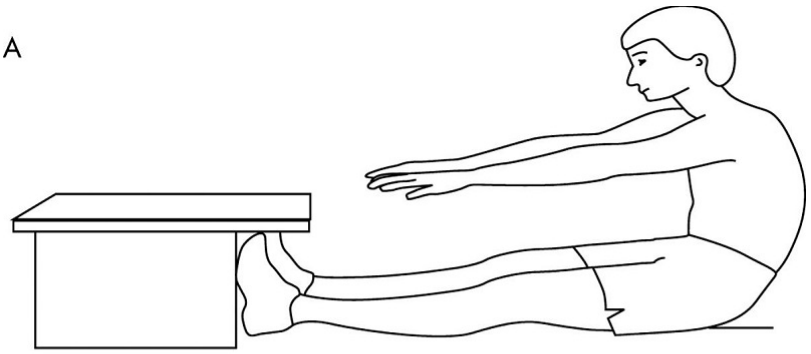
Participants acclimatizing with grip strength measurement equipment and procedure

Participant completing grip strength measurement

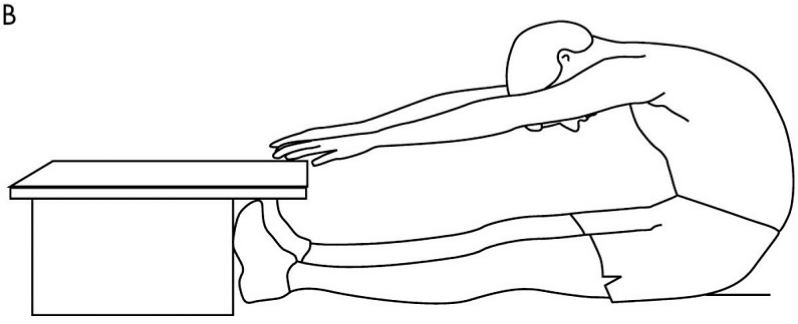
Sit and Reach Test

Preparation
Warm up your muscles with a low-intensity activity such as walking or easy jogging. Then perform slow stretching movements.
Instructions
1. Remove your shoes and sit facing the flexibility measuring device with your knees fully extended and your feet flat against the device about 10 centimetres apart.
2. On an exhale, reach as far forward as you can, with palms down, arms evenly stretched, and knees fully extended; hold the position of maximum reach for about 2 seconds.
3. Perform the stretch 2 times, recording the distance of maximum reach to the nearest 0.5 centimetres: _____cm

A



B



Participant completing sit and reach testing

Running-Based Anaerobic Sprint Test

Procedure: This test requires the participant to undertake six 35 metre sprints with 10 seconds recovery between each sprint. The 1st assistant weighs and records the athlete's weight. The participant warms up for 10 minutes. The assistant will mark out a 35 metre straight on the track with the cones. The assistants each have a stopwatch or be equipped with a digital laser timing system. The participant completes six 35 metre runs at maximum pace with 10 seconds allowed between each sprint for turnaround as follows: The participant, using a standing start, gets ready to sprint; the 2nd assistant gives the command GO for the athlete to start and the 1st assistant starts his/her stopwatch.

When the participant completes the 35 metres: the 1st assistant stops his/her stopwatch, records the time and resets the stopwatch while the 2nd assistant starts his/her stopwatch to time the 10 second turnaround. When 10 seconds has elapsed the 2nd assistant gives the command GO for the participant to start, rests the stopwatch and the 1st assistant starts his/her stopwatch. Repeat 6 times.

Participants completing RAST Testing procedures

Appendix 13: Post-intervention feedback surveys

FIT TO FIGHT
FITNESS TRAINING INTERVENTION EVALUATION

1. Did you receive your fitness results by email?
a. Yes
b. No

2. If yes, how useful do you think the information in the feedback document was?
a. Not at all useful
b. Not very useful
c. Somewhat useful
d. Very useful

3. Did you discuss your fitness results with any of your colleagues?
a. Yes
b. No

4. Did you use the information found in your fitness results to guide your training over the course of the season?
a. Yes
b. No

5. How would you describe how often you logged your workouts over the course of the season (e.g., either on the iPad or paper copy)
a. Never
b. Rarely
c. Occasionally
d. Often
e. Every time

6. How do you feel that the fitness tests in our study captured the level of fitness needed to be a FireRanger?
a. Very Poorly
b. Poorly
c. Fairly
d. Good
e. Very Good

7. Please provide us with any other feedback regarding the Commit to be Fit Program:

_____
_____
_____
_____
_____

FIT TO FIGHT
PSYCHOSOCIAL EDUCATION INTERVENTION EVALUATION

1. Did you receive the 13 psychosocial fact sheets by email?
a. Yes
b. No

2. Did you read the psychosocial fact sheets?
a. Yes
b. No

3. What did you think of the material covered within the fact sheets (e.g. appropriate for FireRangers, visually appealing, easy to understand)?
a. Not at all useful
b. Not very useful
c. Somewhat useful
d. Very useful

4. Were the psychosocial fact sheets sent by email and posted around your base the best way to communicate and educate FireRangers about psychosocial risk factors?
a. Yes
b. No
c. If no, what other ways you would have preferred?

_____
_____

5. In your opinion, did the psychosocial fact sheets talk about issues faced by FireRangers over the course of a fire season?
a. Not at all
b. Somewhat
c. Always

6. Over the course of the past fire season, did you discuss the content of the fact sheets with your fellow FireRangers?
a. Never
b. Rarely
c. Occasionally
d. Often
e. Every time

7. Please provide us with any other feedback regarding the psychosocial fact sheets:

_____
_____
_____
_____

Appendix 14: Pearson Correlation matrix across T1 Measurements (Cronbach's alpha reliability assessment)

		M	SD	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
1.	FireRanger Age (Years)	24.02	5.078	-																						
2.	Number of Years of Fire Experience	3.89	3.297	.66**	-																					
3.	T1: UWES Average	4.63	.663	-.12	-.18**	-	(.886)																			
4.	T1: UWES Vigour Scale Average	4.85	.716	-.04	-.18**	.85**	-	(.807)																		
5.	T1: UWES Dedication Scale Average	4.88	.806	-.12	-.20**	.87**	.66**	-	(.818)																	
6.	T1: UWES Absorption Scale Average	4.20	.791	-.16*	-.09	.86**	.57**	.63**	-	(.693)																
7.	T1: PsyCap Efficacy Scale	27.58	4.921	.03	.00	.45**	.45**	.35**	.36**	-	(.843)															
8.	T1: PsyCap Hope Scale	29.78	4.287	-.05	-.14*	.61**	.61**	.57**	.40**	.62**	-	(.835)														
9.	T1: PsyCap Resiliency Scale	28.90	3.623	.19**	.02	.34**	.49**	.25**	.14*	.42**	.57**	-	(.637)													
10.	T1: PsyCap Optimism Scale	26.96	4.165	-.04	-.22**	.49**	.59**	.48**	.22**	.37**	.58**	.52**	-	(.613)												
11.	T1: PF1-Psychological Support	16.75	2.583	-.34**	-.29**	.45**	.35**	.50**	.35**	.37**	.41**	.07	.36**	-	(.772)											

12.	T1: PF2-Organizational Culture	16.51	2.831	-.40**	-.34**	.44**	.34**	.49**	.34**	.36**	.45**	-.01	.35**	.76**	-	(.807)										
13.	T1: PF3-Clear Leadership & Expectation	16.87	2.602	-.33**	-.25**	.44**	.34**	.47**	.36**	.29**	.44**	.00	.31**	.70**	.78**	-	(.740)									
14.	T1: PF4-Civility & Respect	16.50	2.750	-.37**	-.25**	.43**	.31**	.46**	.35**	.34**	.41**	.02	.29**	.76**	.84**	.75**	-	(.830)								
15.	T1: PF5-Psychological Competencies & Requirements	16.77	2.441	-.30**	-.28**	.40**	.31**	.47**	.27**	.37**	.48**	.11	.36**	.71**	.74**	.76**	.74**	-	(.712)							
16.	T1: PF6-Growth & Development	17.26	2.603	-.42**	-.40**	.48**	.40**	.53**	.33**	.29**	.52**	.04	.40**	.74**	.78**	.79**	.71**	.77**	-	(.800)						
17.	T1: PF7-Recognition & Reward	16.94	2.747	-.48**	-.43**	.46**	.37**	.50**	.33**	.30**	.48**	.09	.41**	.73**	.78**	.75**	.71**	.76**	.81**	-	(.790)					
18.	T1: PF8-Involvement & Influence	16.82	2.513	-.30**	-.23**	.47**	.37**	.50**	.37**	.36**	.49**	.09	.33**	.70**	.73**	.80**	.74**	.73**	.79**	.78**	-	(.767)				
19.	T1: PF9-Workload Management	17.14	2.235	-.27**	-.30**	.37**	.32**	.38**	.29**	.35**	.46**	.12	.34**	.61**	.63**	.67**	.61**	.64**	.67**	.68**	.75**	-	(.713)			
20.	T1: PF10-Engagement	18.81	1.782	-.20**	-.19**	.62**	.50**	.70**	.44**	.38**	.52**	.21**	.45**	.52**	.48**	.48**	.49**	.50**	.56**	.49**	.51**	.51**	-	(.743)		
21.	T1: PF11-Balance	16.20	2.846	-.30**	-.31**	.40**	.34**	.46**	.28**	.39**	.46**	.11	.36**	.73**	.66**	.66**	.65**	.65**	.67**	.70**	.65**	.61**	.51**	-	(.744)	
22.	T1: PF12-Psychological Protection	17.05	2.586	-.37**	-.31**	.42**	.35**	.47**	.29**	.29**	.45**	.15*	.40**	.78**	.79**	.72**	.81**	.74**	.73**	.76**	.74**	.65**	.50**	.69**	-	(.797)

23.	T1: PF13-Protection of Physical Safety	18.28	2.034	-.31**	-.28**	.31**	.27**	.34**	.22**	.24**	.38**	.13	.30**	.64**	.61**	.66**	.60**	.59**	.65**	.66**	.66**	.62**	.44**	.55**	.65**	(.776)
		M	**SD**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**

**Correlation is significant at the .01 level (two-tailed)
*Correlation is significant at the .05 level (two-tailed)

Appendix 15: Pearson correlation matrices for male and female participant measures of physical fitness

MALES		*M*	SD	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
1.	FireRanger Age (Years)	24.13	5.203	1																											
2.	Number of Years of Fire Experience	3.97	3.488	.672**	1																										
3.	Number of Hours Worked During 2016 Fire Season	989.43	168.243	.428**	.448**	1																									
4.	T1: FireRanger Height in M	1.80	.062	0.003	-0.056	-0.007	1																								
5.	T1: FireRanger Weight in KGs	83.07	13.312	.213**	.152*	.161*	.383**	1																							
6.	T1: FireRanger BMI	25.61	3.721	.236**	.198**	.180*	-0.05	.902**	1																						
7.	T1: FireRanger Best Right Grip Strength (in KGs)	60.05	8.500	0.031	0.046	.194*	.282**	.329**	.224**	1																					
8.	T1: FireRanger Best Left Grip Strength (in KGs)	56.46	7.951	.154*	.157*	.271**	.239**	.302**	.215**	.840**	1																				
9.	T1: FireRanger Total Grip Strength (in KGs)	116.51	15.781	0.094	0.104	.241**	.273**	.330**	.229**	.962**	.956**	1																			
10.	T1: FireRanger Best Sit and Reach (in CMs	29.03	8.275	0.063	-0.027	0.132	0.003	-0.098	-0.115	0.135	0.109	0.128	1																		
11.	T1: FireRanger Core Test Time	2.66	.577	-0.017	-0.129	0.08	-.189*	-.380**	-.318**	0.077	0.069	0.077	.166*	1																	
12.	T1: MAX Power Produced (in watts)	682.3	143.12	-.159*	-0.133	0.04	.206**	.422**	.360**	.406**	.348**	.394**	.179*	0.021	1																
13.	T1: MIN Power Produced (in watts)	390.69	83.150	-.158*	-0.104	0.019	0.147	.153*	0.096	.353**	.277**	.330**	.232**	0.028	.648**	1															
14.	T1: Average Power Produced (in watts)	521.03	96.195	-.179*	-0.142	0.021	.176*	.342**	.289**	.425**	.365**	.413**	.236**	0.041	.923**	.834**	1														
15.	T1: Fatigue Index (watts/second)	8.34	3.194	-0.127	-0.127	0.02	0.127	.351**	.321**	.277**	.251**	.276**	0.1	0.047	.872**	.206**	.664**	1													
16.	T1: Watts produced per kilogram	8.32	1.604	-.294**	-.239**	-0.059	-0.07	-.303**	-.295**	.152*	0.123	0.144	.268**	.295**	.727**	.562**	.709**	.648**	1												
17.	T2: FireRanger Weight in KGs	84.80	13.010	.192*	0.139	0.046	.381**	.980**	.887**	.280**	.269**	.287**	-.192*	-.396**	.387**	.163*	.327**	.306**	-.318**	1											
18.	T2: FireRanger BMI	26.19	3.638	.225**	.176*	0.069	-0.07	.865**	.974**	.174*	.184*	.186*	-.219**	-.328**	.312**	0.104	.261**	.262**	-.308**	.894**	1										
19.	T2: FireRanger Max Right Hand Grip Strength	60.79	8.628	0.025	0.096	0.097	.264**	.298**	.202*	.748**	.716**	.764**	0.106	0.02	.355**	.308**	.373**	.249**	0.145	.305**	.202*	1									
20.	T2: FireRanger Max Left Hand Grip Strength	57.52	8.177	0.08	0.141	0.112	.254**	.239**	0.145	.703**	.803**	.783**	0.107	0.027	.295**	.272**	.323**	.194*	0.128	.269**	.167*	.853**	1								
21.	T2: Total Grip Strength (in KGs)	118.27	16.190	0.053	0.124	0.107	.268**	.278**	.180*	.754**	.787**	.803**	0.112	0.023	.343**	.303**	.364**	.236**	0.148	.298**	.192*	.965**	.960**	1							
22.	T2: Best Sit and Reach attempt (in CM)	30.86	7.652	0.05	0.002	0.105	0.004	-0.151	-.171*	.170*	.162*	.174*	.843**	.171*	0.116	.257**	.186*	-0.003	.242**	-.189*	-.213**	.185*	0.148	.173*	1						
23.	T2: FireRanger Core Test Time	2.76	.497	-0.056	-0.025	0.121	-0.125	-.387**	-.360**	0.095	0.116	0.11	.225**	.529**	0.077	0.07	0.079	0.097	.340**	-.403**	-.370**	0.063	0.047	0.057	.257**	1					
24.	T2: Maximum Power Produced (in watts)	669.17	128.791	-.175*	-0.05	-0.004	0.153	.196*	0.152	.380**	.285**	.349**	0.093	0.096	.796**	.674**	.797**	.602**	.649**	.208*	0.157	.393**	.346**	.385**	0.107	0.127	1				
25.	T2: Minimum Power Produced (in watts)	404.03	90.936	-.224**	-0.066	-0.054	0.069	0.002	-0.021	.314**	.222**	.281**	.216*	0.05	.556**	.605**	.618**	.338**	.551**	-0.007	-0.038	.268**	.211*	.249**	.229**	0.146	.623**	1			
26.	T2: Average Power Produced (in watts)	524.91	94.261	-.213*	-0.104	-0.108	0.143	0.113	0.062	.372**	.267**	.336**	.219*	0.118	.753**	.737**	.818**	.499**	.684**	0.122	0.059	.387**	.344**	.379**	.217*	0.155	.919**	.795**	1		
27.	T2: Fatigue Index (watts/second)	7.66	2.833	-0.086	-0.053	-0.007	0.13	.188*	0.141	.238**	0.171	.215*	0.006	0.11	.627**	.393**	.562**	.573**	.515**	.213*	0.165	.294**	.255**	.285**	-0.029	0.133	.841**	0.149	.614**	1	
28.	T2: Watts produced per kilogram	8.06	1.631	-.253**	-0.108	0.001	-0.147	-.456**	-.433**	.174*	0.111	0.15	.221**	.314**	.461**	.505**	.502**	.341**	.826**	-.452**	-.422**	0.164	0.164	.170*	.214*	.351**	.761**	.556**	.766**	.643**	1

**Correlation is significant at the .01 level (two-tailed)
*Correlation is significant at the .05 level (two-tailed)

FEMALES

		M	SD	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
1.	FireRanger Age (Years)	23.63	4.652	1																											
2.	Number of Years of Fire Experience	3.61	2.523	.596**	1																										
3.	Number of Hours Worked During 2016 Fire Season	958.22	172.298	0.192	0.084	1																									
4.	T1: FireRanger Height in M	1.66	0.064	-0.195	-0.012	-.368*	1																								
5.	T1: FireRanger Weight in KGs	70.30	9.245	0.171	0.008	-0.074	.385**	1																							
6.	T1: FireRanger BMI	25.41	3.198	.311*	0.034	0.142	-0.198	.826**	1																						
7.	T1: FireRanger Best Right Grip Strength (in KGs)	38.50	4.974	0.075	0.119	-0.087	.379**	.358*	0.149	1																					
8.	T1: FireRanger Best Left Grip Strength (in KGs)	35.77	4.718	-0.077	-0.159	-0.104	.321*	0.256	0.076	.767**	1																				
9.	T1: FireRanger Total Grip Strength (in KGs)	74.27	9.113	0.001	-0.017	-0.101	.373**	.328*	0.121	.943**	.937**	1																			
10.	T1: FireRanger Best Sit and Reach (in CMs	36.22	7.322	-0.152	0.014	-0.131	0.277	0.223	0.066	0.185	0.135	0.171	1																		
11.	T1: FireRanger Core Test Time	2.52	0.597	0.183	0.034	0.068	-0.223	-.433**	-.317*	0.15	0.132	0.15	-0.171	1																	
12.	T1: MAX Power Produced (in watts)	392.75	80.938	-.298*	-0.114	-0.106	0.037	0	-0.022	0.246	0.245	0.262	-0.12	0.245	1																
13.	T1: MIN Power Produced (in watts)	237.87	46.797	-.471**	-0.15	-0.084	0.089	-0.079	-0.129	0.181	0.112	0.157	-0.013	.302*	.726**	1															
14.	T1: Average Power Produced (in watts)	304.73	57.076	-.350*	-0.105	-0.061	0.027	-0.014	-0.026	0.217	0.168	0.206	-0.094	0.262	.928**	.893**	1														
15.	T1: Fatigue Index (watts/second)	3.94	1.557	-0.123	-0.068	-0.075	-0.067	-0.039	-0.007	0.162	0.223	0.204	-0.172	0.18	.889**	.341*	.688**	1													
16.	T1: Watts produced per kilogram	5.68	1.339	-.344*	-0.115	-0.063	-0.192	-.531**	-.447**	0.029	0.075	0.055	-0.22	.472**	.837**	.650**	.780**	.767**	1												
17.	T2: FireRanger Weight in KGs	71.54	9.845	0.188	0.043	-0.092	.343*	.969**	.825**	.347*	0.283	.337*	0.16	-.440**	0.029	-0.121	-0.008	0.025	-.495**	1											
18.	T2: FireRanger BMI	26.01	3.432	.323*	0.085	0.008	-0.156	.852**	.967**	0.182	0.123	0.163	0.074	-.388*	-0.035	-0.187	-0.066	0.003	-.477**	.872**	1										
19.	T2: FireRanger Max Right Hand Grip Strength	39.48	5.640	-0.09	0.044	-0.204	.357*	0.268	0.084	.855**	.745**	.853**	0.157	0.06	0.218	0.218	0.217	0.113	0.074	0.291	0.113	1									
20.	T2: FireRanger Max Left Hand Grip Strength	37.15	5.377	-0.146	0.039	-0.081	.325*	0.145	-0.013	.796**	.711**	.803**	0.202	0.088	0.227	0.198	0.211	0.146	0.117	0.141	-0.017	.857**	1								
21.	T2: Total Grip Strength (in KGs)	76.63	10.615	-0.121	0.043	-0.15	.354*	0.215	0.038	.857**	.756**	.860**	0.186	0.076	0.231	0.216	0.222	0.134	0.099	0.226	0.051	.965**	.962**	1							
22.	T2: Best Sit and Reach attempt (in CM)	36.93	7.701	-0.038	0.024	0.135	0.128	0.15	0.086	0.189	0.157	0.184	.911**	-0.071	-0.194	-0.056	-0.139	-0.231	-0.242	0.108	0.042	0.24	0.289	0.274	1						
23.	T2: FireRanger Core Test Time	2.69	0.495	0.005	-0.032	0.064	-0.074	-.329*	-0.283	0.102	0.271	0.2	-0.125	.537**	0.065	0.041	-0.007	0.093	0.265	-.357*	-.319*	0.103	0.186	0.15	-0.071	1					
24.	T2: Maximum Power Produced (in watts)	378.87	64.992	-0.186	-0.012	-0.124	0.038	-0.002	-0.02	0.262	0.174	0.233	-0.031	0.141	.706**	.632**	.685**	.534**	.644**	0.01	-0.009	.367*	0.247	0.321	-0.011	0.064	1				
25.	T2: Minimum Power Produced (in watts)	240.23	45.630	-.400*	-0.135	-0.131	0.001	-0.202	-0.209	0.112	0.047	0.085	0.179	0.077	0.27	.518**	.379*	0.055	.355*	-0.201	-0.214	.336*	0.181	0.27	0.236	0.145	.588**	1			
26.	T2: Average Power Produced (in watts)	300.38	48.647	-0.295	-0.081	-0.14	-0.011	-0.068	-0.06	0.28	0.128	0.219	-0.005	0.079	.602**	.633**	.615**	.416*	.584**	-0.068	-0.063	.430*	0.301	.383*	0.024	0.191	.875**	.860**	1		
27.	T2: Fatigue Index (watts/second)	3.55	1.381	0.048	0.091	-0.041	-0.058	-0.019	0.018	0.233	0.154	0.208	-0.232	0.21	.687**	.412*	.567**	.662**	.638**	-0.007	0.029	0.178	0.178	0.186	-0.245	0.076	.830**	0.064	.505**	1	
28.	T2: Watts produced per kilogram	5.39	1.168	-0.277	-0.065	-0.134	-0.156	-.567**	-.484**	0.035	-0.034	0	0.02	.389*	.506**	.556**	.510**	.369*	.766**	-.580**	-.510**	0.189	0.183	0.194	0.075	0.27	.803**	.576**	.728**	.682**	1

**Correlation is significant at the .01 level (two-tailed)
*Correlation is significant at the .05 level (two-tailed)

Appendix 16: Comparison of T1 and T2 Measures within Control Group

A secondary objective of the current research was to document the changes in job demands and resources, personal resources, including physical fitness and psychological capital and work engagement over the course of a wildland fire season in a control group. This objective emerged as a high priority through consultation with the partnering organization, as a desire was expressed across all levels within the organization to document the changes that occur naturally across a wildland fire season within their organization. Further, as several measures in the current study had yet to be utilized within the context of wildland fire, it would offer a unique perspective and baseline for both the current and future intervention programs and policy changes. Contextually, the changes presented across the wildland fire season in study offers a perspective of a low-hazard and activity-level fire season, with the two locations comprising the control group responding to only 33 fires burning a combined 42.1ha. Indeed, the cumulative average number of hours worked across the wildland fire season was 911.8 (*SD*=216.16), statistically significantly fewer hours than the other locations comprising the experimental conditions. Participation and retention rates across both locations was high, with 96% of participants completing both T1 and T2 measurements.

Subjective Measures of Job Demands

A paired-samples t-test was used to determine whether there a statistically significant mean difference between pre- and post-season subjective measures of job demands (see Table A1). There was a statistically significant decline in the scores for each of the three scales, denoting a rise in the psychosocial strain stemming from the subjective measures of job demands across the wildland fire season. The distribution of individuals by

reference category from the Guarding Minds at Work from T1 to T2 can be found in Table A2.

Table A1. Results of paired samples t-test for control group for subjective measures of job demands

Research Measure	T1			T2			Paired Samples t-test		
	N	*M*	*SD*	*N*	*M*	*SD*	*t*	df	*Sig.*
Psychological Job Demands	43	16.65	2.562	43	14.65	2.785	-5.704	42	.000**
Civility & Respect	42	16.55	2.949	42	14.50	2.949	-6.166	41	.000**
Work-Life Balance	43	16.79	2.512	43	15.72	2.814	-2.470	42	.018*
*significant at .05 alpha level **significant at the .001 alpha level									

Table A2. Percentage of participants by subjective measures of job demands reference categories at T1 and T2 for the control group

Scale			Guarding Minds at Work Reference Category			
	Time	*Total N*	*Serious Concerns*	*Significant Concerns*	*Minimal Concerns*	*Relative Strength*
Psychological Job Demands	1	48	-	12.5	29.2	58.3
	2	43	2.3	34.9	39.5	23.3
Civility & Respect	1	48	-	10.4	39.6	50.0
	2	42	4.8	23.8	40.5	31.0
Work-Life Balance	1	48	-	6.3	35.4	58.3
	2	43	-	23.3	34.9	41.9

Job Resources

Paired samples t-test was used to determine whether there was a statistically significant mean difference between the scores for all 10 psychosocial risk factors classified as job resources from T1 to T2 (see Table A3). Mean scores were statistically significantly lower at T2 across all 10 scores from T1, with the greatest differences emerging on organizational culture (95% CI, 2.31 to 3.97) and involvement and influence (95% CI, 1.31 to 3.01). The distribution of individuals by reference category from the Guarding Minds at Work from T1 to T2 can be found in Table A4.

Table A3. Results of paired samples t-test for control group on measures of job resources

	T1			**T2**			**Paired Samples t-test**		
Research Measure	*N*	*M*	*SD*	*N*	*M*	*SD*	*t*	df	*Sig. (2-tailed)*
Psychological Support	42	17.07	2.443	42	15.14	3.081	-4.525	41	.000**
Organizational Culture	43	16.49	2.772	43	13.35	3.146	-7.638	42	.000**
Clear Leadership and Expectations	43	16.84	2.794	43	14.91	2.959	-4.714	42	.000**
Growth and Development	43	17.37	2.268	43	15.91	2.524	-3.871	42	.000**
Recognition and Reward	43	16.84	3.055	43	15.26	3.437	-3.731	42	0.001*
Involvement and Influence	43	17.12	2.402	43	14.95	2.895	-5.139	42	.000**
Workload Management	43	17.26	2.564	43	15.95	2.309	-3.465	42	0.001*
Engagement	43	19.14	1.167	43	17.79	1.872	-5.111	42	.000**
Psychological Protection	42	17.12	2.244	42	15.26	3.650	-3.801	41	.000**

Protection of Physical Safety	43	18.23	1.962	43	17.19	2.710	-2.896	42	0.006*
*significant at .01 alpha level **significant at the .001 alpha level									

Table A4. Percentage of participants by subjective measures of job resources reference categories at T1 and T2 for the control group

			Guarding Minds at Work Reference Category			
Research Measure	*Time*	*Total N*	*Serious Concerns*	*Significant Concerns*	*Minimal Concerns*	*Relative Strength*
Psychological Support	1	48	-	6.3	33.3	60.4
	2	42	2.4	21.4	45.2	31.0
Organizational Culture	1	48	-	14.6	27.1	58.3
	2	43	16.3	27.9	37.2	18.6
Clear Leadership and Expectations	1	48	2.1	12.5	25.0	60.4
	2	43	2.3	30.2	34.9	32.6
Growth and Development	1	48	-	4.2	29.2	66.7
	2	43	-	20.9	34.9	44.2
Recognition and Reward	1	48	2.1	12.5	22.9	62.5
	2	43	4.7	32.6	20.9	41.9
Involvement and Influence	1	48	-	10.4	22.9	66.7
	2		4.7	30.2	34.9	30.2
Workload Management	1	48	-	12.5	22.9	64.6
	2	43	-	11.6	46.5	41.9
Engagement	1	48	-	-	6.3	93.8
	2	43	-	-	27.9	72.1
Psychological Protection	1	48	-	6.3	35.4	58.3
	2	42	7.1	19.0	26.2	47.6
Protection of Physical Safety	1	48	-	2.1	14.6	83.3
	2	43	2.3	7.0	27.9	62.8

Over the course of the wildland fire season, it was anticipated that WFFs in a control group would experience an increase in psychosocial risk as a function of a decline in their evaluation of job demands and resources. Justification for this expectation was

three-fold. First, during the fire season in observation, there was no formal program or policy set out to explicitly address psychosocial risk factors as either job demands or resources amongst the WFFs themselves. Second, scores at the outset of the fire season were particularly elevated as a reflection of the beginning of a new fire season, marked with optimism and excitement. Finally, based on communication through the participatory action sessions with the organization and anecdotal observations across previous fire seasons, it is believed that as the WFFs work their way through the uncertainty of the fire season working in close proximity to the same personnel within each crew, the general morale and disposition of crew members erodes.

Participants in the control group marked a statistically significant decline in scores across all subjective measures of both job demands and resources using the Guarding Minds at Work survey from the outset to completion of the fire season. Whereas at the beginning of the fire season a greater representation of participants scored in the 'relative strength' category as compared to normative data across all scales, the trend reversed for the measurement point following the fire season (Samra et al., 2012a). Indeed, representation in the 'relative' strength category dropped by nearly 20-30% across all job demands and resource scales and below the normative data values (Gilbert, M. et al., 2018). Of particular note is the increase in representation in the more severe normative categories, 'serious concerns' and 'significant concerns' across some factors. On one measure of job demands, civility and respect, growth in the 'serious concerns' category gained by 4.8%, while those reporting 'significant concerns' increased by 13.4%. Within measures of job resources, the most notable decline in scores across the wildland fire season was on the measure of organizational culture, a resource for employees when positive and present in a work environment characterized

by trust, honesty and fairness (Samra et al., 2012b). Whereas no participants reported experiencing 'serious concerns' at T1, 16.3% of respondents at T2 had their score fall within that category, nearly double the normative value (Gilbert, M. et al., 2018). Items within the organizational culture score contributing to the poor T2 ratings related to assessments of accountability within the workplace, having a poor sense of community or belongingness and a lack of trust between employees and management (Samra et al., 2012a). Other measures of job resources with declines approaching or exceeding 50% in the 'relative strength' normative category over the course of the fire season included psychological protection (from 60.4% to 31.0%), involvement and influence (from 66.7% to 30.2%), and clear leadership and expectations (from 60.4% to 32.6%).

Despite the expectation and acceptance of the hypothesized decline in measures of job demands and resources across the wildland fire season, the extent to which scores regressed is noteworthy. Given the nature of the relatively low demand fire season, a more tempered decline in employee appraisals of job demands and resources may have been anticipated in light of the JD-R Theory's proposed relationships (Bakker & Demerouti, 2014). However, a full consideration of context is key here, in particular as it applied to wildland fire. The current sample of participants is made entirely of WFFs, who have trained, prepared, and been resourced for the demands of fighting wildland fires. In the absence of wildland fires, it is possible that several new and previously unforeseen demands could have emerged, for which they were not adequately resourced (for example, spending atypical periods of time at their local base, and in close daily contact with other staff members and management who are not accustomed to their presence). Moreover, the lack of high demands created an environment where the participants were not required to work long hours or overtime, thereby undercutting

their ability to earn the full potential of their income across the wildland fire season. Indeed, as one participant communicated to the researcher on our return visit to his location: “finally I have something meaningful to do with my day!”.

Personal Resources: Physical Fitness

Participants in the control group retained access to the organization’s existing ‘Commit to be Fit’ program, which allows for WFFs to participate in up to one hour of physical activity, exercise or training at the outset of each shift on base where opportunity affords (O.M.N.R.F., 2014a; Young, 2016). During the season in observation, full participation in the program was not mandatory or prescribed, but available as an option to all WFFs irrespective of participation in the current study. Based on previous assessments of in-season fitness (Gaskill et al., 2003), the principle of diminished returns associated with extremely high fitness values was likely to be observed at T1 (Fahey, Insel, Roth, & Wong, 2019; Klavora, 2015), and in consultation with the partnering observation, it was expected that WFFs in the control group would experience a decline in their task-specific physical fitness measures across the fire season. Anthropometrically, male participants in the control group experienced an increase in their BMI over the course of the fire season though still at comparable levels to other studies of WFFs, while female participants level of BMI remained unchanged (Carballo-Leyenda et al., 2019; Coker, Murphy, Johannsen, Galvin, & Ruby, 2019; Gaskill et al., 2003).

<u>Anthropometric Measures</u>

The mean weight and body mass index for males in the Control group was statistically significantly higher at T2 as compared to T1 and displayed in Table A5. There was no statistically significant difference between T1 and T2 measurements of weight and BMI among female participants.

Table A5. Results of paired samples t-test for control group on anthropometric measures

Research Measure	Sex	T1			T2			Paired Samples t-test		
		N	*M*	*SD*	*N*	*M*	*SD*	*t*	*df*	*Sig. (2-tailed)*
Weight (kg)	Males	36	80.38	12.863	36	82.25	12.590	4.499	35	.000**
	Females	6	70.55	8.577	6	71.34	6.866	.575	5	.590
Body Mass Index (kg/m^2)	Males	36	25.06	2.956	36	25.66	3.019	4.421	35	.000**
	Females	6	24.78	3.752	6	25.05	3.245	.561	5	.599
**significant at the .001 alpha level										

Grip Strength

Paired samples t-tests were utilized to determine whether there was a statistically significant mean difference between T1 and T2 measures of grip strength for both male and female participants (see Table A6). Results were not statistically significant, indicating no relative change of grip strength across a wildland fire season.

Table A6. Results of paired samples t-test for control group on measures of grip strength

Research Measure	Gender	T1			T2			Paired Samples T-test		
		N	*M*	*SD*	*N*	*M*	*SD*	*t*	*df*	*Sig.*
Right Hand (kg)	Males	36	60.44	10.426	36	61.30	9.308	.845	35	.404
	Females	6	40.90	4.117	6	42.10	5.739	1.023	5	.353
Left Hand (kg)	Males	36	55.95	9.295	36	57.26	8.903	1.736	35	.091
	Females	6	38.28	5.526	6	38.43	5.649	.134	5	.898
Total Grip Strength (kg)	Males	36	116.39	3.214	36	118.56	17.246	1.453	35	.155
	Females	6	79.18	9.443	6	80.53	11.180	.889	5	.415

Although there was a slight increase in grip strength for both males and females over the fire season, the results were not statistically significant. Consistent with the fitness training principle of diminished returns, it is not surprising a significant increase was not observed. Functionally and given the safety importance of grip strength in wildland firefighting, it is beneficial to know that WFFs were able to maintain their high level of grip strength across the fire season (Phillips et al., 2012; Sell & Hofman, 2014; Sell & Livingston, 2012).

Flexibility

Both male and female participants demonstrated a statistically significant mean increase on flexibility measurements from T1 to T2 (see Table A7). The mean increase among male participants was 2.48cm (95% CI, 1.36 to 3.62) as compared to 2.34cm (95% CI, .07 to 4.60) among female participants.

Table A7. Results of paired samples t-test for control group for measure of flexibility

Research Measure	Gender	T1			T2			Paired Samples T-test		
		N	*M*	*SD*	*N*	*M*	*SD*	*t*	*df*	*Sig*
Flexibility (cm)	Males	36	29.49	7.878	36	31.97	7.791	4.467	35	.000**
	Females	6	35.583	4.043	6	37.92	5.800	2.646	5	.046*
*significant at .05 alpha level **significant at the .001 alpha level										

Assessments of WFF flexibility increased statistically significantly from pre- to post-season measurement points across the fire season for both males and females. Functionally, both males and females, on average were able to reach an average of 2.48cm and 2.34cm further on the sit and reach test respectively following the fire season. As a functional measure of low-back health, this result is positive and denotes a movement closer to the 90th percentile in a normative data set of Canadians aged 20-24 years and the in-season measure of specialist IHC crews in the USA (Hoffmann et al., 2019; Sell & Livingston, 2012).

Core Strength

Paired samples t-tests did not reveal any statistically significant mean differences in core strength values from T1 to T2 for either male or female participants (see Table A8).

Table A8. Results of paired samples t-test for control group for core strength test

Research Measure	Gender	T1			T2			Paired Samples T-test		
		N	*M*	*SD*	*N*	*M*	*SD*	*t*	*df*	*Sig.*
Core Strength (min)	Males	35	2.60	.574	35	2.74	.482	1.531	34	.135
	Females	6	2.86	.340	6	3.00	0.000	1.000	5	.363

Both male and female participants in the control group increased their time by an average of 8 seconds from T1 to T2 over the course of the fire season. Though not statistically significant, the maintenance of core strength and stability over the course of the season is meaningful, especially as at the end of the season, all female participants were able to successfully complete the test in its entirety. Results on this measure would indicate a rejection of the hypothesized decline in fitness across the wildland fire season.

Anaerobic Capacity

Table A9 displays results from paired samples t-tests conducted to test whether there was a statistically significant mean different between T1 and T2 measures of anaerobic capacity for both male and female participants. Across all measures, there was no statistically significant difference for either male or female participants in the control group.

Table A9. Results of paired samples t-test for control group on measures of anaerobic capacity

Research Measure	Gender	T1			T2			Paired Samples T-Test		
		N	*M*	*SD*	*N*	*M*	*SD*	*t*	*df*	*Sig.*
Maximum Power (watts)	*Males*	35	635.47	114.50	35	644.85	117.48	.766	34	.449
	Females	5	392.08	89.486	5	377.96	60.256	2.646	4	.542
Minimum Power (watts)	*Males*	34	375.02	66.659	34	383.76	100.37	.528	33	.604
	Females	5	264.42	54.818	5	258.70	28.037	-.666	4	.837
Average Power (watts)	*Males*	30	489.74	83.817	30	508.80	86.320	1.930	29	.063
	Females	5	321.54	68.712	5	314.08	37.021	-.375	4	.727
Fatigue Index (watt/sec)	*Males*	30	7.34	2.761	30	7.47	2.374	.389	29	.700
	Females	5	3.31	1.470	5	3.08	1.443	-.343	4	.749
Relative Peak Power Output (watts/kg)	*Males*	35	8.03	1.534	35	7.95	1.767	-.540	34	.593
	Females	5	5.493	1.489	5	5.32	1.242	-.515	4	.634

Both male and female participants in the control group maintained their pre-season level of anaerobic capacity across all measures. Most notable is the maintenance of relative peak power output (W per kg) over the source of the fire season, as participant weight had increased significantly across the season. Given the relatively low-intensity of the fire season, it is possible that participants were able to maintain their level of anaerobic fitness through more intense training as a part of their regular work-day through the existing 'Commit to be Fit' program. Previously, it was documented that WFFs entering a fire season 'over-fit' and their level of aerobic capacity decline to mid-season where it leveled off to the equivalent requirements for the task of wildland firefighting (Gaskill et al., 2003).

Personal Resources: Psychological Capital

There was a statistically significant mean decrease for both Hope and Optimism subscale scores of the Psychological Capital Questionnaire from T1 to T2 in the Control group (see Table A10).

Table A10. Results of paired samples t-test for control group on measures of psychological capital

	T1			T2			Paired Samples T-Test		
PsyCap Scale	*N*	*M*	*SD*	*N*	*M*	*SD*	*t*	*df*	*Sig. (2-tailed)*
Efficacy	42	28.79	4.672	42	27.79	5.475	-1.299	41	.201
Hope	43	31.05	3.879	43	29.23	4.475	-2.392	42	.021*
Resiliency	44	29.89	2.713	44	29.91	3.395	.046	43	.963
Optimism	43	26.63	2.960	43	25.21	3.549	-2.420	42	.020*
*significant at the .05 alpha level									

Across the fire season, participants level of psychological capital declined across two of the four subscales, Hope and Optimism. As Hope encapsulates individual willpower and ability to achieve desired outcomes, the decline represents a potential threat to the cohesive functioning of a crew in stressful or arduous conditions (Avey et al., 2009). Optimism, viewed as the ability or style of attributing positive causes and explanations to events within one's environment or daily functioning also decline significantly over the course of the fire season (Avey et al., 2009; Luthans, Avolio, et al., 2007). It is not surprising that given the relatively low-demand fire season that individual's level of Hope and Optimism declined, however, it should be noted that their levels are still comparable to other similar occupation groups and contexts (Krasikova et al., 2015; Wingerden et al., 2016).

Motivation: Work Engagement

Paired samples t-tests revealed a statistically significant mean difference in overall work engagement (Mean Difference = 0.38, 95% CI, .19 to .57) and two of its subscales, vigour (Mean Difference = .41, 95% CI, .10 to .72) and dedication (Mean Difference = .74, 95% CI, .5 to .98) from T1 to T2 measurement points (see Table A11). There was no statistically significant mean difference for the absorption scale across the fire season.

Table A11. Results of paired samples t-test for control group on measures of work engagement

	T1			**T2**			**Paired Samples T-Test**		
Work Engagement Scale	*N*	*M*	*SD*	*N*	*M*	*SD*	*t*	*df*	*Sig. (2-tailed)*
Average Sore Overall	45	4.71	.576	45	4.33	0.733	-4.006	44	.000**
Vigour Subscale	46	4.93	.578	46	4.52	1.004	-2.631	45	.012*
Dedication Subscale	46	5.05	.730	46	4.31	0.941	-6.241	45	.000**
Absorption Subscale	46	4.25	.744	46	4.04	0.807	-1.802	45	.078
*significant at the .05 alpha level **significant at the .001 alpha level									

The overall UWES score and Vigour and Dedication subscales all statistically significantly declined across the wildland fire season; however, scores all remained within the average range based on normative data (Schaufeli & Bakker, 2003). The relative decline in scores is also comparable to declines observed over time in other studies involving first responder population groups (Biggs et al., 2014). Given the

uncertainty of a fire season, it is also posited that the change in work engagement in this instance is highly contextualized and a function of a low-activity fire season that fell short and challenged the expectations for many WFFs (Barton et al., 2015; Maphis, 2011).

Summary of Impact of Wildland Fire Season

Across a low-demand wildland fire season for a control group, there was a marked decline in individual appraisal of job demands and resources, psychological capital and work engagement while levels of physical fitness were maintained or increased resulting in partial confirmation of the expected changes.

Appendix 17: Comparing intervention conditions individually

Fitness Training Intervention Evaluation

In an effort to evaluate the impact of the fitness training intervention, independent samples t-tests were used to compare the mean difference scores from T1 to T2 across all variables with the control group. There was no statistically significant difference on the mean difference scores for the three subjective measures of job demands, psychological capital or work engagement. The difference in mean scores on measures of psychological support, organizational culture and involvement and influence were statistically significant and shown in the table below. On each of these measures, a greater decline from T1 to T2 was reported within the control group as compared to the fitness training intervention group. Across all measures of physical fitness, only the difference in the measurement of flexibility statistically significantly differed from T1 to T2, with a greater increase noted within the control group. With respect to objective measures of job demands, participants in the fitness training intervention group worked more hours across the wildland fire season than those in the control group a statistically significant difference of 81.55 hours (95% CI, 12.90 to 150.21), $t(117) = -2.353$, $p = .020$ (see Table A12).

Table A12. Independent samples t-test results comparing fitness and control experimental conditions on change in job resource scores, flexibility and total number of hours worked from T1 to T2

Measure	Control		Fitness Intervention		*t*	df	*p*
	M	*SD*	*M*	*SD*			
JR: Psychological Support	-1.93	2.762	-.68	2.103	-2.464	72.712	.016*
JR: Organizational Culture	-3.14	2.696	-1.92	2.510	-2.382	104	.019*
JR: Involvement and Influence	-2.16	2.760	-1.05	2.624	-2.104	104	.038*
Flexibility (males only)	2.49	3.339	.32	5.457	2.113	85	.038*
JD: Hours worked	911.79	216.16	993.35	161.71	-2.353	117	.020*
*significant at the .05 alpha level							

Psychosocial Education Intervention Evaluation

The mean difference in scores from T1 to T2 across all variables from the participants in the psychosocial education intervention group were compared using independent samples t-tests with that of the control group. Statistically significant results are displayed in Table A13. Total number of hours work approached statistical significance, but were included, nonetheless.

Table A13. Independent samples t-test results comparing psychosocial education and control experimental conditions from T1 to T2

	Control		Psychosocial Intervention				
Measure	*M*	*SD*	*M*	*SD*	*t*	df	*p*
JD: Hours worked	911.79	216.16	982.75	128.915	-1.891	90	.062
JD: Civility & Respect	-2.05	2.152	-.34	2.754	-3.048	75	.003*
JD: Psychological Job Demands	-2.00	2.299	-.86	2.394	-2.160	78	.034*
JR: Psychological Support	-1.93	2.762	-.06	2.229	-3.259	76	.002*
JR: Organizational Culture	-3.14	2.696	-.68	2.615	-4.133	78	.000**
JR: Clear Leadership	-1.93	2.685	-.36	2.497	-2.670	77	.009*
JR: Growth & Development	-1.47	2.482	-.32	2.237	-2.145	78	.035*
JR: Involvement and Influence	-2.16	2.760	-.22	2.486	-3.256	77	.002*
JR: Workload Management	-1.30	2.464	-.06	2.414	-2.261	77	.027*
JR: Psychological Protection	-1.86	3.167	-.05	2.210	-2.896	77	.005*
JR: Physical Safety	-1.05	2.370	.43	2.180	-2.887	78	.005*
PR: Flexibility (males only)	2.49	3.339	.55	3.554	2.256	63	.028*
PR: Max Power (males only)	9.38	72.470	-27.470	60.873	2.044	57	.046*

*significant at the .05 alpha level
**significant at the .001 alpha level

Comparing delivery of both interventions to control Group

Independent samples t-tests were used to compare the mean difference scores from T1 to T2 of the participants receiving both the fitness training and psychosocial education to the control group. Complete results can be found in the Table on the following page. One-way ANOVAs compared the mean scores for all four experimental conditions simultaneously and yielded no statistically significant results apart from what is reported in Table A14.

Table A14. Independent samples t-test results comparing the fitness training and psychosocial education and control experimental conditions from T1 to T2

Measure	Control		Fitness & Psychosocial Intervention		*t*	df	*p*
	M	*SD*	*M*	*SD*			
JD: Hours worked	911.79	216.16	1021.52	149.231	-3.221	113	.002*
JD: Civility & Respect	-2.05	2.152	-.75	2.244	-2.838	91	.006*
JD: Psychological Job Demands	-2.00	2.299	-.43	1.972	-3.561	92	.001**
JD: Work-Life Balance	-1.07	2.840	.21	2.452	-2.360	93	.020*
JR: Psychological Support	-1.93	2.762	-.31	2.293	-3.081	91	.003*
JR: Organizational Culture	-3.14	2.696	-.56	2.071	-5.277	93	.000**
JR: Clear Leadership	-1.93	2.685	-.69	2.183	-2.479	93	.015*
JR: Growth & Development	-1.47	2.482	-.60	2.251	-1.788	93	.077
JR: Reward & Recognition	-1.58	2.779	-.62	2.410	-1.814	93	.073
JR: Involvement & Influence	-2.16	2.760	-.83	2.455	-2.495	93	.014*
JR: Workload Management	-1.30	2.464	-.39	2.173	-1.903	92	.060
JR: Engagement	-1.35	1.730	-.71	1.730	-1.787	93	.077
JR: Psychological Protection	-1.86	3.167	.02	1.679	-3.461	59.57	.001**
JR: Physical Safety	-1.05	2.370	-.33	1.543	-1.713	69.57	.091
PR: PsyCap Hope Scale	-1.81	4.973	.75	3.515	-2.913	92	.004*
PR: PsyCap Efficacy Scale	-1.00	4.988	1.21	4.736	-2.146	87	.035*
PR: Fatigue Index (males)	.13	1.803	-1.44	2.561	2.752	58	.008*
PR: Max Power (males)	9.38	72.470	-43.49	87.490	2.665	63	.010*
PR: Relative Peak Power Output (males)	-.08	.851	-.59	.939	2.311	63	.024*

*significant at the .05 alpha level
**significant at the .001 alpha level

Comparing delivery of both interventions to individual delivery

Independent samples t-tests comparing the mean scores on all variables between the psychosocial education experimental condition and the dual intervention condition yielded no statistically significant differences. Results from comparisons between the dual intervention experimental group and the fitness training experimental group yielded statistically significant differences on two measures of personal resources (PsyCap's efficacy and optimism scales), three measures of job resources (organizational culture, workload management and psychological protection), and two measures of job demands (psychological job demands and work-life balance), with the higher mean difference scores in favour of the dual intervention experimental group. Results of this comparison can be found in Table A15.

Table A15. Independent samples t-test results comparing the fitness training and psychosocial education and fitness training experimental conditions from T1 to T2

	Fitness Intervention Only		Fitness & Psychosocial Intervention				
Measure	*M*	*SD*	*M*	*SD*	*t*	df	*p*
JD: Psychological Job Demands	-1.25	1.959	-.43	1.972	-2.222	112	.028*
JD: Work-Life Balance	-1.08	2.947	.21	2.452	-2.159	113	.013*
JR: Organizational Culture	-1.92	2.510	-.56	2.071	-3.132	113	.002*
JR: Workload Management	-1.41	2.582	-.39	2.173	-2.250	112	.026*
JR: Psychological Protection	-1.22	2.511	.02	1.679	-3.151	108.40	.002*
PR: PsyCap Optimism Scale	-3.00	4.273	-1.04	4.015	-2.463	109	.015*
PR: PsyCap Efficacy Scale	-.83	4.362	1.21	4.736	-2.348	109	.021*
*significant at the .05 alpha level							

Appendix 18: Evaluating Intervention Impact on Job Stress

T2 Job Stress Survey results by experimental condition

				Intervention Condition											
	Total Sample			**Control**			**Psychosocial**			**Fitness**			**Fitness + Psychosocial**		
Job Stress Survey Scale	*N*	*M*	*SD*	*N*	*M*	*SD*	*N*	*M*	*SD*	*N*	*M*	*SD*	*N*	*M*	*SD*
Job Stress Index	202	47.04	7.843	45	46.96	7.946	38	46.08	7.441	65	48.14	8.006	54	46.48	7.895
Job Stress Severity	207	43.27	9.416	46	41.35	8.784	40	43.30	9.332	67	43.52	9.473	54	44.57	9.910
Job Stress Frequency	204	51.27	8.908	45	52.51	10.257	38	49.18	8.696	65	52.77	8.448	56	49.95	8.132
Job Pressure Index*	203	46.44	7.486	45	44.51	5.911	39	45.82	8.306	65	47.75	7.327	54	46.91	8.031
Job Pressure Severity	207	43.63	9.653	46	40.80	8.783	40	43.73	9.745	67	43.85	9.251	54	45.70	10.432
Job Pressure Frequency	205	50.01	8.070	45	49.04	8.276	39	48.41	8.729	65	52.00	7.435	56	49.59	7.897
Level of Organizational Support Index	202	48.04	8.523	45	49.93	9.804	39	46.67	7.965	64	48.33	8.549	54	47.11	7.610
Level of Organizational Support Severity	207	44.69	9.557	46	44.57	9.333	40	44.15	9.929	67	44.75	9.836	54	45.13	9.361
Level of Organizational Support Frequency**	205	50.32	9.913	45	53.40	11.458	39	48.31	9.526	65	50.88	10.168	56	48.61	7.901

*Fitness Training Intervention: $z = -2.07$, $p = .039$
**Psychosocial Education Intervention: $z = 1.90$, $p = .057$

Appendix 19: Participant feedback regarding fitness training intervention material across experimental condition

	Overall		Fitness Intervention Only		Psychosocial + Fitness Interventions	
Item	**N**	**%**	N	%	N	%
How would you describe how often you logged your workouts?						
Never or Rarely	**31**	**26.3**	10	15.4	21	39.6
Occasionally	**42**	**35.6**	23	35.4	19	35.8
Often	**32**	**27.1**	22	33.8	10	18.9
Every Time	**13**	**11.0**	10	15.4	3	5.7
Did you receive your fitness results and feedback by email?						
Yes	**96**	**80.7**	52	78.8	44	83.0
No	**23**	**19.3**	14	21.2	9	17.0
How useful was the information in the feedback document?						
Not at all or not very useful	**7**	**7.1**	4	7.3	3	6.8
Somewhat useful	**46**	**46.5**	22	40.0	24	54.5
Very useful	**46**	**46.5**	29	52.7	17	38.6
Did you discuss your fitness results and feedback with your peers?						
Yes	**94**	**80.3**	52	78.8	42	82.4
No	**23**	**19.7**	14	21.2	9	17.6
Did you use the information found in the feedback to guide your training?						
Yes	**55**	**48.2**	32	49.2	23	46.9
No	**59**	**51.8**	33	50.8	26	53.1

Appendix 20: Participant feedback regarding psychosocial intervention materials by experimental condition

	Overall		Psychosocial Intervention		Psychosocial + Fitness Interventions	
Item	**N**	**%**	N	%	N	%
Did you receive the fact sheets by email?						
Yes	**86**	**92.5**	37	92.5	49	92.5
No	**7**	**7.5**	3	7.5	4	7.5
Did you read the psychosocial fact sheets?	**66**	**71.0**	25	62.5	41	77.4
Yes	**27**	**29.0**	15	37.5	12	22.6
No						
What did you think of the material covered within the fact sheets?						
Not at all useful	**2**	**2.3**	0	0	2	4.0
Not very useful	**4**	**4.6**	2	5.4	2	4.0
Somewhat useful	**56**	**64.4**	22	59.5	34	68.0
Very useful	**25**	**28.7**	13	35.1	12	24.0
Were the fact sheets sent by email and posted around your work location the best way to communicate with you about psychosocial risk factors?						
Yes	**82**	**91.1**	37	94.9	45	88.2
No	**8**	**8.9**	2	5.1	6	11.8
Did the fact sheets talk about relevant issues faced by wildland firefighters over the course of a season?						
Not at all	**1**	**1.1**	1	2.7	0	0
Somewhat	**62**	**70.25**	24	64.9	38	74.5
Always	**25**	**28.4**	12	32.4	13	25.5
Over the course of the fire season, did you discuss the content of the fact sheets with your fellow colleagues?						
Never	**30**	**33.0**	12	30.8	18	34.6
Rarely	**31**	**34.1**	13	33.3	18	34.6
Occasionally	**26**	**28.6**	12	30.8	14	26.9
Often	**4**	**4.4**	2	5.1	2	3.8