

Childhood Adversity, Deployment-Related Stress, and Mental Health in the Canadian Armed Forces

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Disclaimer

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Table of Contents

Disclaimer	ii
Acknowledgements	vi
List of Tables	viii
List of Figures	x
Abbreviations	xi
Abstract	xii
Introduction	1
Adverse Childhood Experiences (ACEs) and Adult Mental Health Outcomes	2
Canadian Armed Forces: ACEs and mental health outcomes	5
Relationship between deployment-related stress and mental health outcomes	7
Canadian Armed Forces: deployment-related stress and mental health outcomes	8
Research Objectives and Hypothesis	10
Study Design	13
Methods	13
Data Sources	13
The Canadian Forces Recruit Health Questionnaire (RHQ)	13
The Enhanced Post-Deployment Screening (EPDS) Questionnaire	13
Linkage of RHQ to EPDS	14
Primary Exposure: DRSE	19
Novel classification of the DRSE scale	19
Coding of DRSE exposure variables	24
Variable: Adverse Childhood Experiences	25
Selection of ACE variables in the RHQ-EPDS dataset	25
Coding of individual ACE variables	28
Analysis of individual ACEs	31
Investigating stress inoculation and stress sensitization	31
Scale and categorical ACE “types” and ACE “intensity” variables	33
Outcome Measures	35
SF-36 MCS	35
Post-Traumatic Stress Disorder (PTSD)	38
Depression	42
Suicidal Ideation	44
Anxiety	44

Panic disorder	45
Confounder selection.....	45
Demographic considerations	47
Causal pathway.....	48
Coding of confounders	50
Statistical Methods.....	56
Regression	56
Power and sample size analysis	57
Treatment of missing data	58
Results.....	63
A. Descriptive statistics	64
Covariates.....	64
Outcomes.....	66
ACEs	72
DRSEs	76
Sensitivity Analysis.....	80
B. Regression Results	82
Research Objective 1: DRSE and mental health.....	82
Primary outcome: SF-36 MCS	82
Secondary Outcomes	86
Research Objective 2: ACE and mental health	95
Analysis of individual ACE variables	95
Summative scales and categorical ACE analyses.....	95
Non-linear investigation.....	105
Research Objective 3: ACE-DRSE effect modification	106
Validation with secondary outcomes.....	114
Discussion	115
A. Study population.....	116
Proportion of mental health issues.....	116
DRSE estimates of prevalence	118
ACE estimates of prevalence.....	119
B. Research question one: DRSE and mental health	122
Conclusions	124
C. Research Objective 2: ACE and mental health	126

Conclusions	127
D. Research Objective 3: ACE-DRSE effect modification.....	128
Conclusions	130
E. Strengths and Limitations	131
Implications.....	139
APPENDIX A: EPDS – “Deployment Experiences” Questionnaire.....	142
APPENDIX B: ACE questions in the RHQ	143
APPENDIX C: EPDS – PCL-C PTSD screen.....	145
APPENDIX D: EPDS – PHQ-9 Depression Screen.....	146
APPENDIX E: EPDS – PHQ-9 Anxiety Screen	147
APPENDIX F: EPDS – PHQ-9 Panic Screen.....	148
APPENDIX G: Possible confounders.....	149
APPENDIX H: References supporting confounder selection	151
APPENDIX I: Analysis of missing PCL-C data	152
APPENDIX J: Full models of scale “All DRSE” association with each mental health outcome	154
APPENDIX K: Covariate estimates in DRSE models for each mental health outcome	160
APPENDIX L: Adjusted estimates of association for individual ACE models	168
APPENDIX M: Covariate estimates in ACE models for each mental health outcome.....	171
APPENDIX N: ACE “types” and “intensity” supplemental figures	176
Bibliography	179

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List of Tables

Table 1: Types of childhood adversities inquired about in the RHQ	26
Table 2: Scoring of ACE variables	29
Table 3: Types of childhood adversities contained within cumulative types of ACE variables ..	32
Table 4: Categorical ACE variables cut-offs	33
Table 5: Proportions of covariates within linked dataset population.....	64
Table 6: Proportions of mental health outcomes	67
Table 7: Continuous ACE variable summary statistics	72
Table 8: Estimated population proportion of categorical ACE variables	73
Table 9: Individual ACE frequency	73
Table 10: Continuous DRSE variable summary statistics	76
Table 11: Categorical DRSE variable summary statistics	78
Table 12: Estimated population proportions of “Deployment Experiences” scenarios.....	79
Table 13: DRSE summary statistics for missing and non-missing outcome respondents.....	80
Table 14: ACE summary statistics for missing and non-missing outcome respondents	81
Table 15: Adjusted estimates of association between DRSE and mental health outcomes.....	84
Table 16: Scale “All DRSE” and PTSD outcomes, by PCL-C scoring method.....	86
Table 17: “All DRSE” and depression outcomes, by PHQ scoring method	89
Table 18: The association of ACE variables and mental health outcomes	97
Table 19: Fully adjusted ACE-DRSE interaction terms	106
Table 20: Scale “Distressing DRSE” and scale “ACE types” interaction models	108
Table 21: Scale “Distressing DRSE” and scale “ACE intensity” interaction models	109
Table 22: “Distressing DRSE” scale and categorical “ACE types” interaction models.....	111
Table 23: Categorical “Distressing DRSE” and categorical “ACE types” interaction models ..	113
Table 24: Linked dataset potential confounder questions.....	149
Table 25: Confounder literature review	151
Table 26: “pcldiagD” missing values	152
Table 27: Scale “All DRSE” and SF-36 MCS (linear regression models 1-4).....	154
Table 28: Scale “All DRSE” and PTSD-likelihood (multinomial regression models 1-4)	155
Table 29: Scale “All DRSE” and possible/probable depression (ordinal logistic regression models 1-4)	157
Table 30: Scale “All DRSE” and suicidal ideation (logistic regression models 1-4).....	158
Table 31: Scale “All DRSE” and anxiety (logistic regression models 1-4)	159
Table 32: Fully adjusted scale “All DRSE” & all outcomes	160
Table 33: Fully adjusted categorical “All DRSE” & all outcomes.....	162
Table 34: Fully adjusted scale distressing & contextual DRSE & all outcomes	164
Table 35: Fully adjusted categorical distressing/contextual DRSE models & all outcomes	166
Table 36: Modelling one type of ACE at a time with SF-36 MCS	168
Table 37: SF-36 MCS models 1-4 with each type of ACE represented as individual variables	169
Table 38: Type of ACE (q77) scale and all outcomes	171
Table 39: Types of ACE (q77) categories and all outcomes	172
Table 40: All types of ACE scale and all outcomes	172
Table 41: All types of ACE categories and all outcomes	173
Table 42: q77 ACE intensity scale and all outcomes	173
Table 43: q77 ACE intensity categories and all outcomes	174

Table 44: All ACE intensity scale and all outcomes	174
Table 45: All ACE intensity categories and all outcomes	175

List of Figures

Figure 1: Theoretical Model	12
Figure 2: Pathway for inclusion in the RHQ-EPDS linked dataset	15
Figure 3: SF-36 Measurement Model ¹³²	37
Figure 4: Histogram of number of years served in the military.....	53
Figure 5: Age at the time of EPDS completion	55
Figure 6: Histogram of SF-36 MCS (linked RHQ-EPDS dataset)	66
Figure 7: Proportion of screen-positive mental illness in the linked RHQ-EPDS dataset.....	68
Figure 8: PTSD frequency in the RHQ-EPDS linked dataset.....	69
Figure 9: Depression frequency in the RHQ-EPDS linked dataset	71
Figure 10: ACE pie charts.....	75
Figure 11: All DRSE histogram.....	76
Figure 12: Distressing DRSE histogram.....	77
Figure 13: Contextual DRSE histogram	77
Figure 14: Deployment stressors and mental health quality of life	83
Figure 15: Categorical deployment stressors and mental health quality of life.....	85
Figure 16: Deployment stressor scale variables and PTSD likelihood.....	87
Figure 17: Categorical deployment stressors and PTSD likelihood	88
Figure 18: DRSE and depression, suicidal ideation, & anxiety disorders (other than panic).....	90
Figure 19: Categorical deployment stressors and depression	92
Figure 20: Categorical deployment stressors and suicidal ideation.....	93
Figure 21: Categorical deployment stressors and anxiety disorders (excluding panic).....	94
Figure 22: Cumulative childhood adversity (including novel ACEs) and SF-36 MCS	98
Figure 23: Intensity of childhood adversity (including novel ACEs) and SF-36 MCS.....	99
Figure 24: Number of types of childhood adversity and PTSD.....	101
Figure 25: Intensity of childhood adversity and PTSD-likelihood.....	102
Figure 26: Number of childhood adversities and depression, suicidal ideation, and anxiety.....	103
Figure 27: Intensity of childhood adversity and depression, suicidal ideation, and anxiety	104
Figure 28: ACE & “Distressing DRSE” scale variable interaction	110
Figure 29: Categorical ACE & DRSE scale interaction	112
Figure 30: “ACE types” versus “ACE intensity” variables and SF-36 MCS	176
Figure 31: “ACE types” versus “ACE intensity” categorical variables and SF-36 MCS	177
Figure 32: “ACE types” versus “ACE intensity” scale variables and PTSD	178

Abbreviations

ACE: Adverse childhood experience
AOR: Adjusted odds ratio
BMI: Body mass index
CAF: Canadian Armed Forces
CFMHS: Canadian Forces Mental Health Survey
CGP: Canadian general population
DFHP: Directorate Forces Health Protection
DND: Department of National Defense, Government of Canada
DRSE: Deployment-related stressful experience
DSM: Diagnostic and Statistical manual of mental disorders (4th edition (IV-TR) or fifth edition)
EPDS: Enhanced post-deployment screening questionnaire
HPA: Hypothalamic-pituitary-adrenal
IED: Improvised explosive device
IPV: Intimate partner violence
NCM: Non-commissioned members
PAF: Population attributable fraction
PCL-C or PCL: PTSD checklist – civilian version
PHQ: Patient health questionnaire
PTSD: Post-traumatic stress disorder
RHQ: Recruit health questionnaire
SF-36: Short form health survey (36 item)
SF-36 MCS: SF-36 Mental Component Summary
SF-36 PCS: SF-36 Physical Component Summary

Abstract

Background

For decades, researchers have been striving to better understand the complex mix of factors underlying post-combat mental illness, in the hope of enabling better outcomes for military personnel. This study focuses on investigating the behavior and possible interaction of two risk factors for poor mental health post-deployment to a combat mission: adverse childhood experience (ACE) and deployment-related stressful experience (DRSE).

Methods

A longitudinal dataset linking data from 3302 military personnel at recruitment to data collected post-deployment to Canada's mission in Afghanistan was analysed, using novel scoring systems for exposure classification.

Results

Significant ACE-DRSE interaction terms were found in relation to SF-36 MCS, depression and suicidal ideation: the negative effect DRSE had on mental health outcomes was amplified as ACE levels increased.

Conclusion

Individuals with a history of childhood adversity are more susceptible to the negative mental health impacts of stressful experiences during deployment to a combat zone.

[Word count: 148]

Introduction

The Canadian Department of National Defence (DND) has found itself the focus of ongoing media attention in recent years due to a series of highly publicized suicides among those who served in support of the mission to Afghanistan, as well as ongoing complaints from military families and veterans over perceived inadequate mental health care services.^{1,2} As part of an evolving, multifaceted strategy spanning over 15 years to improve mental health of active military personnel and veterans, DND has contributed to a large body of research that attempts to identify and characterize risk factors for mental health problems post-deployment.^{3,4} Such risk factors can include a) deployment factors (such as injury, length of deployment, and stressful deployment experiences); and, b) pre-deployment factors (such as resiliency factors, personality and adverse childhood experiences).^{5,6}

This thesis examines both deployment and pre-deployment factors that are postulated to be associated with mental health in the military. It analyzes a longitudinal dataset that links data collected at recruitment (i.e., the “Recruit Health Questionnaire” (RHQ)) to data collected post-deployment to the Afghanistan mission (i.e., the “Enhanced Post Deployment Screening” (EPDS)). The linked dataset allows the exploration of two main risk factors for mental health problems: adverse childhood experiences (ACE) and deployment-related stressful experiences. Six mental health outcomes are examined, including general mental health status (indicated by the SF-36 Mental Component Summary (SF-36 MCS) quality of life measure), post-traumatic stress disorder (PTSD), depression, suicidal ideation, anxiety disorders, and panic disorder.

This thesis hypothesizes that ACEs behave as an effect modifier of the relationship between deployment stressors and mental health outcomes, such that the effect of deployment stressors on poor mental health outcomes will be stronger among those who have experienced higher levels of childhood adversity. In other words, having adverse experiences as a child can lead one to become hyper-responsive to stress as an adult (i.e., “stress sensitization”) and more likely to develop mental health problems. In addition, the current study hypothesizes that low levels of ACE confer a protective effect (“stress inoculation”), so that individuals are more resilient in the face of deployment-related stress than those who have experienced no ACEs at all.

Adverse Childhood Experiences (ACEs) and Adult Mental Health Outcomes

ACE is a broad, encompassing term that includes abuse (emotional, physical, or sexual), maltreatment (including abuse, exposure to intimate partner violence (IPV), physical neglect, and emotional neglect), household dysfunction, and experiences that are psychologically distressing.^{7,8} The idea that traumatic or chronically stressful environments during childhood predispose one to developing psychopathology throughout all stages of life has been well-researched, in high-income and low-income countries alike.^{5,8-12} It has been estimated that approximately 20-30% of poor mental health outcomes in the U.S. general population may be attributable to ACEs.¹³ Studies on the Canadian general population have demonstrated an association between child abuse and mental health¹⁴, including suicidal ideation, depression, alcohol use disorder, psychotropic medication use.¹⁵⁻¹⁷ Research suggests that the more types of childhood adversity experienced, the higher the odds of developing mental health issues.^{14,18,19}

The influence of ACEs was first considered in military populations in the 1990s. To date, there have been a handful of international studies^{20–27} that demonstrate vulnerability to poor mental health due to childhood adversity in deployed military personnel, while one study found childhood adversity and deployment stressors to have separate effects.²⁸ Childhood abuse, both physical and sexual, was found to be an important factor in the development of combat-related PTSD in US Desert Storm veterans.²⁹ Another study found that childhood abuse was associated with PTSD symptom severity; and that of those veterans with PTSD, 60% reported childhood physical abuse, and 41% reported childhood sexual abuse.³⁰ These types of findings linking childhood adversity to health outcomes in veterans have mirrored studies of active military in the UK²³ and the US.^{22,28} One small study found no association between ACEs and PTSD symptoms.³¹ For the most part, studies on military populations have been constrained due to underrepresentation of females and the use of screening tools that were not designed for assessing mental health outcomes specifically.^{4,32}

The mechanism frequently proposed to explain the association between ACEs and mental health is “stress sensitization” – whereby ACEs can lead one to be at risk for hyper-responsivity to stress as an adult and more prone to mental health problems. For example, childhood experiences such as physical or sexual abuse can adversely affect healthy development, leading one to become less resilient throughout the life course.¹⁰ The concept of “stress sensitization” is supported by sound animal^{33,34} and human evidence, showing that stress reactivity changes in response to early trauma.^{35–37} An advantage of animal models is that they can control and manipulate experiences across the life course, whereas human evidence is subject to masking of the effect of early trauma by subsequent life experiences. In rats, it has been demonstrated that

the hypothalamic-pituitary-adrenal (HPA) axis' response to stress is permanently altered when subjected to persistent stressful stimuli in the early stages of life. This is accompanied by changes in hypothalamus activity and other forebrain changes in corticosteroid receptor systems, which determine glucocorticoid negative feedback sensitivity.³⁴ In monkeys, early stress has been connected with numerous behavioural and physiological responses, including depressive-like behavioural responses, altered HPA axis functionality, and increased risk of passing these changes onto the next generation.³³

It has been postulated that childhood traumas tend to create certain personality and psychological characteristics that can reduce one's ability to recover from traumatic experiences as an adult. Such characteristics that have been studied include risk-taking, impulsivity, impaired risk recognition, problems with self-regulation, and sensation-seeking behaviours during adulthood.²⁸

Chronic childhood traumas may be associated with various environmental factors during childhood that increase risk for poor coping with stress as an adult, such as chaotic environments characterized by poor social and family support, mental illness, substance abuse, and antisocial behaviour.²⁷ It has been postulated that in such environment, children use dissociative strategies in relationships and that this may indirectly lead to social isolation, and subsequently increase risk for poor mental health. In addition, repeated traumatic experiences may have a dose-response effect on adverse mental health outcomes, as has been demonstrated in studies on Holocaust survivors³⁸, Israeli soldiers³⁹, shipwreck survivors⁴⁰, and Vietnam veterans.⁴¹ This vulnerability to stress-related mental disorders may be partially explained by gene-environment

interactions during critical phases of development during childhood, whereby childhood adverse experiences can affect the genetic programming of emotional and cognitive brain circuitry.³⁶

While there is adequate support in the literature for the existence of stress sensitization, in recent years, there have been studies that have identified a second-order effect of ACE in its association with mental health. The underlying mechanism proposed has been “stress inoculation” – whereby ACEs in moderation can improve one’s capacity to cope with stress as an adult.^{36,42–44} This theory challenges the notion that an absence of exposure to adversity is optimal; rather, it asserts that the relationship between exposure to adversity and later coping ability is U-shaped – where a low number of adverse events are associated with optimal outcomes. The experience of low levels of adversity has been theorized to “toughen” individuals, where “toughness” may involve perceiving novel adverse situations as manageable as opposed to overwhelming. When coupled with support and the opportunity for recovery, an individual may become more resilient in the face of subsequent stressors or trauma.^{45,46} “Stress inoculation” has been discussed in the literature as related to the psychological constructs of mastery and control⁴⁷ and resilience.^{46,48,49}

Canadian Armed Forces: ACEs and mental health outcomes

To date, a handful of cross-sectional studies have attempted to characterize “stress sensitization” in the Canadian Forces using the Canadian Community Health Survey – Canadian Forces supplement or the Canadian Forces Mental Health Survey (2013).^{5,50–52} A dose-response effect – whereby the risk of mental disorders rises with the number of ACEs – has been suggested by a number of studies looking at Canadian populations, including active Canadian military.^{50,51} Sareen et al.⁵ failed to find a significant multiplicative interaction between combat exposure and

ACE exposure, but found an additive effect of deployment-related trauma exposure and ACEs on post-deployment mood and anxiety disorders. They estimated that approximately 20% of post-deployment mood and anxiety disorders were attributable to ACEs, with physical abuse in particular having the greatest impact, and they did not find significant gender differences. Of note, they were unable to adjust for deployment-related trauma exposure in logistic regression models looking at the associations between ACEs and adult-onset mood or anxiety disorders because the timing of onset could not be determined from the survey data.

Afifi et al.⁵² provided further evidence supporting that child abuse exposure may increase the likelihood of suicide-related outcomes, more so than exposure to deployment-related trauma. Their study also determined that individuals with a history of child abuse may be more likely to enter the military (close to half of military personnel, compared to roughly one third of the Canadian general population). The authors argued that this could partially explain higher rates of suicide relative to civilians (albeit previous work by DND failed to find higher rates of suicide using comparisons to the Canadian general population, not a comparable working population⁵³). Their findings also suggest that the association between child abuse history and suicide-related outcomes may be significantly weaker in military personnel relative to civilians. The authors postulated that selection of more resilient individuals through continued military service may in part explain this finding, in addition to positive aspects of military life (for example, meaningful and secure employment, escaping a negative home environment or community). This is in keeping with the findings of Canadian Forces Cancer and Mortality Study⁵⁴, which suggested that longer military service has a “protective” effect: suicide rates were over two times higher in veterans with less than 10 years of service than those with over 10 years of service.

Relationship between deployment-related stress and mental health outcomes

Numerous studies in different countries over the last five decades have suggested that there is a relationship between deployment-related stress in the military and adverse mental health outcomes.^{55,56} A handful of negative studies, however, have also been published that failed to find such an association with most or all mental disorders^{57–59} or suicide.^{60,61}

A large study conducted on US military veterans from 1965-1971 found that depression, anxiety, alcohol abuse/dependence were significantly more prevalent in those who had served in Vietnam, versus those who had not.⁶² A recent re-analysis of this study of Vietnam veterans, which attempted to address limitations such as recall bias, found an even stronger dose-response relationship with war-related PTSD (18.7% for lifetime rate; 9.1% current PTSD 11-12 years after the war).⁶³ Other studies have also similarly characterised the relationship between deployment to Vietnam and adverse mental health outcomes.^{64,65}

The relationship between deployment-related stress and mental health outcomes has more recently been demonstrated for US operations in Afghanistan and Iraq, where social and mental health outcomes have included referral for general mental health problems, PTSD, major depression, substance abuse, job loss, divorce/separation, and partner abuse.^{56,66–70} Prigerson et al.⁶⁶ studied a nationally representative civilian sample of US men from 1990-1992 and found that 27.8% of past year PTSD, 7.4% of past year major depression, and 8% of past year substance abuse problems were attributable to lifetime combat exposure in men. Black et al.⁶⁷ found that higher rates of PTSD, panic disorder, and generalized anxiety disorder to be

associated with deployment. Connorton et al.⁶⁸ failed to find a relationship between combat and major depression or generalized anxiety disorder, but found that combat was associated with increased PTSD and alcohol or drug issues.

A 2013 DND study⁷¹ calculated an incidence of 13.5% (95% CI: 12.1%-14.8%) for mental disorders attributable to deployment in support of the mission in Afghanistan, over a median follow-up of 1364 days. This study likely underestimates incidence because the estimate is derived from apparent use and non-use of Canadian Forces mental health services - those who did not seek treatment within the military health care system would not have been detected. Furthermore, in the time period since this estimate was calculated, more mental disorders attributable to deployment will have developed.

Canadian Armed Forces: deployment-related stress and mental health outcomes

Using data from the 2002 Canadian Community Health Survey Cycle 1.2 Canadian Forces Supplement (N=8441), Sareen et al.⁵⁵ suggested that deployment alone is not sufficient to increase the risk of adverse mental health outcomes post-deployment. Rather, their variables “exposure to combat” and “witnessing atrocities and massacres” were found to be significant in increasing the risk of adverse mental health outcomes post-deployment (AOR 1.37 (95% CI: 1.09-1.72) and 1.77 (95% CI: 1.39-2.26), respectively).

In another study using the same data source, Sareen et al.¹³ estimated population attributable fractions (PAFs) of adverse mental health outcomes due to deployment. In this study, the authors used a dichotomous variable to assess for exposure to deployment (either combat or

peacekeeping) without taking into consideration exposure to stressful or traumatic events during deployment. No association with suicidal ideation, alcohol dependence, panic disorder, nor generalized anxiety disorder was found; only PTSD was found to be significantly associated with deployment (PAF 46.6% for men; 23.6% for women). Major depression was the solitary mental health outcome significantly associated with those who had been deployed for both combat and peacekeeping. The same research group analyzed data from the 2012/2013 Canadian Community Health Survey – Mental Health and the 2013 Canadian Forces Mental Health Survey and found significantly higher odds lifetime and past-year suicidal ideation in military personnel compared to the Canadian general public (lifetime: 1.32 (95% CI: 1.17-1.50); past year: 1.34 (95% CI: 1.09-1.66), with similar results for lifetime and past-year suicidal plans².

A 2016 report⁴ released by DND on suicide mortality in the Canadian Armed Forces provided more detail on the relationship between deployment and risk of suicide: they suggested that deployment was associated with an increased risk of suicide for Regular Force males under Army command compared to those under non-Army command (age-adjusted suicide rate ratio = 2.49, 95% CI: 1.81, 3.42). In addition, Regular Force males under Army command in the combat arms trades had statistically significantly higher rates compared to those Regular Force males in non-Combat Arms trades (31.62/100,000 (95% CI: 24.51, 40.66) compared to 16.52 (95% CI: 13.48, 20.22)). However, overall, suicide rates in the Canadian Armed Forces did not significantly increase over time and were not statistically higher than those in the Canadian population; experiencing trauma during deployment was discussed as a possible risk factor via mental disorders, possibly confounded by ACE or another lifetime trauma.

Research Objectives and Hypothesis

Figure 1 details a theoretical model of the relationship between deployment-related stress and mental health outcomes, and the possible effect modification of this relationship by adverse childhood experiences.

The following research objectives were investigated in this thesis:

1. To examine the relationship between deployment-related stress experiences (DRSEs) and mental health outcomes
 - a. Primary Outcome: general mental health status (measured by SF-36 MCS score)
 - b. Secondary Outcomes:
 - i. Post-Traumatic Stress Disorder (PTSD)
 - ii. Depression
 - iii. Suicidal ideation
 - iv. Anxiety
 - v. Panic disorder

Hypothesis: *There is a dose-dependent relationship between DRSEs and mental health outcomes, including SF-36 MCS, depression, suicidal ideation, PTSD, anxiety, and panic disorder.*

2. To examine the relationship between adverse childhood experiences (ACEs) and mental health outcomes
 - a. Primary Outcome: general mental health status (measured by SF-36 MCS score)

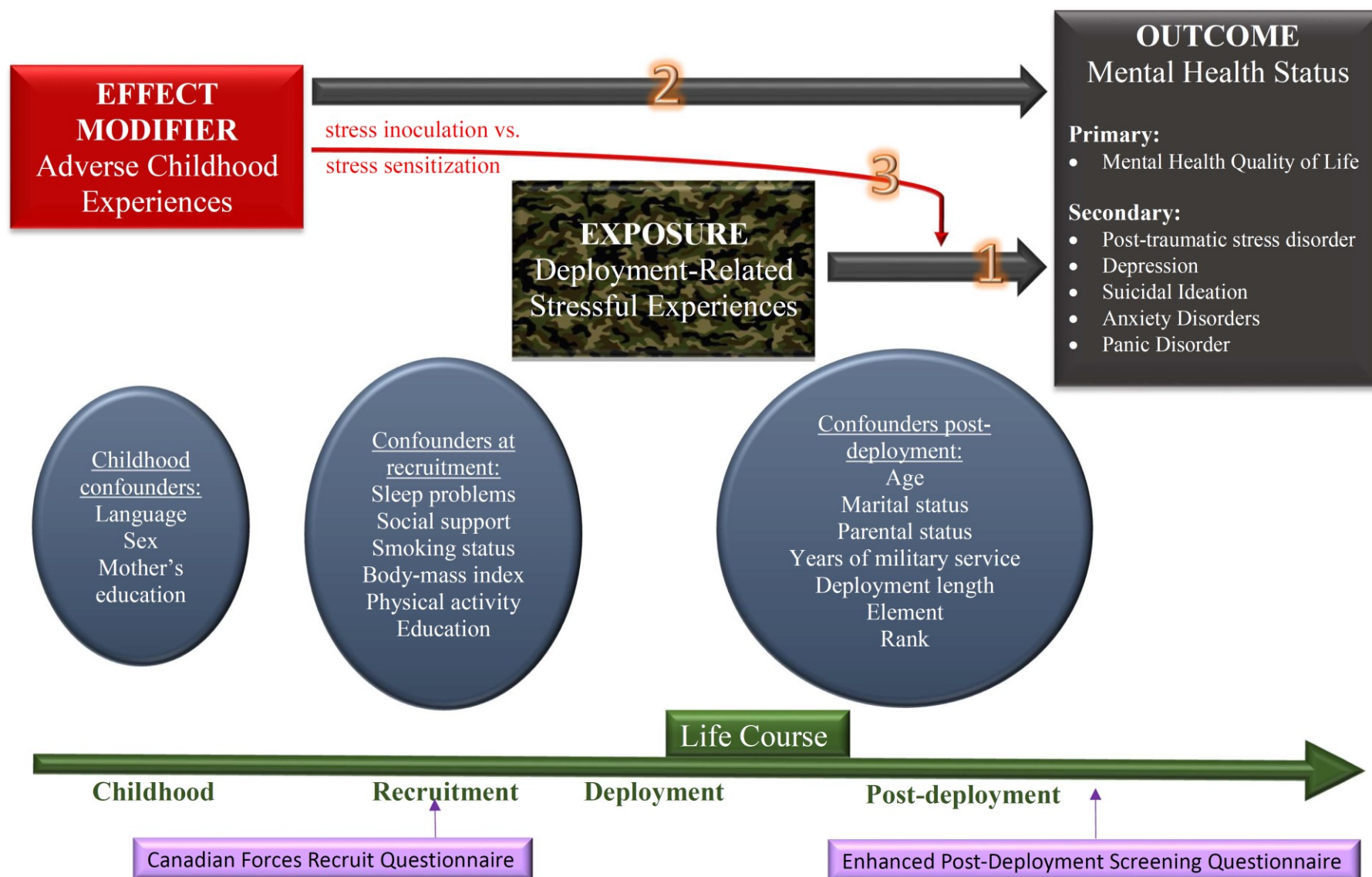
- b. Secondary Outcomes:
 - i. Post-Traumatic Stress Disorder (PTSD)
 - ii. Depression
 - iii. Suicidal ideation
 - iv. Anxiety
 - v. Panic disorder

Hypothesis: *There is a dose-dependent relationship between ACEs and mental health outcomes, including SF-36 MCS, depression, suicidal ideation, PTSD, anxiety, and panic disorder. Having experienced multiple types of ACEs have a cumulative effect on stress sensitization. Having experienced low levels of ACEs has a protective effect and improves mental health outcomes in comparison to having experienced no ACEs. Moderate and high levels of ACEs result in stress sensitization.*

- 3. To examine the effect ACEs have on the relationship between DRSE and general mental health status (as measured by SF-36 MCS score)

Hypothesis: *ACEs behave as an effect modifier of the relationship between DRSE and mental health outcomes.*

Figure 1: Theoretical Model



Study Design

Methods

This thesis is a prospective analysis of a longitudinal dataset that was created in 2011. It links two self-report assessments administered by DND: the Canadian Forces Recruit Health Questionnaire (RHQ) and the Enhanced Post-Deployment Screening (EPDS). The dataset captures CAF members returning from combat and peace support operations in support of the mission in Afghanistan up to 2011, who completed questionnaires at recruitment and after deployment.^{72,73}

Data Sources

The Canadian Forces Recruit Health Questionnaire (RHQ)

The RHQ is a voluntary 27-page paper-and-pencil questionnaire that has been offered to all CAF recruits during the first week of basic training since 2003.⁷⁴ The RHQ provides baseline self-report assessments for a variety of psychological and epidemiological constructs, and draws upon questions from multiple sources – all measures in the RHQ have demonstrated acceptable reliability and validity.^{72,74,75} The RHQ is not anonymous; however, the results are confidential and are not used for screening purposes. Thus, the results may be generalizable to other countries that do not screen their recruits for mental illness.

The Enhanced Post-Deployment Screening (EPDS) Questionnaire

The EPDS is a mandatory but confidential process that begins with the administration of 14-page questionnaire booklet for those who have gone on deployment overseas for 60 days or longer.

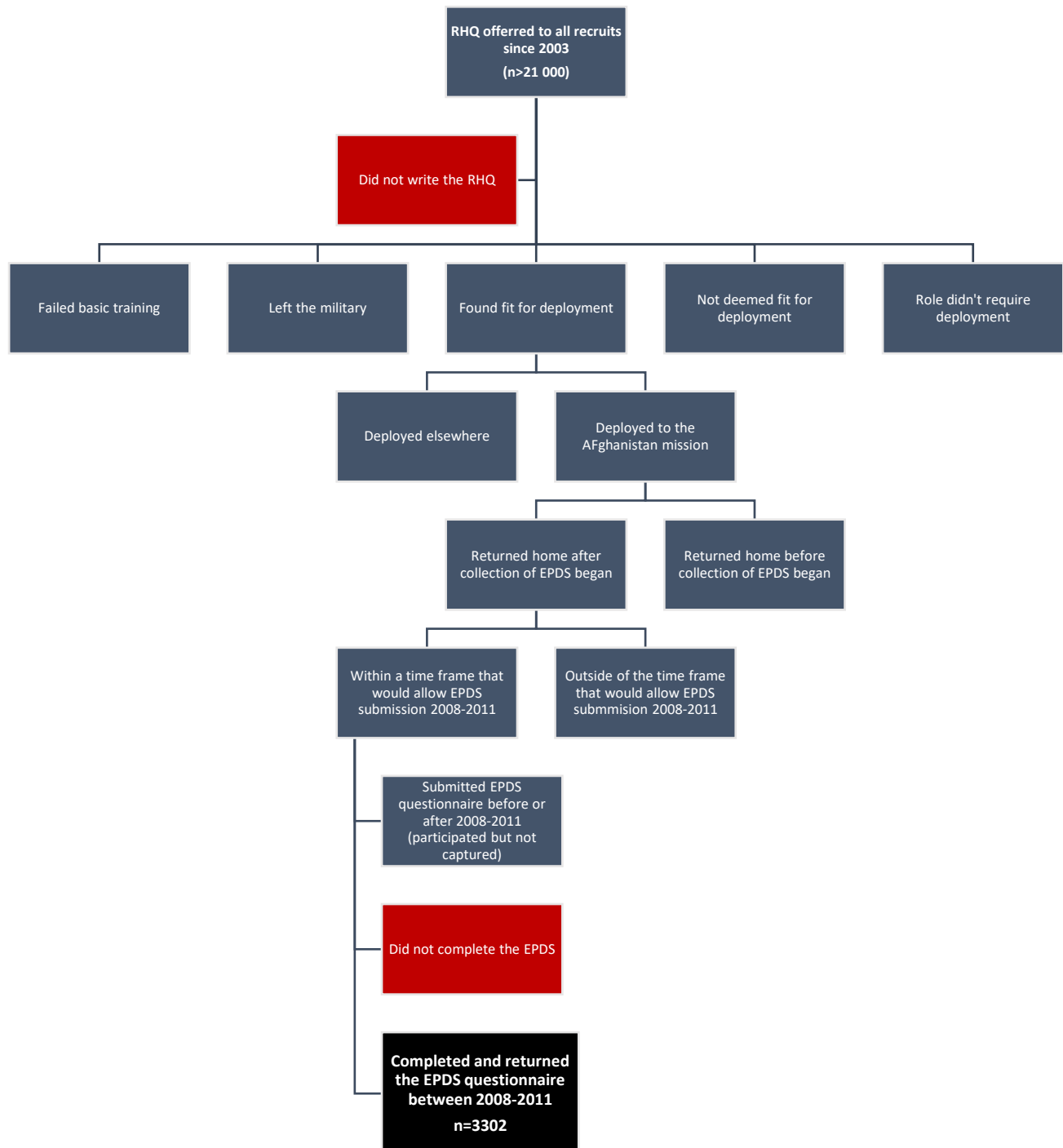
The questionnaire is followed by a 40-minute, semi-structured interview by a mental health clinician.⁷⁶ Whether identified through the screening process or by self-presenting to medical services, the mental health clinic administers treatment and provides further support. Numerous modified work programs are made available when needed; however, despite the program's well-intentioned goals of returning CAF members to regular duties, success rates are perceived to be poor. Among CAF members who had been diagnosed with mental disorders related to their service in support of the mission in Afghanistan, 40.9% continued to experience career limitations related to their mental health at five years post-deployment.⁷⁷

The EPDS questionnaire contains the SF-36 health survey, the Patient Health Questionnaire (PHQ), AUDIT (alcohol questionnaire), the PCL-C screen for PTSD (see below), a screen for traumatic deployment experiences, and an injury screen. The questionnaire is most often completed within six months from the end of deployment, with 97% completing within 12 months. The EPDS questionnaire provides self-report assessments of combat experiences (which have been adapted from the Combat Exposure Scale) and a variety of mental health outcomes.

[Linkage of RHQ to EPDS](#)

Each CAF member has a unique service number assigned to them. Using service numbers, DFHP matched EPDS data collected January 2008 to 2011 to RHQ data, collected since 2003. Matching was not possible for all members who completed the EPDS due to incomplete data.⁷⁸ Figure 2 depicts the pathway recruits would follow in order to be included in the linked dataset; numbers of CAF members to populate boxes are reported where they were available.

Figure 2: Pathway for inclusion in the RHQ-EPDS linked dataset



Between July 2003 and December 2009, 21 817 respondents completed the RHQ, representing approximately 70% of recruits. However, an accurate participation rate for the RHQ section of the linked dataset was not calculated. Firstly, an end date for RHQ inclusion in the linked dataset was not determined; rather, the linked dataset was created based on EPDS data from 2008-2011.

Secondly, participation rates varied greatly over the years, particularly between pre-2007 recruits and post-2007 recruits. In 2003 it was 95%; in 2003-2004, it was 92%; and, from 2003-2006, it was over 75%.⁷⁹ After the elimination of pre-enrolment physical fitness screening, those who enrolled between 2007 and 2009 (12 361 recruits) had a response rate of 60%, and were demonstrated to have higher proportions of poorer health and somatic symptoms, high BMI, physical inactivity, probable cases of depression, and probable cases of PTSD, less favourable “dispositional” characteristics (as per personality screening), and higher health risk behaviour rates, such as risky alcohol use and smoking. The 2007-2009 cohort of recruits were less likely to have been offered the EPDS because they had a higher likelihood of failing basic training, early military attrition, and not being found fit for deployment, due to higher rates of poor physical and mental health.

Because the linked dataset was created in 2011, later recruits who were eventually deployed may not have had the opportunity to be screened or complete the EPDS (basic training is 14 weeks, 4-5 weeks for Army/Navy, followed occupation training (few months to a year)⁸⁰, deployment of six or more months, and then a 12 month window where 97% of all completed EPDS questionnaires were returned⁸¹). The linked dataset contains 28 (0.86%) respondents who report being in the military one year or less, and 68 (2.10%) were in the military two years and under.

As such, the participation rate for the sub-population of RHQ respondents who are in the linked dataset is most likely higher than 70% and closer to pre-2007 participation rates (see Figure 2).

The sub-population of CAF members who completed the RHQ and were also eligible for the EPDS are quite different from the general recruit population to which the RHQ was administered, suggesting that the participation rate may be higher for those who were eligible for the EPDS. RHQ respondents who did not pass basic training, who left the military early, and who were not selected for deployment, or who were deployed elsewhere, are not relevant to the response rate calculation for this study; however, such recruits are included in the overall 70% response rate for the RHQ. Rather, to calculate the response rate for the RHQ section of the linked dataset, one would require the number of recruits since 2003 who were eligible for the RHQ and the EPDS but did not complete the RHQ.

It is unclear whether or not the overall EPDS response rate of 80%⁷² is applicable to the subset of those who completed the RHQ in the linked dataset. The EPDS completion rate includes those who did not complete the RHQ, either because they were recruited before 2003 or they chose not to complete the RHQ. Those recruited 2003 or later would by definition be a younger cohort than those recruited before 2003. As such, the linked dataset respondent EPDS participation rate could possibly be different from the general EPDS participation rate.

In summary, a final participation rate for the linked RHQ-EPDS dataset was never calculated by DFHP, while the overall response rate of 56% (calculated from the overall RHQ 70% completion rate and the overall EPDS 80% completion rate) is most likely an underestimate. The

participation rate of interest to this study would be determined from those who were recruited since 2003 and eligible for post-deployment screening approximately 2008-2011 (and therefore eligible for both the RHQ and EPDS).

Primary Exposure: DRSE

The EPDS “Deployment Experiences” questionnaire measures DRSEs using a count variable score from 0-30 that was adapted from a 37-item “Combat Experiences Scale” used by Killgore et al.⁸², which sought to look for links between combat experiences and risk-taking, unsafe behaviour among returning military personnel. It is to be distinguished from the similarly named US Army’s Walter Reed Army Institute for Research “Combat Exposure Scale”⁸³, a 7-item Likert-type questionnaire (from which a weighted score is calculated), which was designed to detect psychological outcomes, namely post-traumatic stress disorder. Several scenarios in the EPDS are virtually identical to scenarios contained in other mental health studies conducted by the U.S. military, such as an 11-item combat experiences questionnaire⁸⁴, and another 16-item scale reported in Castro et al.⁸⁵

The EPDS “Deployment Experiences” questionnaire score is a simple sum of positive responses to 30 scenarios of highly stressful or traumatic situations that CAF members may have been exposed to while on deployment (see APPENDIX A: EPDS – “Deployment Experiences” Questionnaire). Self-reported combat exposure has been demonstrated to be reliable, as was established in a study that compared responses against military records.⁶³

Novel classification of the DRSE scale

Civilians reading the DRSE scenarios in the EPDS can easily envision them all as traumatic; however, the subjective view of a CAF member might be quite different, especially depending on the context of the scenario. Many scenarios listed are part of regular daily activities for combat arms CAF member - duties that they were trained to do. Contingent on one’s trade, the

scenarios could be perceived as somewhat stressful, or in other cases, render a sense of accomplishment, be validating, provide job satisfaction, or even be exciting. For example, it is a daily activity for a combat engineer to "participate in IED/mine clearing" (#28). "Shooting or directing fire at the enemy" (#12) is an expected, normal daily activity that most combat arms CAF members are well-trained for, particularly snipers.

Given the resources available, it was not possible to directly account for the trade of CAF members because DFHP was unable to append data describing a respondent's trade (for example, military occupation code (MOC) and military occupational structure identification (MOS ID)) to the dataset provided for this thesis. In addition, it was not possible to use service numbers to distinguish between those who are "combat arms" and those who are "non-combat arms" in the dataset extracted by DFHP.

Even so, the dataset used in this thesis contained an overrepresentation of combat arms CAF members and those who worked outside of the protection of Kandahar Airfield: 90% of the dataset respondents were non-commissioned members (i.e., not officers), 91% were 35 years of age and under (50% were 26 years of age and under), 90% served 7 years or less (with 78% having served 5 years or less), and 88% were in the Army (as opposed to the Navy or Air Force). For a study population that was largely comprised of combat arms CAF members in the early years of their careers, it was suspected that the summative DRSE scale coalesces the effect of highly traumatizing events with those that are less likely to be perceived as traumatic.

Although the “Deployment Experiences” questionnaire in the EPDS has been demonstrated to be reliable and valid, a new method was devised to separate context-dependent DRSEs from those that are universally highly distressing, which was then validated.

Validation of novel classification of DRSE

Selection criteria for validators of the novel scoring system included: having had combat experience in the Afghanistan mission (“Operation Athena”) along with having clinical experience with CAF combat arms personnel deployed to the mission in Afghanistan (either in a mental health capacity or providing psychological support). DFHP staff who had training in public health or epidemiology in addition to the other criteria were prioritized as validators.

The validation instructions were designed to encourage validators to represent the reactions of combat arm CAF members specifically in Kandahar, while discouraging the personal reaction of the validator (who likely was a health care worker who mainly stayed within the relative safety of the base). To encourage validators to visualize different possibilities for each described exposure, they could classify scenarios as traumatizing depending on the context (i.e., marked as a “depends” scenario). To help validators consider whether a trade exists for which such activities are frequently encountered and are an expected part of the work routine, they could mark the “normal” category. The “normal” category was also useful to help determine if the validator was following instructions carefully and if they were aware about the variety of regular duties of combat arms CAF members are trained for. A “high” category was the third classification option for validators, to mark scenarios that are universally distressing to anyone, regardless of their military role.

Five validators independently classified the 30 DRSE scenarios as either “normal”, “depends”, or “high.” It was observed that verbal reasoning justifying their choices while filling out the form was exceedingly similar among validators. There was very good inter-rater reliability, with a kappa coefficient of 0.838 ($Z=14.51$, $P<0.001$).⁸⁶ Exposures were classified as “highly distressing” where at least 4 respondents were in agreement.

The following scenarios were consistently rated as highly disturbing:

1. Seeing dead bodies or human remains - #3
2. Handling or uncovering human remains -#4
3. Witnessing an accident which resulted in serious injury or death - #5
4. Seeing dead or seriously injured Canadians - #6
5. Knowing someone seriously injured or killed - #7
6. Being in threatening situations where you were unable to respond because of rules of engagement - #11
7. Seeing ill/injured women or children who you were unable to help - #18
8. Feeling directly responsible for the death of a non-combatant - #21
9. Witnessing a friendly fire incident - #22
10. Feeling responsible for the death of Canadian or ally personnel - #23
11. Having a member of your own unit become a casualty - #24
12. Had a buddy shot or hit who was near you - #26
13. Having difficulty distinguishing between combatants and non-combatants - #27
14. Seeing a unit member blown up or burned alive - #30

The following scenarios were consistently put into the context-dependent group:

1. Being attacked or ambushed - #1
2. Receiving small arms fire - #2
3. Improvised explosive device (IED)/booby trap exploded near you - #8
4. Working in areas that were mined or had IEDs - #9
5. Having hostile reactions from civilians - #10
6. Shooting or directing fire at the enemy - #12
7. Calling in fire on the enemy - #13
8. Engaging in hand-to-hand combat - #14
9. Clearing/searching homes or buildings - #15
10. Clearing/searching caves or bunkers - #16
11. Being wounded/injured - #17
12. Receiving incoming artillery, rocket, or mortar fire - #19
13. Feeling directly responsible for the death of an enemy combatant - #20
14. Had a close call, was shot or hit but protective gear saved you - #25
15. Participating in IED/mine clearing - #28
16. Sniper fire - #29

When validators discussed the rationale behind some of their choices (after submitting their responses), the concept of moral injury arose, defined by Litz et al⁸⁷ as “perpetrating, failing to prevent, bearing witness to, or learning about acts that transgress deeply held moral beliefs and expectations.” Many of the scenarios rated as universally disturbing involve the abrupt and

severe contradiction of personal and shared expectations about the rules or the code of conduct; for example, one validator described CAF members recounting that such experiences were “not supposed to happen.”

Coding of DRSE exposure variables

Summative scales and categorical variables were created for each exposure variable. The distressing and context-dependent scenarios were coded as two separate variables and were both considered in all models.

To facilitate comparisons across categorical DRSE variables, the same cut-offs were used. The base category set as “no DRSE exposure”, the low category was set as one to three DRSEs, the medium category was set as four to seven, and the high category was set as eight or more DRSEs. The maximum DRSEs experienced in the “All DRSE” variable was 28; for the “Distressing DRSE” variable, it was 14; and, for the “Contextual DRSE” variable, it was 15.

Variable: Adverse Childhood Experiences

Selection of ACE variables in the RHQ-EPDS dataset

Previous ACE analyses conducted at DND used a count variable that summed RHQ questions 77a through 77h, which originated from “The Recruit Assessment Program” (RAP) tool. The RAP was jointly developed by the US Department of Defense, Department of Veterans Affairs, and Department of Health and Human Services^{88,89}, and its questions were derived from the Adverse Childhood Experiences Study^{90,91}, Childhood Trauma Questionnaire^{92,93}, the Conflict Tactics Scales⁹⁴, and sexual abuse questions from Wyatt (1985)⁹⁵. The questionnaire reflects experiences prior to 17 years of age, and addresses “childhood abuse” (defined as physical, sexual, and emotional abuse)⁷ and “child maltreatment” (defined as exposure to intimate partner violence (IPV), physical neglect, emotional neglect)⁷, in addition to the household factors of mental illness and alcohol abuse.

The RHQ contains a handful of ACE variables, in addition to the question 77, series that address household dysfunction and psychological distressing factors that are distinct from “childhood abuse” and “child maltreatment” (see Table 1 and APPENDIX B: ACE questions in the RHQ). ACEs of this nature have been included in other ACE studies^{8,96,97}.

Table 1: Types of childhood adversities inquired about in the RHQ

ACE Subtypes	Type of Variable	RHQ Question #
1. In comparison to two parents, raised by:	Dichotomous/Ordinal	11
a. One parent		11
b. Grandparent(s)		11
c. Other relatives		11
d. Foster parents/guardians/group home/institution/other		11
2. Adopted as a child	Dichotomous	12
3. Father died before 10 years of age – <i>corrupt data</i>	Dichotomous	15
4. Father died after 10 years of age – <i>corrupt data</i>	Dichotomous	15
5. Mother died before 10 years of age – <i>corrupt data</i>	Dichotomous	17
6. Mother died after 10 years of age – <i>corrupt data</i>	Dichotomous	17
7. Parents with substance abuse/dependence – <i>dropped</i>	Dichotomous	18
8. Parent with Mental Illness – <i>dropped</i>	Dichotomous	19
9. Parent with Depression – <i>dropped</i>	Dichotomous	20
10. Parent with Anxiety – <i>dropped</i>	Dichotomous	20
11. Parent with Manic-depressive illness – <i>dropped</i>	Dichotomous	20
12. Parent with Schizophrenia – <i>dropped</i>	Dichotomous	20
13. Residential instability	Dichotomous	70
14. Neglect	Dichotomous/Ordinal	77 a & b
a. Physical neglect	Dichotomous/Ordinal	77a
b. Emotional neglect	Dichotomous/Ordinal	77b
15. Emotional abuse	Dichotomous/Ordinal	77c
16. Physical abuse	Dichotomous/Ordinal	77d
17. Intimate partner violence	Dichotomous/Ordinal	77e
18. Sexual abuse	Dichotomous/Ordinal	77f
19. Lived with mental illness in household	Dichotomous	77g
20. Living with alcoholic in household	Dichotomous	77h

Errors and redundancies within the dataset necessitated the dropping of several proposed ACE variables once access to the dataset was granted. The parental death variables (numbers three through six in Table 1) were improperly inputted into the dataset and were therefore unusable. Details of parental mental illness and substance abuse/dependence (numbers seven through twelve) were dropped because of redundancy with question 77g and 77h; question 77 items were prioritized for consistency and comparability.

In total, three new ACE variables were selected and used to create a novel ACE variable that combined these variables with those in question 77. The original DND ACE variable, question 77a-h, was retained for comparative analyses. The new variables added included: residential

instability, not being raised by parent(s) or grandparent(s), and being adopted. Residential instability, or moving frequently, during childhood has been considered an ACE⁹⁸ and is associated with increase exposure to a wide range of ACEs.⁹⁹

Disruptions to family structure (i.e., separation and divorce) have been studied in ACE literature.^{8,11,12,17,19,91,98,100–105} Along similar lines, data on who raised respondents was available in the linked dataset; non-traditional family structures fall into the class of family-level stressors. Family-level stressors have been classified as ACEs since the 1990s, when the traumatic impact of subtler forms of adversities gained recognition.^{96,106}

Adoption has been argued to be another type family-level stressor that is both a marker for early life adversity and an ACE in of itself. Adoptees often experience other adverse childhood experiences before adoption.^{107,108,109} It has been argued that both pre- and post-adoption adversities affect post-institutionalized children in varying ways, especially regarding recovery from socioemotional problems, cognitive delays, and physical growth retardation.^{109,110,111} Adoptees have higher rates of externalizing symptomatology, learning disabilities, hyperactivity, attention deficit hyperactivity disorder mental health issues and are overrepresented in various mental health and special education settings.^{107–109,112–114}

Both biological and psychosocial reasons have been offered to explain the increased risk for psychological maladjustment among adoptees.¹⁰⁷ Biological sources include genetic vulnerability, poor prenatal and reproductive conditions, which can have negative consequences on the developing brain in the short-term and long-term, resulting in lifelong impairments in

physical and mental health.^{12,37} Other sources include negative interpersonal experiences associated with the adoption itself.¹¹⁵ Psychological and social theories have been put forth to explain in detail how adoption interferes with normal psychological development.¹⁰⁷ For example, the environments inside and outside the homes of adoptive families interact in a complex manner and influence the growth and development of adoptees.¹¹⁰ Adopted family life is characterized by additional challenges that complicate universal tasks of family life, such as stigma surrounding adoption - an issue that tends to be overlooked.^{107,116} For example, because of their unknown genetic past and lack of biological link to their parents, adopted children often face stigma that they are second rate and that their parents are not “real parents.”

Coding of individual ACE variables

Initially, each individual ACE variable was examined independently, as a dichotomous variable and as an ordinal variable when possible. Ordinal variables were converted to dichotomous variables using pre-determined cut-offs based on the literature (see Table 2).

Table 2: Scoring of ACE variables

ACE variables	Dichotomous	Ordinal
Question 77 ACE variables (from RAP questionnaire)		
A: Physical neglect: felt protected 1 – Never true 2 – Rarely true 3 – Sometimes true 4 – Often true 5 – Very often true	1 1 0 0 0	4 3 2 1 0
B : Emotional neglect: felt loved 1 – Never true 2 – Rarely true 3 – Sometimes true 4 – Often true 5 – Very often true	1 1 0 0 0	4 3 2 1 0
C : Emotional abuse 1 – Never true 2 – Rarely true 3 – Sometimes true 4 – Often true 5 – Very often true	0 0 1 1 1	0 2 3 4 5
D : Physical abuse 1 – Never true 2 – Rarely true 3 – Sometimes true 4 – Often true 5 – Very often true	0 0 1 1 1	0 2 3 4 5
E : IPV 1 – Never true 2 – Rarely true 3 – Sometimes true 4 – Often true 5 – Very often true	0 0 1 1 1	0 2 3 4 5
F : Sexual abuse 1 – Never true 2 – Rarely true 3 – Sometimes true 4 – Often true 5 – Very often true	0 1 1 1 1	0 3 4 5 6
G : FHx MI 0 – No 1 – Yes	0 1	0 3
H :FHx EtOH 0 – No 1 – Yes	0 1	0 3
Novel household dysfunction variables		
Raised by 1 – Two parents 2 – One parent 3 – Grandparent or grandparents 4 – Other relatives 5 – Foster parents/guardians/group home/institution/other	0 0 0 1 1	0 1 2 3 4
Adoption 0 – Not adopted 1 – Adopted	0 1	0 3
Residential Instability 0 – Did not frequently move 1 – Frequently moved	0 1	0 3

* bold numbers indicate a screen-positive response

The cut-offs in that data provided by DND differed from those described in the literature for emotional abuse, physical abuse, and IPV (DND scored these three variables as positive when “rarely true”). From what could be ascertained from RAP documentation⁸⁸, scoring of the original RAP ACE questionnaire was based on Dube et al.⁹¹ Dube et al. scored the emotional and physical abuse questions as positive when they occurred “often” or “very often”, as opposed to all answers except “rarely true.” A Canadian study that looked solely at physical abuse, sexual abuse, and IPV scored physical abuse and IPV as positive when they occurred “sometimes or more.”^{14,117} For the purposes of this study, the Canadian study’s scoring method was applied to both emotional and physical abuse for consistency. It was the most up to date study, was done on a Canadian population, and was viewed as a compromise between Dube et al. and DND.

The variable concerning family structure was dichotomized based on whether one was raised by parent(s) or grandparent(s), versus being raised by other relatives, foster parents, guardians, in a group home or institution, or other. A study by Turner et al.¹¹⁸ used two biological parents as the base category, compared to step-families and single parents; however, the categories available in the dataset did not match well. Being raised by other relatives could possibly have been included in the base category; however, relatives are an ill-defined group that could include distant relatives and perhaps relatives through marriage, depending how it was interpreted by the respondent. Lineal kinship includes parents (first-degree relative) and grandparents (second degree relatives), as opposed to aunts/uncles (third-degree relative) and cousins (fourth-degree relative or higher). For consistency and due to the closeness of genetic relatedness, parent(s) and grandparent(s) was chosen as the base category.

Analysis of individual ACEs

Each type of ACE was tested for its association with all mental health outcomes, using regression modelling. A major issue with this type of analysis was that examining individual ACEs is difficult to interpret because ACEs do not occur in isolation.¹⁰⁶ In most cases, this type of analysis is done when there are limited types of ACEs available for analysis. For this thesis, pie charts were constructed for each type of ACE that demonstrate the percentage of co-occurring ACEs.

Investigating stress inoculation and stress sensitization

As was discussed earlier, stress inoculation is hypothesized to occur with low ACE severity, versus none, moderate or high ACE severity. Quantifying ACE severity can be conceptualized two ways: a) the degree of multiple types of ACEs, and b) the degree of frequency or intensity of ACEs.

A) Degree of multiple types of ACEs

It has been argued that experiencing a low number of types of ACEs is a fair representation of experiencing low ACE severity.¹¹⁹ Given that most ACEs are highly interrelated and tend to co-occur, the experience of one or two ACEs in isolation is generally considered to be a marker that overall childhood adversity was less severe¹²⁰; most studies on childhood adversity tally the number of ACEs reported to represent ACE severity.^{10,11,19,22,26,27,105,108–111} Therefore, scale variables were created to detail the degree of multiple types of ACEs, based on question 77 alone and the “all ACE” variable that additionally includes the novel household dysfunction ACEs (see Table 3).

Table 3: Types of childhood adversities contained within cumulative types of ACE variables

“Question 77” ACE variable includes:	“All ACE” variable includes:
1. Physical neglect	1. Physical neglect
2. Emotional neglect	2. Emotional neglect
3. Emotional abuse	3. Emotional abuse
4. Physical abuse	4. Physical abuse
5. IPV	5. IPV
6. Sexual abuse	6. Sexual abuse
7. Mental illness in the household	7. Mental illness in the household
8. Alcohol use disorder in the household	8. Alcohol use disorder in the household
	9. Non-linear kinship guardianship
	10. Adoption
	11. Residential Instability

B) Degree of frequency or intensity of ACEs

A handful of studies addressing stress inoculation account for the frequency or intensity of the ACE experienced, which has been argued to enhance measurement sensitivity.^{19,43,119,122,123} For this thesis, “ACE intensity” variables were created that retained frequency data on ACEs, when available. The RHQ-EPDS dataset contained eleven different types of ACEs and of these, seven had ordinal frequency data and four were dichotomous.

Dichotomous cut-offs for ordinal variables served as the basis for the weighted ordinal scale created for this thesis (see Table 2). The level at which a variable screened positive was set at a value of three, across all variables (both dichotomous and ordinal). The lowest level of each variable was assigned a value of zero regardless of the number levels between the lowest level and the cut-off level. For each level above a positive screen, a value of one was added to the cut-off value of three, as it represents a more severe response. For each level below a positive screen, a value of one was subtracted from the cut-off value of three, as it represents a less severe response. For example, in order to screen positive for physical neglect, one must have responded

“rarely true” or “never true” to the question about having “felt protected.” Therefore, a value of three was assigned to “rarely true” and a value of four was assigned to “never true”, as it is a more severe response. There were three levels below a positive screen; with each subsequent level, a value of one was subtracted from the previous level, such that “sometimes true” was valued at two, “often true” was valued at one, and “very often true” was valued at zero.

The maximum possible score for the “question 77 ACE intensity” variable was 35, and for the “all ACE intensity” variable, it was 45.

Scale and categorical ACE “types” and ACE “intensity” variables

Scale variables for ACE “types” and “intensity” variables were created for both “question 77” and “all ACE” variables, for a total of four scale variables. In addition, to facilitate the investigation of stress inoculation and stress sensitization, categorical ACE variables were created from each scale variable, as depicted in Table 4.

Table 4: Categorical ACE variables cut-offs

	Cumulative types of ACE		ACE intensity	
	Question 77	All ACE	Question 77	All ACE
No ACE	0	0	0	0
Low ACE	1	1	1-5	1-5
Medium ACE	2-3	2-3	6-11	6-11
High ACE	4-8	4-11	12-35	12-45

Cut-offs for low, medium, and high categories of ACE “types” and “intensity” variables required some consideration. It was reasoned that standardizing cut-offs between ACE variables would most facilitate comparisons, for example rather than using tertiles. For ACE “types” variables, the base category was set as “no ACE”, the low category was equivalent to one ACE, the medium category was set as two to three ACEs, and the high category included the remaining number of ACEs.

For ACE “intensity” variables, the cut-off for low ACE to was set to be approximately equivalent to the experience of one ACE: five was chosen as a cut-off because it was the maximum score possible if a respondent scored positive for only one ACE at the maximum level of intensity (see Table 2).

Regression modelling was used to characterize the association between low, medium, and high ACE variables and mental health outcomes. “Question 77” and “all ACE” variables were compared during initial modelling before selection of the ACE variables to include in the final models.

Non-linear associations

An alternate method to investigate stress inoculation and stress sensitization was to test whether quadratic models or other polynomial models might better explain the data, a method that has infrequently been used.^{43,44,119} Increasing severity of adversity has been hypothesized to be associated with worse outcomes in a non-linear fashion.¹²⁴ Therefore, tests to ascertain whether polynomial models were better than linear models at explaining the association between ACE

and SF-36 MCS were conducted, for all four scale variables: cumulative types of ACE and intensity versions of “question 77” and “all ACE” variables.

Outcome Measures

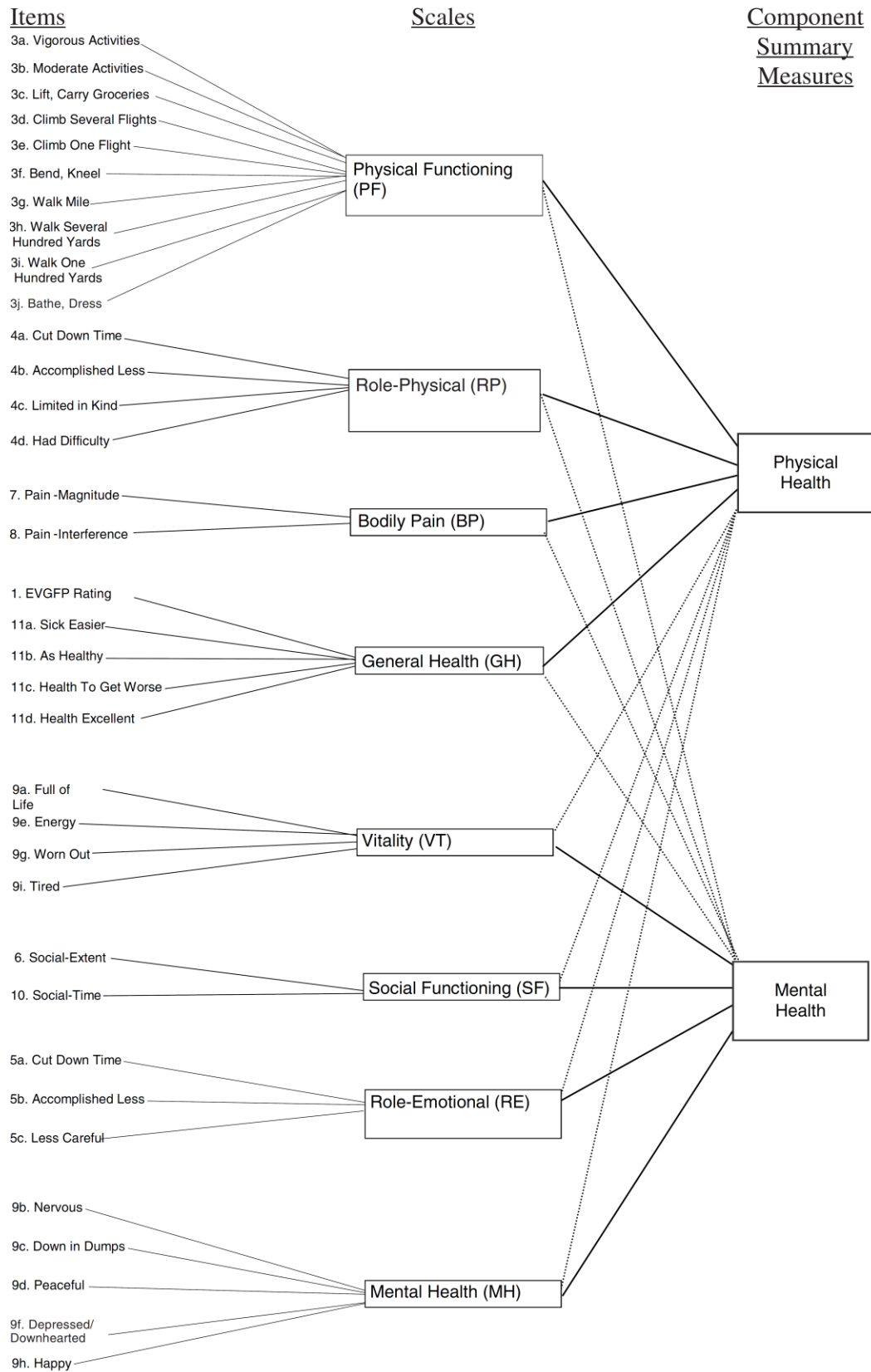
SF-36 MCS

The primary outcome, SF-36 Mental Component Summary, was calculated using data from the SF-36 questionnaire within the EPDS. The SF-36, or the Short Form 36, was developed in the U.S. and is one of the most widely used generic measures of health-related quality of life.¹²⁵ It is a well-validated and reliable scale that assesses patient health across eight dimensions.¹²⁶ An advantage of using SF-36 data over disease-specific scales is that it provides information on functional health status from the individual’s point of view regardless of disease-state, treatment group, or demographic information. Interpretation of these dimensions can be statistically complicated; more straightforward interpretations are made possible with the Physical Component Summary measure (PCS) and the Mental Component Summary measure (MCS), which are aggregate summary measures.

The PCS and MCS are reliable and validated measures, constructed based on factor analysis of correlations among the eight dimensions, visualized in Figure 3.¹²⁷ They were intended to be able to distinguish a physical from a mental health outcome, but there remains some controversy on this issue.¹²⁸ They are argued to be advantageous over SF-36 dimensions because they have smaller confidence intervals, they have more levels defined, they eliminate floor and ceiling effects, and they enable the comparison of disease burden across populations.^{127,129}

SF-36 MCS is considered a general measure of mental health quality of life. In mental health tests, it consistently performed cross-culturally as well or better than the best SF-36 mental health dimension at detecting changes in mental health status.¹³⁰ The changes SF-36 MCS detects have been demonstrated to be clinically meaningful.¹³¹

Figure 3: SF-36 Measurement Model¹³²



As with all SF-36 scales and summary measures, the MCS is scored so that 50 is the mean for the U.S. general population and 10 is the standard deviation.¹³³ Canadian norms have been suggested for the SF-36 MCS, 51.7 (95% CI: 51.5, 51.9).¹³⁴ A difference of three points has been demonstrated to be clinically significant: individual respondent scores below 45 and group mean scores below 47 are interpreted as below the average range for the general population, indicating a less functional status or a worse outcome.¹³² The lowest MCS score possible signifies “Frequent psychological distress, social and role disability due to emotional problems, health rated ‘poor’”, whereas the highest possible MCS score signifies “Frequent positive affect, absence of psychological distress and limitations in usual social/role activities due to emotional problems, health rated ‘excellent’.”¹³⁰

Although the MCS has been demonstrated to detect mental illness¹³⁰, it is informative to use this measure as an indicator of overall mental status or wellbeing. Giving heed to the population approach in epidemiology¹³⁵, using the SF-36 opens up interpretations for social relevance of differences in health status and outcomes. Mental health quality of life is not often considered in mental health research and this research would help address this gap in the literature.

Post-Traumatic Stress Disorder (PTSD)

The EPDS contains the PCL-C, a validated and reliable screening instrument for PTSD^{136,137}. It is a 17-item self-report measure based on the DSM-IV diagnostic criteria for PTSD (items are listed in APPENDIX C: EPDS – PCL-C PTSD screen).¹³⁸ Recommended cut-off points differ based on whether the questionnaire is used non-anonymously in screening settings (where active military are aware they are being screened, and when there are career implications if a

respondent screens positive).¹³⁹ A cut-off score of 50, indicating a high likelihood of PTSD diagnosis, has been used conventionally, including in anonymous epidemiological studies of military populations¹³⁶; however, lower cut-offs are argued to be more ideal in screening settings post-deployment and are in fact recommended by the few studies that address this issue.^{140–142}

In the context of screening, PCL scores have been demonstrated to be lower than in surveillance research: one study found that the reported mean PCL score for the surveillance sample was over 10 points higher than that of the screening sample.¹⁴¹ This difference is at least partially explained by underreporting due the stigma associated with possible referral to mental health services in the military and career implications, as well as the damage to one's self-worth and sense of identity with the acknowledgement that one is experiencing psychological challenges.^{143,144} Screening post-deployment is theorized to be different from screening in mental health settings because in the latter, the respondent is already seeking mental health care. Bliese et al.¹⁴¹ recommend using a cut-off value of 30 to 34 (specificity ~0.90, sensitivity over 0.70), based on their study of U.S. Army soldiers participating in a post-deployment mental health screen returning from Iraq, where respondents were being screen based on their responses to the questionnaire. On the other hand, a cut-off value of 50 had a sensitivity of 0.24 and a specificity of 0.98 in the U.S. Army post-deployment screening population.

An Australian study¹⁴² of active military, however, suggests that the 30 -35 cut point should be used for screening only, and that the 50 cut-off is better for epidemiological study of active military. However, such epidemiological studies are not of military populations who are aware of being screened, with implications for respondents' careers. The sensitivities and specificities

differ somewhat between Bliese et al. and Searle et al.'s studies (the latter doesn't present all data: only for PCL >30 and then 50+).

In addition, the National Centre for PTSD (US Department of Veterans Affairs) suggests that when the estimated prevalence of PTSD is 15% or below, or when the PCL is used in the Department of Defense screening, the PCL cut-off should be within 30-35. Estimated PTSD proportions of the study population are: 13.13% (for a score of 30 or over; 2.25% for a score of 50 or over).

In addition to using a total symptom severity score (summing all scores, range 17-85), the National Centre for PTSD states that the PCL can alternatively be scored dichotomously based on the DSM-IV, which better reflects symptom patterns used for diagnosis clinically:

- At least 1 B item (questions 1-5)
- 3 C items (questions 6-12)
- At least 2 D items (questions 13-17)
- Where symptoms rated as “moderately” or above (3 or more) are counted as “present”

Timing of administration of the EPDS warrants attention in terms of understanding what the PCL-C questionnaire captures. Duration of symptoms and the time elapsed between the occurrence of the event and the onset of symptoms are important in the determination of whether symptoms meet diagnostic criteria for five different trauma- and stressor-related disorders in the DSM 5.¹⁴⁵ The EPDS is usually completed within six months of returning home after deployment, while the PCL-C asks about symptoms that have occurred within the last month.

The traumatic event causing reported symptoms may have occurred at any point during any deployment, including the day before deployment ended, especially in the case of severe injury.

The number of positive responses to PCL-C items are not capable of indicating what type of trauma- and stressor-related disorders are occurring (out of the five different DSM diagnostic possibilities). Acute stress disorder can only occur within 3 days to 1 month of the traumatic event, whereas PTSD can only be diagnosed after one month of symptoms. PTSD symptoms usually occur within three months of the traumatic event, but can also appear after a delay of months to years. Acute stress disorder precedes PTSD in about half of PTSD cases¹³⁸. PCL-C items also capture diagnostic criteria for adjustment disorder (begins within three months but can be delayed, and last no longer than six months, unless the stressor is persistent; for example, a chronic injury resulting from the traumatic experience). Adjustment disorder, “other specified trauma- and stressor-related disorder” and “unspecified trauma- and stressor-related disorder” are possibly diagnosed when the diagnostic criteria for PTSD, acute stress disorder, and adjustment disorder are not met. These disorders are not necessarily less severe than PTSD but they generally sit on the PTSD continuum.^{145,146}

Although the title “PTSD-likelihood” is used in this thesis, the dataset captures a handful of other trauma- and stressor-related disorders, which are important to address clinically for DND, in any case. At the population level, the PCL-C gives a general picture about the level of post-traumatic symptomatology that is being experienced.

Given these considerations, three different methods for scoring “PTSD-likelihood” were tested:

1. A 50 cut-off to create a dichotomous variable (screen-positive PTSD versus screen-negative PTSD).
2. 30 and 50 cut-offs to create variable with 3 categories:
 - a. Unlikely PTSD: 17-29 PCL-C score
 - b. Likely PTSD: 30-49 PCL-C score
 - c. Very Likely PTSD: 50+ PCL-C score
3. Using DSM-based scoring of criteria, to create a dichotomous variable (screen-positive PTSD versus screen-negative PTSD).

Initial modelling of this thesis' first and second objectives tested all three types of PTSD-classification.

Depression

The EPDS contains the Patient Health Questionnaire (PHQ), from which depression can be screened with high sensitivity (0.93) and specificity (0.89).¹⁴⁷ The PHQ is a well-validated multiple-choice self-report inventory that has been marketed for screening of depressive disorder, anxiety, alcohol abuse/dependence, bulimia nervosa/binge eating, and somatoform disorder in primary care settings.¹⁴⁸ The PHQ has also been used in military populations.¹⁴⁹

The PHQ's 9-item depression scale, with scores ranging from 0-27, can be used as a severity measure of depressive symptoms or for screening of "Major Depressive Syndrome" (MDD) and "Other Depressive Syndrome"(ODD) (see APPENDIX D: EPDS – PHQ-9 Depression Screen

for details).¹⁵⁰ There are four methods for classifying PHQ-9 results described in its instruction manual¹⁵¹:

1. DSM-based classification (three categories):
 - a. Unlikely depressive disorder
 - b. MDD: five or more (out of nine) depressive symptom criteria are met, and one of the symptoms is depressed mood or anhedonia, suicidal ideation is counted whenever present
 - c. ODD: as in MDD but instead of five criteria, two to four criteria are met
2. Cut-off score of 10: used frequently^{152,153}; a cut-off between 8-11 was found to be optimal by a meta-analysis¹⁵⁴
3. Cut-off scores of 10 and 15 (three categories):
 - a. Unlikely depressive disorder
 - b. “Yellow flag”, for possible depression
 - c. “Red flag”, for probable depression
4. Five categories of depression severity:
 - a. None (0-4)
 - b. mild (5)
 - c. moderate (10)
 - d. moderately severe (15)
 - e. severe depression (20)

Among these options, three different methods of scoring depression as measured by the PHQ were tested in the initial round of regression models: DSM-based classification (screen-negative

versus MDD versus ODD); a cut-off of 10 (screen-negative versus screen-positive); and, cut-offs of 10 and 15 (screen-negative versus “possible” versus “probable” depression). All initial models compared the three outcomes.

Suicidal Ideation

Suicidal ideation was measured by the EPDS PHQ-9 ninth item that inquires if respondents have been bothered by “Thoughts that you would be better off dead or of hurting yourself in some way” over the preceding two weeks. Respondent options are: “not at all”, “several days”, “more than half the days”, or “nearly every day.” A response of “several days” or higher was set as a positive screen for suicidal ideation. This item has been associated with increased risk of suicide attempt or death¹⁵⁵, and has been demonstrated to identify many patients who do not report active suicidal ideation in interview.¹⁵⁶ In addition, this question has been used to assess for suicidal ideation in non-military populations^{156,157}, US military and veterans^{149,158}, and the UK military.²⁵

Anxiety

The EPDS’ PHQ contains a general screen for anxiety symptoms other than panic disorder - symptoms typical of generalized anxiety disorder.^{159,160} It has been shown to be accurate and valid as a screening tool for diagnosing anxiety disorders in clinical populations^{148,161} and in high-risk groups¹⁶², with a diagnostic accuracy of 93%.¹⁵² Respondents screen positive for anxiety when they answer “More than half the days” to the first item, and to three or more of the remainder of the items (see APPENDIX E: EPDS – PHQ-9 Anxiety Screen for anxiety questions found in the EPDS).

Panic disorder

The original PHQ contains two questions that screen for panic syndrome (see APPENDIX F: EPDS – PHQ-9 Panic Screen for questions): to screen positive for panic syndrome, the respondent must answer “Yes” to a-d of the first question, and “Yes” to four or more of the second question. The PHQ panic disorder screen has been widely used, and has a diagnostic accuracy of 96% of medical patients when compared with a structured psychiatric interview.¹⁶³ DND’s RHQ contains both panic disorder screening questions in their entirety; however, the questionnaire of interest to this study, the EPDS, only contains question one. To demonstrate that question one alone was a sufficient screen for panic disorder, this study investigated the extent to which there was agreement among the first and second items in the RHQ. It was found that item one had a 69.70% accuracy in predicting panic disorder. As a result, a dichotomous panic variable was created based on the EPDS PHQ panic question.

Confounder selection

Potential confounders were chosen a priori due to: a) their association with the exposure; b) being a cause or marker of a cause of the outcome; and c) not being on the causal pathway between exposure and outcome.¹⁶⁴ Variables selected as confounders were thought to be risk factors, preventive factors, or markers/correlates for a cause of poor mental health outcomes based on clinical knowledge, biological knowledge, and plausible mechanisms (see APPENDIX G: Possible confounders for a list of potential confounders that were available in the RHQ-EPDS dataset).

In addition to reviewing the literature to justify inclusion of each covariate with each exposure and outcome (see APPENDIX H: References supporting confounder selection), the characteristics of each potential covariate was discussed with DND staff - not only to ascertain relevance, but to assist in the selection of base and comparator categories. Multiple perspectives were collected from staff with a variety of backgrounds, including those with a background in mental health, epidemiology, and deployment experience in the Afghanistan mission. There were several instances of conflicting opinions among staff and in the literature. Causal diagrams, known as directed acyclic graphs (DAGs), were used to aid in the determination of covariates.¹⁶⁵ These diagrams “link variables by arrows that represent direct causal effects (protective or causative of one variable on another).”¹⁶⁶

Throughout the progress of this thesis, covariate selection was modified, resulting in a handful of iterations of models. At first, when investigating associations between deployment-related stress and mental health outcomes, models were organized by demographics (language, sex, number of children, marital status, age, education), lifestyle factors at recruitment (social support, BMI, physical activity, sleep problems, smoking status), and military factors (rank, element, duty status, deployment length, number of previous deployments, and years of military service). However, this organization did not hold when considering ACE and mental health. If examined separately, the first two research objectives (where DRSE and ACE are exposures) would include similar but not identical groupings of covariates. However, since the last research question examines DRSE as an exposure and ACE as an effect modifier, it was decided that one set of models was required for all three research objectives.

Final models were organized by life-course stage during which the confounder variable was captured, a framework reasoned to be applicable to all three research questions. Model one was an unadjusted model including only exposure and outcome; model two additionally included childhood factors, namely language, sex, and mother's education; model three added variables occurring at the time of recruitment (specifically, lifestyle factors and education); and, model four added variables added post-deployment (military factors, marital and parental status).

Demographic considerations

Language and sex were included in all initial models; however, education, income, and parental education posed some difficulties in the consideration of both DRSE and ACE models. Parental education is associated with outcomes via education at recruitment and income, which in turn influence rank (university-educated CAF members tend to make officer, versus non-commissioned members).

It was hypothesized that parental education, education at recruitment, rank, and income variables were collinear; these variables were significantly associated to one another using chi-square tests (rank was associated with income ($p < 0.001$), education ($p < 0.001$), mother's education ($p = 0.041$), and father's education ($p = 0.004$)). The literature was not instructive as to which variables were most important to include – most of these variables were included, not necessarily together, in the literature.^{5,52,55,59,61,90,97,167} The literature is lacking in studies that deal with income and education data captured both at recruitment and post-deployment (i.e., rank), which made comparisons difficult. Once access to the dataset was granted, it was discovered that income and father's education had over 10% missing values, so they were dropped.¹⁶⁸ The

remaining variables (respondent education, mother's education, and rank) were variably included before final models were decided upon.

Rank roughly represents both education at recruitment and income in the post-deployment phase of life, and as such, it was preferentially included in all initial analyses. Rank made more sense to include in the DRSE models, since rank and DRSE variables were both collected at the same time in the EPDS. However, including parental education and education at recruitment made more sense for ACE models because the ACE questions were also captured at recruitment. Fundamentally, it was a choice between the education variables captured at recruitment and rank post-deployment. Given the numerous covariates that were considered for the final models, attempts were made to cut out variables that might represent similar underlying concepts, to avoid model over-fitting.¹⁶⁹ Nonetheless, as the thesis progressed, it was reasoned that each variable had its own effects separate from one another. Therefore, parental education was adjusted for in model two because it is strongly argued to be a confounder of the association between ACE and mental health, along with language and sex. Education was included in model three, which includes the variables captured at recruitment. Rank was included alongside the post-deployment variables in model four.

Causal pathway

Five RHQ variables temporally precede ACEs and are easily conceptualized to have an association with ACEs: place of birth (not released by DND due to confidentiality), language, sex, father's education (dropped due to high proportion of missing data), and mother's education. These confounders cannot be on the causal pathway between ACEs and mental health and they

are well supported in the literature: of note, a landmark study done by Felitti et al.⁹⁰ examining the relationship between ACEs and leading causes of death in adulthood, adjusted solely for age, gender, race, and education.

Age is a known confounder of ACEs: older respondents tend to report significantly fewer ACEs than younger respondents.⁹⁶ The age variable included in the RHQ-EPDS dataset presented some difficulties: when age has been used in ACE models in the literature, it was the age at the time the ACE survey was filled out. DND was not able to provide an accurate age variable for the RHQ, when ACE data was captured. Nonetheless, because the dataset consisted of predominantly young (50% were 26 years of age and under) and early in their military careers (78% served 5 years or less), and because post-deployment age confounds the DRSE-mental health relationship, post-deployment age was included in model four for consistency across research objectives.

Mental health variables at recruitment were not included in this study on account of their being on the causal pathway between ACE and mental health post-deployment.

Models three and four include covariates that have the possibility of being on the causal pathway between ACEs and mental health. Nonetheless, they were included in the ACE analysis for comparison and consistency with other studies of CAF members.^{5,52} Model two results are reported for final ACE analyses; however, model four is reported for ACE-DRSE interaction models (because model four variables confound the association between the primary exposure, DRSE, and mental health).

Coding of confounders

Childhood variables (model two)

English and French were the two language categories available in the dataset: English was set as the base category. Male was coded as the base category for sex. Mother's education had ten levels that were collapsed into three categories: "did not complete high school", "high school graduate", and "completed post-secondary education." As per Statistics Canada¹⁷⁰, postsecondary education was defined as completion of any college, CEGEP, or other non-university certificate or diploma, and any university certificate or diploma below a bachelor level, and any university degree.

Recruitment variables (model three)

The base category for smoking status was set as "never smoked", with comparator categories being "ex-smoker" and "current smoker." BMI was coded into three categories: normal/underweight, overweight, and obese. Collapsing this variable into two categories: normal/underweight (reference) and overweight/obese was considered; however, this was deemed unnecessary because of sufficient number of respondents per category. Physical activity was provided by DND as a three-category variable: active, moderately active, and not active. Sleep problems was provided by DND as a three-category variable: sleep problems most of the time, sometimes, and never. For clarity, this was collapsed into: "normal sleep" and "disturbed sleep." The Social Support Scale was divided into tertiles: the lowest tertile contained scores from 19 to under 75, indicating low social support. The middle tertile contained score from over 74 to 90 and for this sample, indicate moderate levels of social support. The highest tertile

contained score ranging from 90 to 95, indicating high levels of social support. In the same manner as “mother’s education”, respondent education at recruitment was categorized as “did not complete high school” (base category), “high school graduate”, and “completed post-secondary education.”

Risky sexual behaviour (dichotomous variable: “STI in past” vs. “no STI in past”) was dropped because it cannot be used in both DRSE and ACE models. It was initially included in ACE models because it has some support as a covariate in the literature.^{90,171} Another argument supporting its exclusion is that it might lie on the causal pathway between ACEs and mental health.

Post-deployment variables (model four)

The number of children a respondent has was provided in the EPDS. However, qualitatively, it was determined that whether one is a parent is a more important issue than the number of children one has. A dichotomous variable was created that distinguished parents (comparator category) from non-parents (reference category).

Regarding marital status, being single was coded as the reference category, married was the next level category, and being widowed/divorced/separated was the third category. Collapsing single and widowed/divorced/separated into one category (“not presently married”) was considered, with the reference category being “married”; however, there were sufficient respondents per category to retain three levels.

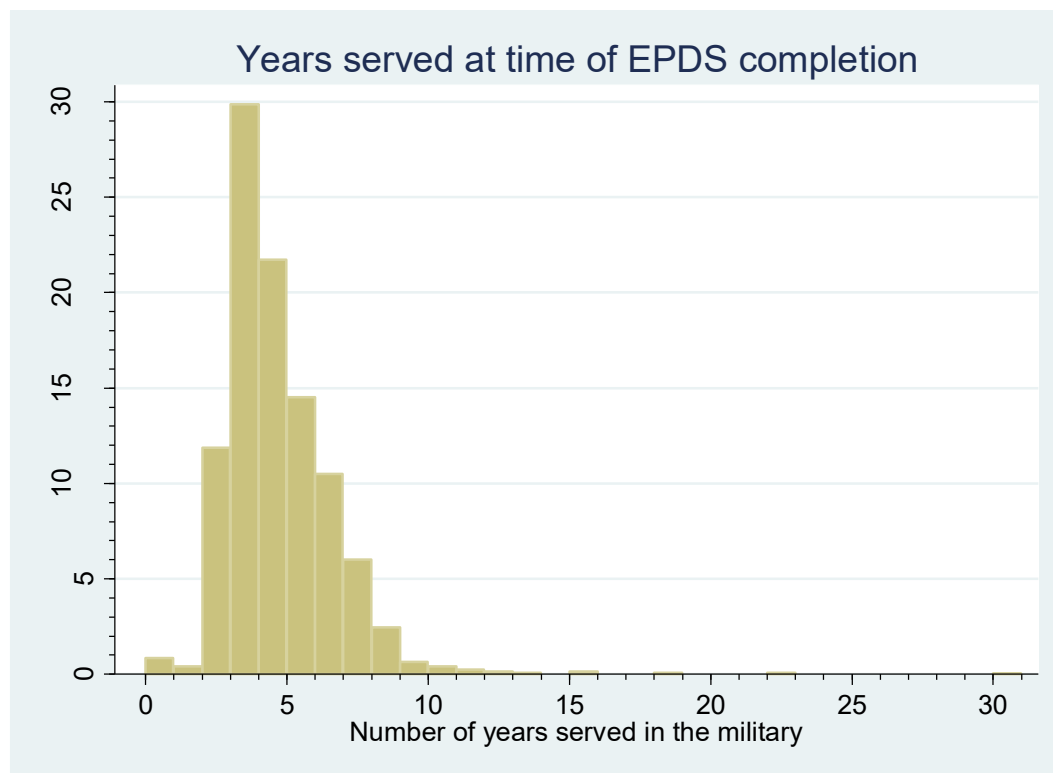
The dataset contained six military variables captured post-deployment: rank, element (Air Force, Army, Navy), duty status (regular vs. reserve), deployment length, number of previous deployments, and years of military service. There were very few reserve respondents (n=17) so these respondents were excluded from analysis (a sensitivity analysis showed that duty status was not significant and it did not change the estimate of the main exposure noticeably). Similar studies of military populations did not include the remaining five variables. Years of military service and number of previous deployments were thought to be similar concepts. Having been previously deployed has been associated in the literature with markers of better mental health: those who qualify to be re-deployed are a select population with high levels of resilience, in part due to the development of DRSE-coping strategies and appropriate expectations.¹⁷² Because DRSEs can influence whether or not one is re-deployed, this variable can possibly lie on the causal pathway, so it was dropped as a covariate.

The rank variable contained three levels of information: officer, senior NCM, and junior NCM. There were only eight respondents who were senior NCM, so the variable was collapsed into a dichotomous variable: officer (base category) versus NCM.

Both the number of years served in the military (interval variable, see Figure 4) and a three-category variable separating those having served 5 years or less, 6-15 years, and 16 years or more were provided by DND. Data quality issues were of concern because the RHQ was initiated in 2003, therefore those responses over 7 years were possibly inputted incorrectly or were counting years served in the reserves. Collapsing the DND categorical variable into two categories (≤ 5 years versus ≥ 6 years) was reasoned to be unhelpful because qualitative feedback

from DFHP staff suggested that number of years in the military matters the most for those who have had the least, especially those under two years. Dividing the scale variables into tertiles resulted in the cut-offs being 3.6 years and five years, which was not informative for those who served under two years. In order to retain sufficient numbers per category while taking into account qualitative information, the years in the military interval variable was divided into 3 categories: “under 2.5 years”, “2.5 to under 5.5 years”, and “5.5 years and over” (which mirrors DND categories of “5 years or less” and “6 years or more”).

Figure 4: Histogram of number of years served in the military

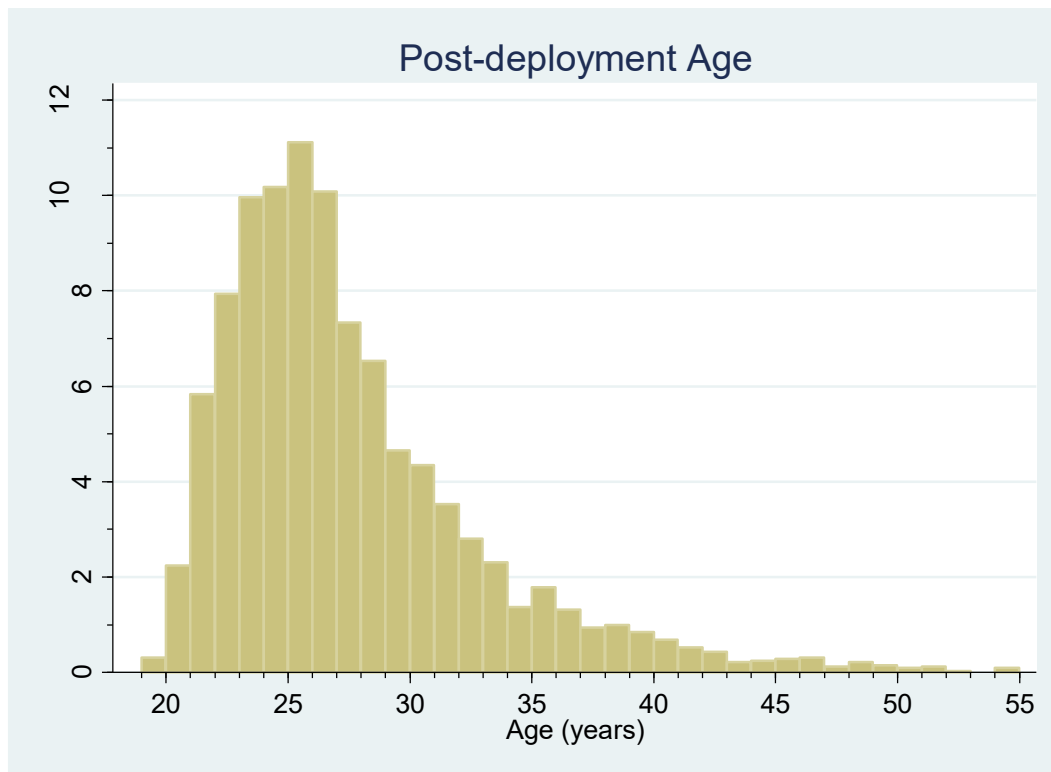


Based on qualitative information from clinical staff, it was thought that having been deployed for less than 2 months had more of a negative impact on mental health than having a normal length or long deployment. It was argued that those who were deployed less than two months did not

complete the regular training with their unit, which involves creating social bonds and normalizing expectation of deployment hardships. Those who were not part of a unit did not benefit from these months of preparation and being part of a cohesive team that becomes “like family.” Normal deployments to Kandahar lasted six months, and this was later revised to nine months to accommodate CAF staff requirements for the Vancouver 2010 Olympics. However, there were not enough responses for those who had been deployed for less than 2 months. Therefore, the deployment length variable was re-categorized into a dichotomous variable: “6 or more months” (reference) and “5 or less months.”

Three age variables were provided by DND: 1) a scale variable calculating age at recruitment using birthdates and year of completion of RHQ survey, which was dropped due to a high number of errors; 2) a scale variable ranging from 19-55 (100 missing) for post-deployment age (see Figure 5); and, 3) a post-deployment age four-category variable, consisting of “24 years or less”, “25 – 35 years”, “35 – 45 years”, and “45 years or more” (1 missing). Imputation for the categorical variable by DND was not discussed. Because there were only 47 respondents in the 45+ year category, the post-deployment age scale variable was collapsed into three categories: “19 to 24 years”, “25 to 34 years”, and “35 years and over.”

Figure 5: Age at the time of EPDS completion



Statistical Methods

Statistical analyses were carried out using STATA and analyses used a level of statistical significance set at $\alpha = 0.05$. All analyses were conducted with the appropriate considerations towards power. A minimum of 10 respondents per independent variable was required for modelling.¹⁷³ Estimate proportion with 95% confidence intervals¹⁷⁴ were calculated for all exposures, covariates, and outcomes.

Regression

Linear, logistic, ordinal logistic, and multinomial logistic regression models were used for SF-36, binary, ordinal, and categorical outcomes, respectively. The proportional odds test was used to determine whether an outcome was ordinal. Covariates were selected in advance based on the literature and expert advice. Initially, stepwise selection was attempted; however, it was reasoned that selecting a limited number of covariates in advance (regardless of their p value) was the most appropriate technique to answer this thesis' research objectives, to avoid over-fitting¹⁶⁹, and to maintain consistency with similar types of studies in mental health. Chi square tests were conducted to look for significant difference in rates of secondary outcomes by proposed confounders^{175,176}; however, the results were not used to select covariates for final models (they are not appended for brevity). Bias due to confounding was judged to occur when inclusion of the potential confounder changed the estimate of association in regression modelling.^{177–179}

Regression modelling of all individual ACEs treated as separate variables was attempted, in separate models as well one model with each ACE represented as an individual variable.

Summative ACE scale and categorical variables were created for question 77 alone and for all

possible ACE, which were compared with each other. For ACE analyses, model two covariates were set as producing fully adjusted estimates of association (models three and four contain covariates that possibly sit on the causal pathway).

To look for non-linear relationships between ACEs and mental health outcomes, STATA's `ovtest` command (which tests for omitted variables) was used to test the appropriateness of polynomial models¹⁸⁰ to explain the relationship between ACEs and mental health outcomes. In addition, manually created quadratic ACE terms were individually tested for significance.

ACE variables were tested for effect modification of the relationship between DRSE and mental health outcomes using interaction terms in regression models (multiplicative interaction). For validation, interaction terms were tested with the other mental health outcomes. For ACE-DRSE interaction models, model four covariates were selected to produce fully adjusted estimates of association.

Power and sample size analysis

Given that dataset was compiled in the past and the sample size already set, minimum detectable difference was thought to be informative for preparation of this thesis.¹⁸¹ To calculate minimum detectable difference, the null (hypothesized) mean was set as 0, the pre-determined power level was set as 0.8, the sample size was 3302, and the standard deviation was 9.706 for the study population. The minimum detectable difference in SF-36 MCS score was calculated to be 0.0488 with 80% power.

Treatment of missing data

Missing and non-missing respondents for each outcome were compared with respect to DRSE and ACE variables.

Exposures

There were 214 respondents with at least one missing response to the EPDS Deployment Experiences Scale (6.48%). Mean imputation was used to replace missing values for those with two or less missing values (193 (5.8%) respondents) and those missing three or more values were coded as missing (21 (0.6%) respondents).

13.2% (435) responses were missing from ACE questions 77a-h, and 509 (15.4%) from total ACE responses (a combination of eleven dichotomous and ordinal items). For those missing one or two items, missing values were assigned a score of zero. Imputation was not attempted for this variable; Cheema et al.¹⁶⁸ do not recommend imputation when there are more than 10% missing values. Those missing three or more values were coded as missing.

Outcomes

There were 14 respondents missing from the SF-36 MCS score provided by DND; 15 suicidal ideation respondents were missing; 55 anxiety respondents were missing; and, 19 respondents were missing panic responses. These were all coded as missing.

There were 135 (4.1%) PTSD scores that contained missing values from the PCL-C 17-item questionnaire (see APPENDIX I: Analysis of missing PCL-C data for details on missing data in

PTSD summary variables provided by DFHP). Respondents missing more than 2 PCL-C responses were coded as missing, of which there were nine (0.3%). Mean imputation was used for respondents missing one or two values (126 values were imputed). This type of imputation is most likely to underestimate PCL scores for missing respondents, because most likely, this data is not missing at random. As discussed earlier, there is substantial stigma related to experiencing mental health difficulties in the military, resulting in PTSD questionnaire underestimating PTSD scores.^{51,141,143,144} In addition, the questionnaire could possibly trigger PTSD symptoms, making it very difficult for such a respondent to proceed.

The depression questionnaire (PHQ-9) had 58 (1.8%) respondents with missing values. Respondents missing 2 or more values were scored as missing (7 (0.2%) respondents), and mean imputation was used for those missing one value (51 (1.5%) values were imputed).

Covariates

Covariates with more than 10% missing data were not included in analysis. A combination of methods was used to deal with missing data. Language and parental status had the most missing data (6% and 7%, respectively).

Confounding variables were coded as either dichotomous or categorical, so mean imputation was arguably not an optimal method. Deterministic hot deck imputation¹⁸² was chosen when possible. For missing BMI category (121 (4%) missing), a “weight perception” variable contained in the dataset was used to estimate values for missing responses. Those who perceived themselves as overweight had a mean BMI of 28.5 – consequently, missing BMI responses for individuals who

perceived themselves as overweight were assigned a BMI of overweight. Those who perceived themselves as underweight had a mean BMI of 21.3, so their missing BMI category responses were assigned a value of normal BMI (in any case, the BMI variable collapsed underweight and normal weight individuals). Those who perceived themselves as “just about right” had a mean BMI of 24.1, so their missing BMI category responses were also assigned a value of normal BMI.

Mother’s education and father’s education were reasoned to be similar enough for imputation ($\chi^2 p < 0.001$), so father’s education was used to impute missing values for mother’s education (missing decreased from 9.4% to 6.2%).

For parental status (246 (7.4%) missing), the average number of children based on marital status categories were used to assign values to missing responses. 98% of those who were single had no children, so single respondents with missing parental status responses were assigned a value of “no children”. Married and widowed/divorced/separated respondents on average each had one child (mean number of children of 0.53 and 0.70, respectively), so when missing, married and widowed/divorced/separated respondents were classified as “parents”.

The physical activity variable was missing 137 (4.1%) responses, so mean substitution was used (60.2% of respondents were physically active). For further substantiation, physical activity levels were checked for each category of BMI, given the general relationship between the two concepts. The majority of each BMI category was active (60% of those who are of normal/underweight BMI; 64% of those who are overweight; and, 54% of those who are obese).

For social support scale, 130 (4%) responses were missing; there was a similar question asking about the number of confidants a respondent has. This variable was recoded into tertiles; there appeared to be a weak relationship between the number of confidants one has and social support score. 47% of those in the lowest tertile of number of confidants were in the lowest tertile of social support (versus 33% in the medium tertile, and 20% in the highest tertile). 38% of those in the middle tertile for confidants were also in the middle tertile of social support (versus 32% in the highest and 29% in the lowest). 43% of those in the highest tertile for confidants were in the highest social support tertile versus 33% in the middle and 23% in the lowest). It was felt that number of confidants was not related enough to social support for hot deck imputation to be used.

Education had 3% missing. Rank was used to impute all missing education responses, which brought down missing values to zero. If one was an officer, it was most likely that the respondent held a post-secondary education. If one was a non-commissioned member, it was most likely that they had completed high school.

As described earlier (in the Post-deployment variables (model four) section), two variables concerning years served in the military were extracted from the linked RHQ-EPDS dataset by DND and provided for analysis in this thesis; however, for the purposes of this thesis, a three-category variable was created that distinguished those who served less than 2.5 years, 2.5 to under 5.5 years, and over 5.5 years. The scale variable provided by DND on years served in the military had 59 missing values; however, the three-category variable provided by DND had zero

missing values and imputation methods were not available (due to staffing changes). For imputation, when a respondent was positive for “6-15 years” or “16 years or more” in the DND three-category variable, a positive response for “those who served over five years” was imputed for the newly created three-category variable when missing. It was discovered that all 59 missing responses had been imputed by DND into this category.

Results

A. Descriptive statistics

Covariates

Descriptive statistics of the study population are found in Table 5. The final study population consisted of 3302 CAF members. The majority of the study population was English (63%), male (90%), had been in the military for 5 years or less (72%) with a median of four years, were in the army (88%), were non-commissioned members (NCM) (90%), and were not parents after deployment (77%). Respondents tended to be of normal weight or underweight (60%), active (62%), have no sleep difficulties (53%), not to have ever smoked (55%), and not to have engaged in risky sexual activity at the time of recruitment (95%). The majority of the sample had at least a high school education (82%), as did their mothers (68%).

Table 5: Proportions of covariates within linked dataset population

Model (by life-course stage)	Covariate*		Frequency	Missing
1. Childhood				
	Language			186 (6%)
		English	1974 (63%)	
		French	1142 (37%)	
	Sex			0 (0%)
		Male	2984 (90%)	
		Female	318 (10%)	
	Mother's Education			204 (6%)
		No high school	671 (22%)	
		High school complete	1430 (46%)	
		Post-secondary complete	997 (32%)	
2. At recruitment				
	Smoking status			55 (2%)
		Never smoked	1793 (55%)	
		Ex-smoker	681 (21%)	
		Current smoker	773 (24%)	
	Body-Mass Index (BMI)			35 (1%)
		Normal weight or underweight	1961 (60%)	
		Overweight	1077 (33%)	
		Obese	229 (7%)	
	Physical activity			0 (0%)
		Active	2041 (62%)	
		Moderately active	630 (19%)	
		Inactive	631 (19%)	
	Sleep problems			52 (2%)
		Normal sleep	1717 (52%)	
		Disturbed sleep	1533 (47%)	

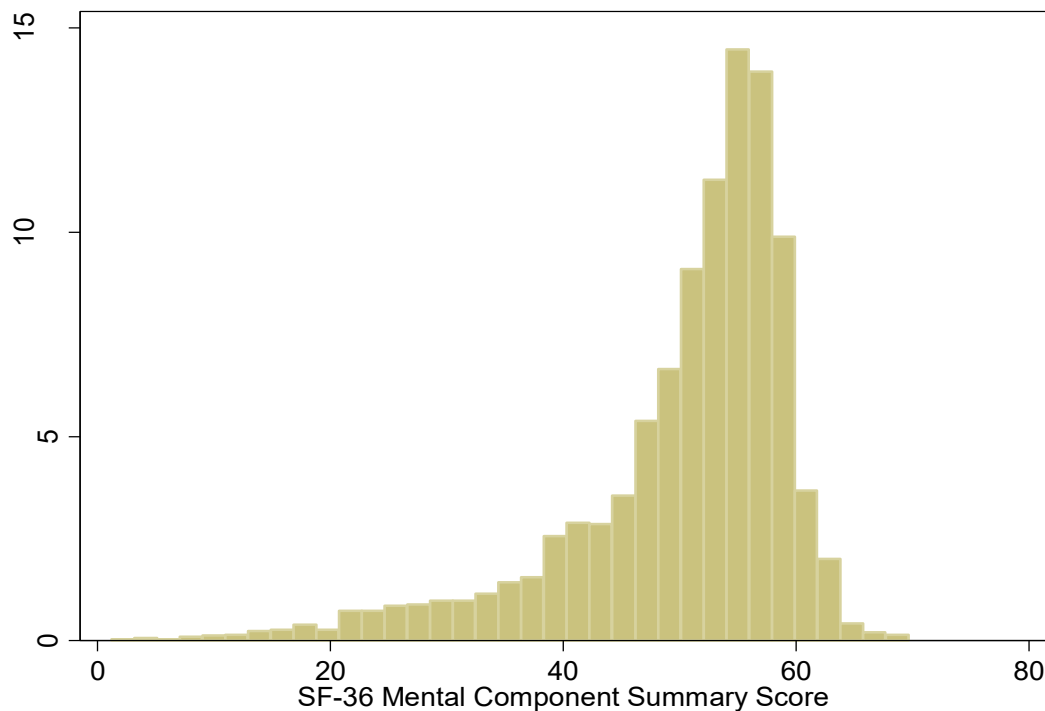
Social support				
	<i>a) scale</i>	<i>Range: 19-95</i>		<i>130 (4%)</i>
		<i>Mean: 77.75 (SD 16.98)</i>		
		<i>Median: 82</i>		
	<i>b) 3 categories</i>	High tertile (>90 to 95)	1017 (31%)	53 (2%)
		Medium tertile (>74 to 90)	1133 (35%)	
		Low tertile (19 to <75)	1099 (34%)	
Education				
		No high school	591 (18%)	0 (0%)
		High school complete	2031 (62%)	
		Post-secondary complete	680 (21%)	
3. Post-deployment				
Parental Status				
		Does not have children	2531 (77%)	0 (0%)
		Has children	771 (23%)	
Marital status				
		Single	1807 (55%)	0 (0%)
		Married	1357 (41%)	
		Widowed/divorced/separated	138 (4%)	
Years in the military				
	<i>a) continuous</i>	<i>Range: 0-31</i>		<i>59 (2%)</i>
		<i>Mean: 4.57 years (SD 1.89)</i>		
		<i>Median 4.08</i>		
	<i>b) 3 categories</i>			0 (0%)
		less than 2.5 years	222 (7%)	
		2.5 – 5.5 years	2149 (65%)	
		Over 5.5 years	931 (28%)	
Branch				
		Army	2901 (88%)	8 (0.2%)
		Navy	112 (3%)	
		Air Force	281 (9%)	
Rank				
		Officer	321 (10%)	0 (0%)
		Non-commissioned member	2981 (90%)	
Deployment length				
		Normal length (6+ mos)	2783 (84%)	0 (0%)
		Short deployment (≤5 mos)	519 (16%)	
Age post-deployment				
	<i>a) continuous</i>	<i>Range: 19-55</i>		<i>100 (3%)</i>
		<i>Mean 27.02 (SD 5.32)</i>		
		<i>Median: 26</i>		
	<i>b) 3 categories</i>			1 (0%)
		24 years or less	1209 (37%)	
		25 to 34 years	1782 (54%)	
		35 years or more	310 (9%)	

*reference category is listed first; italicized variables were not used in regression models

Outcomes

SF-36 MCS had a mean of 50.3 (SD: 9.7), a median of 56.7, and a range of 1 to 70. A histogram of SF-36 MCS scores approximated a normal distribution (see Figure 6), although it was skewed to the left. Transformations did not improve normality.

Figure 6: Histogram of SF-36 MCS (linked RHQ-EPDS dataset)



The population proportion estimates for PTSD, depression, suicidal ideation, anxiety disorder other than panic disorder, panic disorder, and any mental illness are presented in Table 6 and Figure 7. The linked RHQ-EPDS dataset estimates a 15.54% frequency for any mental illness. Panic disorder was dropped as an outcome; significant associations were not detected in initial models, likely due to the small number of respondents with panic disorder (n=52).

Table 6: Proportions of mental health outcomes

Outcome	Categories	Frequency (%)	Population Proportion [CI]	Missing (%)
PTSD				9 (0.3%)
A) 50 cut-off	Screen-negative PTSD	3216 (97.66%)	0.977 [0.971, 0.981]	
	Screen-positive PTSD	77 (2.34%)	0.023 [0.019, 0.029]	
B) 30 and 50 cut-offs	Screen-negative PTSD	2852 (86.61%)	0.866 [0.854, 0.877]	
	Screen-positive PTSD	441 (13.39%)	0.134 [0.123, 0.146]	
	Likely PTSD	364 (11.05%)	0.111 [0.100, 0.122]	
	Very likely PTSD	77 (2.34%)	0.023 [0.019, 0.029]	
C) DSM-based	Screen-negative PTSD	3160 (95.96%)	0.960 [0.952, 0.966]	
	Screen-positive PTSD	133 (4.04%)	0.040 [0.034, 0.048]	
Depression				10 (0.3%)
A) DSM-based	Screen-negative depression	3067 (93.17%)	0.932 [0.923, 0.940]	
	Screen-positive depression	225 (6.83%)	0.067 [0.059, 0.076]	
	Likely 'other depressive disorder'	129 (3.92%)	0.039 [0.033, 0.046]	
	Likely 'major depressive disorder'	96 (2.92%)	0.029 [0.024, 0.035]	
B) 10 and 15 cut-offs	Screen-negative depression	3071 (93.29%)	0.933 [0.924, 0.941]	
	Screen-positive depression	221 (6.71%)	0.067 [0.059, 0.076]	
	Possible depression	142 (4.31%)	0.043 [0.037, 0.051]	
	Probable depression	79 (2.40%)	0.024 [0.019, 0.030]	
Suicidal Ideation				15 (4.5%)
	No suicidal ideation	3211 (97.69%)	0.977 [0.971, 0.981]	
	Suicidal ideation	76 (2.31%)	0.023 [0.019, 0.029]	
Anxiety				55 (1.7%)
	No anxiety disorder excl. panic	3171 (97.66%)	0.977 [0.971, 0.981]	
	Anxiety disorder excl. panic	76 (2.34%)	0.023 [0.019, 0.029]	
Panic				19 (0.6%)
	No panic disorder	3231 (98.42%)	0.984 [0.979, 0.988]	
	Panic disorder	52 (1.58%)	0.016 [0.012, 0.021]	
Any mental illness				71 (2.2%)
	Screen-negative any mental illness	2729 (84.46)	0.845 [0.832, 0.857]	
	Screen-positive any mental illness	502 (15.54%)	0.155 [0.143, 0.168]	

Figure 7: Proportion of screen-positive mental illness in the linked RHQ-EPDS dataset

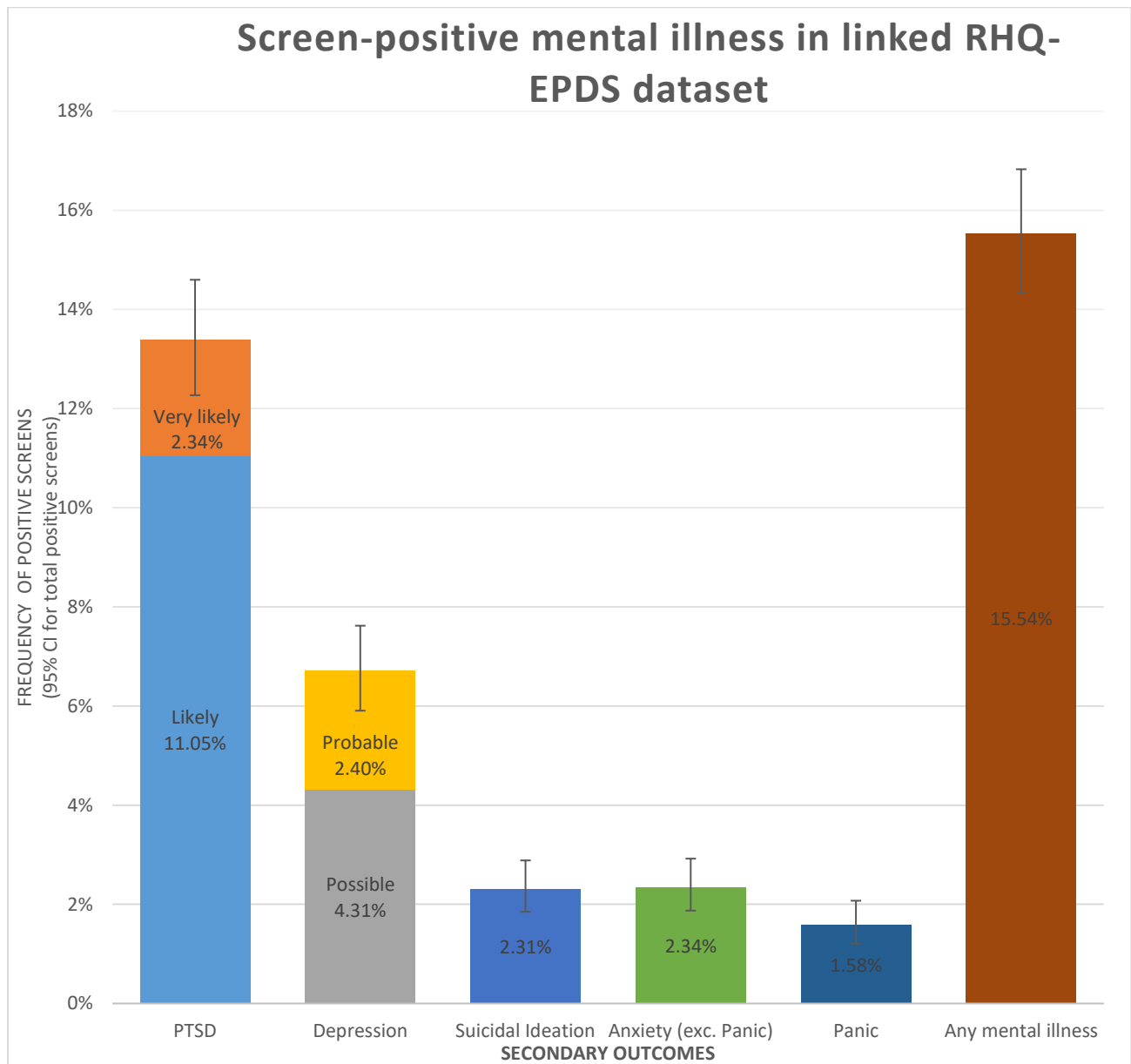
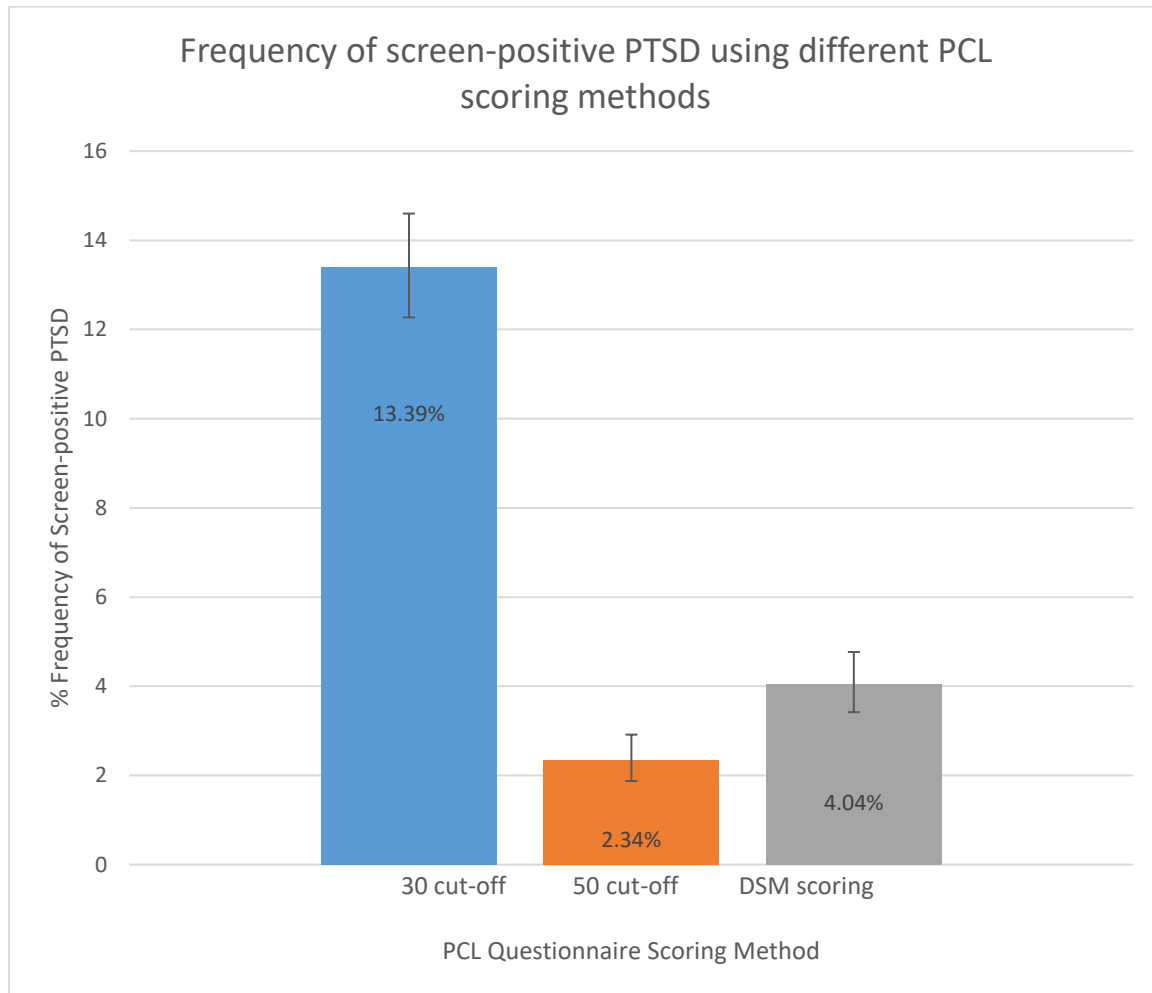


Figure 8 contrasts the results of using three different scoring methods to screen for PTSD. Using a cut-of 50 for the PCL-C questionnaire on post-traumatic stress symptoms, the estimated frequency of PTSD was 2.34% (CI: 1.87%, 2.91%); however, as discussed earlier, a 30 cut-off is considered to yield better estimates of post-deployment populations who are aware they are being screened and whose careers may be affected by the outcome of the questionnaire. Using a

30 cut-off, the estimated PTSD proportion was 13.39% (CI: 12.27%, 14.60%). DSM-based scoring of the PCL-C questionnaire yielded an estimated PTSD proportion of 4.04% (CI: 3.42%, 4.77%).

Figure 8: PTSD frequency in the RHQ-EPDS linked dataset

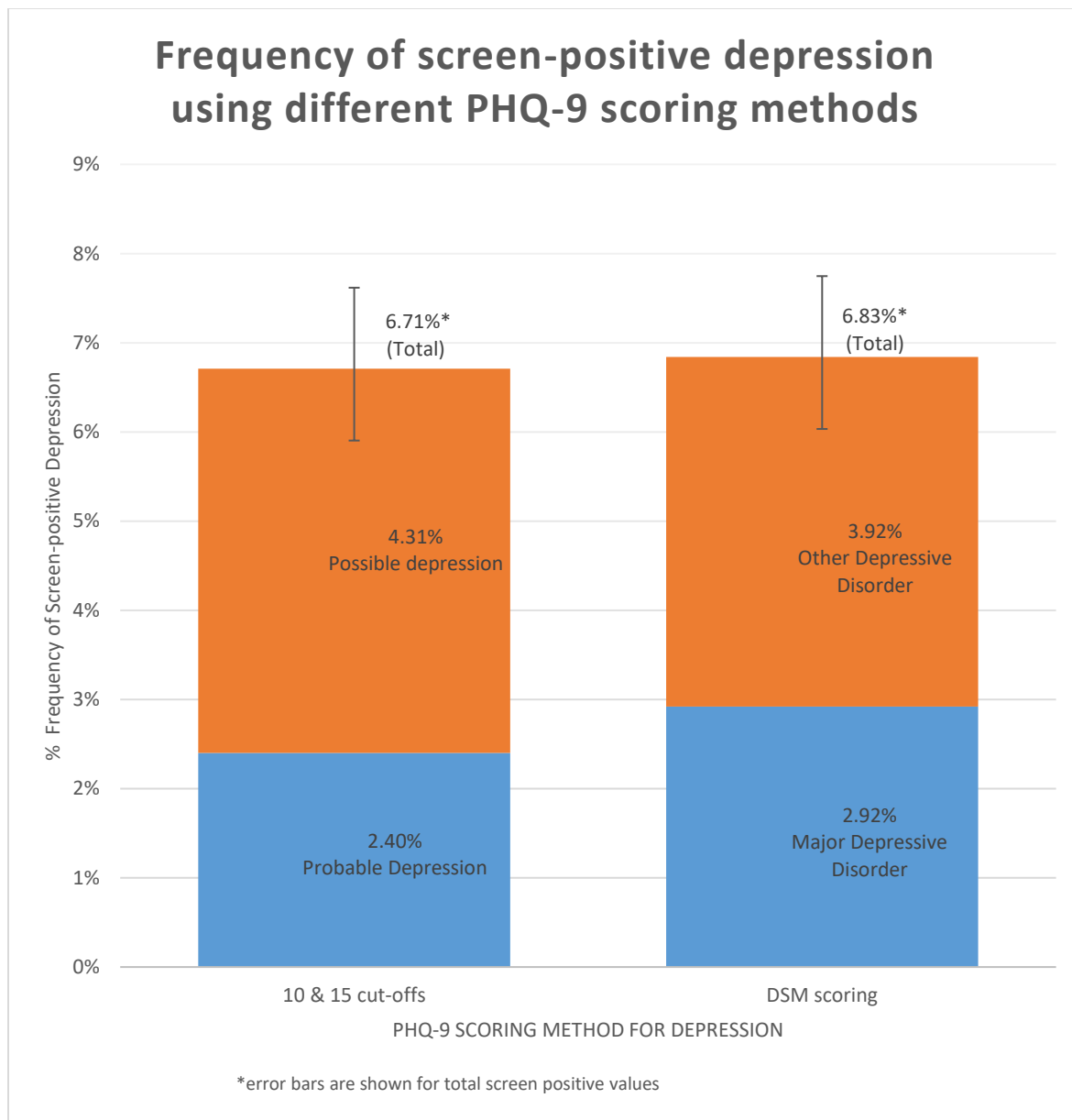


1347 (40.8%) of respondents reported experiencing any level of symptoms from the PCL-C questionnaire, and attributed them directly to stressful deployment experiences. 17.5% reported having symptoms as a result of experiences during their private life, and 9.4% as result of experiences while on duty but not while deployed. 33.8% reported having no stressful experience

causing PCL questionnaire symptoms, which was roughly equivalent to the percentage of those who negatively responded to all PCL questions (34.3%).

The estimated proportion of depression varied minimally depending on the scoring method used for the PHQ-9 questionnaire, as shown in Figure 9. Using a cut-off of 10 (for possible depression), depression proportion was estimated at 6.7% (CI: 5.9%, 7.6%); a cut-off of 15 (probable depression) produces a lower estimate of 2.4% (CI: 1.9%, 3.0%). There were 79 respondents who screened positive for probable depression. The proportion of clinically significant depression (either major or other depressive disorder) was 6.8% (CI: 5.7%, 8.1%). Suicidal ideation proportion was estimated at 2.3% (CI: 1.9%, 2.9%), anxiety disorder (other than panic) at 2.3% (CI: 1.9%, 2.9%), and panic disorder at 1.6% (CI: 1.2%, 2.1%).

Figure 9: Depression frequency in the RHQ-EPDS linked dataset



ACEs

The average number of types of ACEs contained within “question 77” reported was 1.02 (SD 1.34, range 0-8); while the average number of “all ACEs” reported was 1.22 (SD 1.48, range 0-9) (see Table 7). 51% of the study population experienced one or more of the ACEs contained in question 77 (95% CI: 0.487, 0.522) (see Table 8). This rose to 58.3% when the additional three ACEs in the “all ACE” variable were included (95% CI: 0.565, 0.600). The mean question 77 “ACE intensity” score was 5.4 (SD: 5.1), roughly equivalent to one ACE type at high frequency or intensity. The mean novel “ACE intensity” score was 6.2 (SD: 5.6), roughly equivalent to two types of ACE at lowest frequency or intensity.

Table 7: Continuous ACE variable summary statistics

	Mean (SD)	Median	range
Quest. 77: types	1.02 (1.34)	1	[0, 8]
Quest. 77: intensity	5.36 (5.10)	4	[0, 33]
All ACE: types	1.22 (1.48)	1	[0, 9]
All ACE: intensity	6.24 (5.64)	5	[0, 37]

Table 8: Estimated population proportion of categorical ACE variables

ACE variable	Frequency (%)	Population proportion [95% CI]	Missing (%)
Ques. 77: types			209 (6.3%)
none	1532 (49%)	0.495 [0.478, 0.513]	
low: 1 type	728 (24%)	0.235 [0.221, 0.251]	
med: 2-3 types	635 (21%)	0.205 [0.191, 0.220]	
high: 4-8 types	198 (6%)	0.064 [0.056, 0.073]	
Ques. 77: intensity			
none	666 (22%)	0.215 [0.201, 0.230]	
low: 1-5 score	1187 (38%)	0.384 [0.367, 0.401]	
med: 6-11 score	851 (28%)	0.275 [0.260, 0.291]	
high: 12-35 score	389 (13%)	0.126 [0.115, 0.138]	
All ACE: types			209 (6.5%)
none	1288 (42%)	0.417 [0.400, 0.435]	
low: 1 type	829 (27%)	0.269 [0.253, 0.285]	
med: 2-3 types	704 (23%)	0.228 [0.214, 0.243]	
high: 4-11 types	265 (9%)	0.086 [0.076, 0.096]	
All ACE: intensity			
none	492 (16%)	0.159 [0.146, 0.173]	
low: 1-5 score	1185 (38%)	0.384 [0.367, 0.401]	
med: 6-11 score	909 (29%)	0.295 [0.279, 0.311]	
high: 12-45 score	500 (16%)	0.162 [0.149, 0.175]	

Frequency of each type of ACE is shown in Table 9: the most common ACE was emotional abuse (33.5%), followed by residential instability (17.6%), physical abuse (16.5%), and alcohol problems in the household (16.2%).

Table 9: Individual ACE frequency

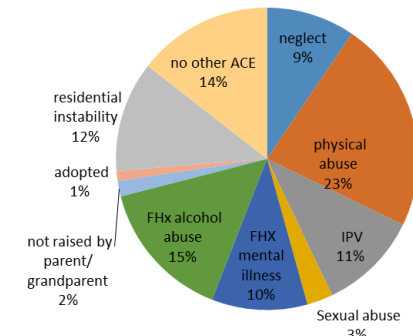
	Frequency	% [95% CI]	Missing (%)
Raised by:			34 (1%)
Two parents	2421	74.1% [72.6%, 75.6%]	
One parent	760	23.3% [21.8%, 24.7%]	
Grandparent(s)	28	0.9% [0.6%, 1.2%]	
Other relatives	8	0.2% [0.1%, 0.5%]	
Foster parents, guardian, group home, institution, other	51	1.6% [1.2%, 2%]	
parent(s) or grandparent(s)	3209	98.2% [97.7%, 98.6%]	
Other	59	1.8% [1.4%, 2.3%]	
Adopted			38 (1.2%)
No	3206	98.2% [97.7%, 98.6%]	
Yes	58	1.8% [1.4%, 2.3%]	
Residential Instability			155 (4.7%)
Stable residence	2594	82.4% [81.1%, 83.7%]	
Residential Instability	553	17.6% [16.3%, 18.9%]	
Physical Neglect			

	No	2921	94% [93.1%, 94.8%]	194 (5.9%)
	Yes	187	6% [5.2%, 6.9%]	
Emotional Neglect				
	No	2889	94% [93.1%, 94.7%]	227 (6.9%)
	Yes	186	6% [5.3%, 6.9%]	
Emotional Abuse				
	No	2051	66.5% [64.9%, 68.2%]	220 (6.7%)
	Yes	1031	33.5% [31.8%, 35.1%]	
Physical Abuse				
	No	2573	83.5% [82.1%, 84.8%]	220 (6.7%)
	Yes	509	16.5% [15.2%, 17.9%]	
IPV				
	No	2816	91.4% [90.4%, 92.4%]	222 (6.7%)
	Yes	264	8.6% [7.6%, 9.6%]	
Sexual Abuse				
	No	2999	97.1% [96.5%, 97.7%]	215 (6.5%)
	Yes	88	2.9% [2.3%, 3.5%]	
Household Mental Illness				
	No	2568	86.6% [85.3%, 87.8%]	337 (10.2%)
	Yes	397	13.4% [12.2%, 14.7%]	
Household Alcohol Problem				
	No	2580	83.8% [82.5%, 85.1%]	225 (6.8%)
	Yes	497	16.2% [14.9%, 17.5%]	

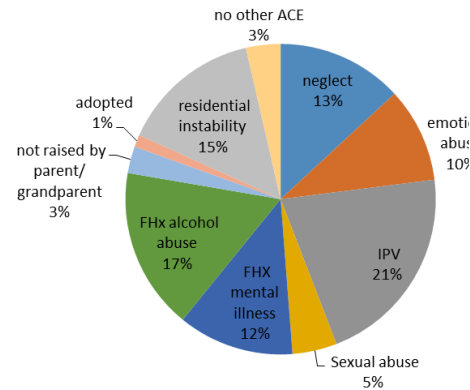
Co-occurrence of ACEs are shown in pie charts (Figure 10). Because co-occurring ACEs did not occur in isolation, percentages did not add up to 100%. Emotional abuse was the most common ACE and was most often concurrent with other ACEs. ACEs occurred in isolation infrequently: residential instability occurred the most often in isolation (20%), followed by adoption (16%), emotional abuse (14%), household mental illness (12%), household alcohol abuse (9%), neglect (7%), not being raised by parents or grandparents (5%), physical abuse (3%), IPV (2%), and sexual abuse (2%).

Figure 10: ACE pie charts

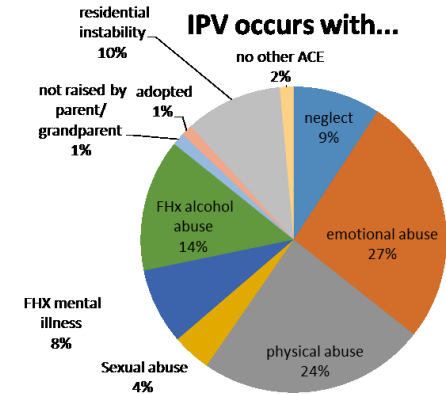
Emotional Abuse occurs with...



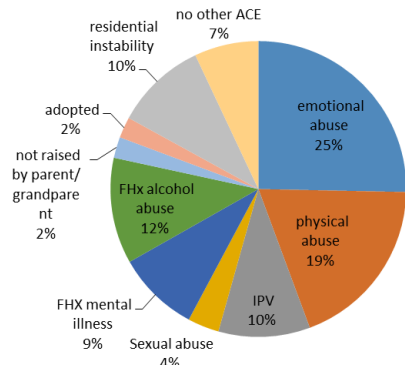
Physical abuse occurs with...



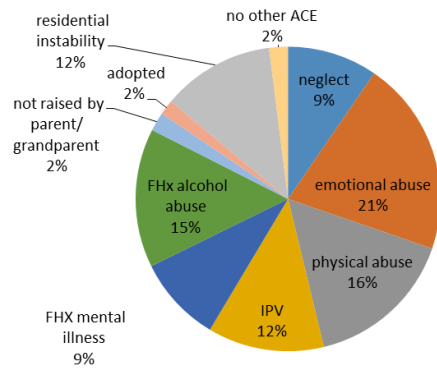
IPV occurs with...



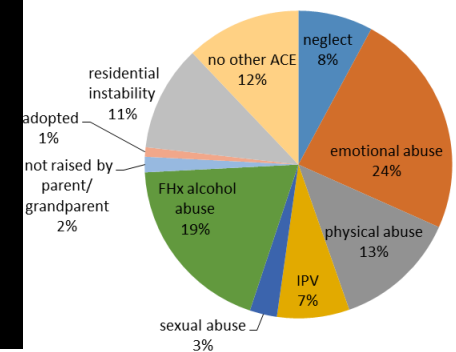
Neglect occurs with...



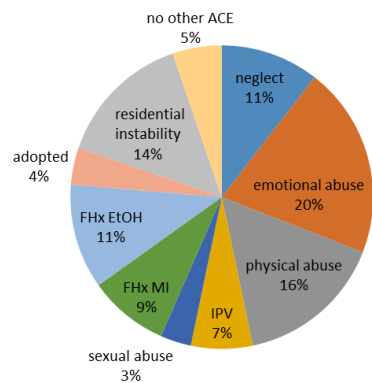
Sexual abuse occurs with...



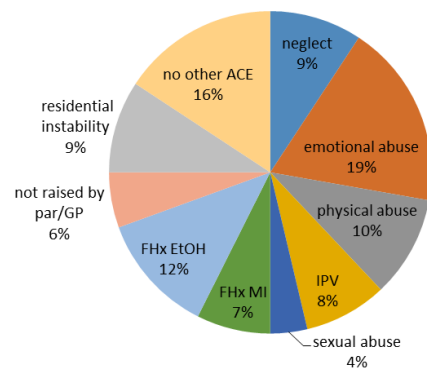
Household mental illness occurs with



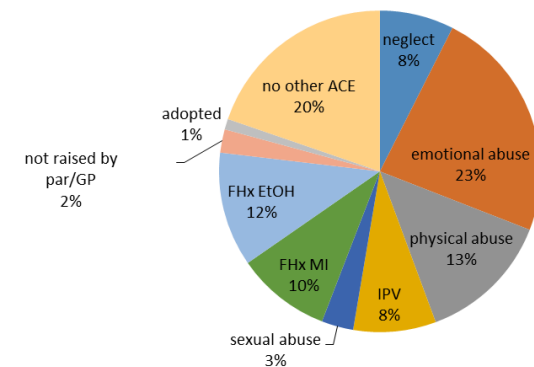
Not being raised by parents or grandparents occurs with...



Adoption occurs with...



Residential instability occurs with...



DRSEs

CAF members experienced an average of 8.9 DRSEs, 3.6 distressing DRSEs, and 5.3 contextual, with 0.6% missing values (see Table 10). The maximum number of any DRSEs experienced was 29, of distressing DRSEs was 14, and of contextual DRSEs was 15. DRSE were not normally distributed; in general, frequency decreased with increasing number of DRSEs experienced (see Figure 11, Figure 12, and Figure 13).

Table 10: Continuous DRSE variable summary statistics

	Mean (SD)	Median	range
All DRSE	8.87 (6.59)	8	[0, 29]
Distressing DRSE	3.55 (3.15)	3	[0, 14]
Contextual DRSE	5.32 (3.81)	5	[0,15]

Figure 11: All DRSE histogram

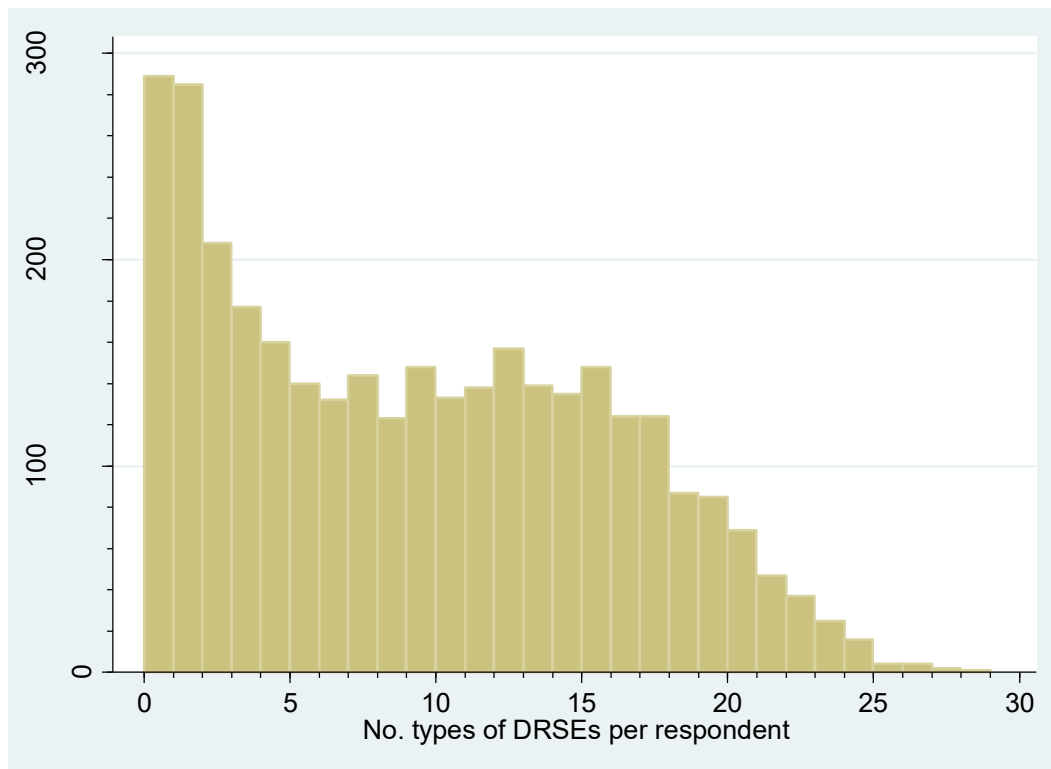


Figure 12: Distressing DRSE histogram

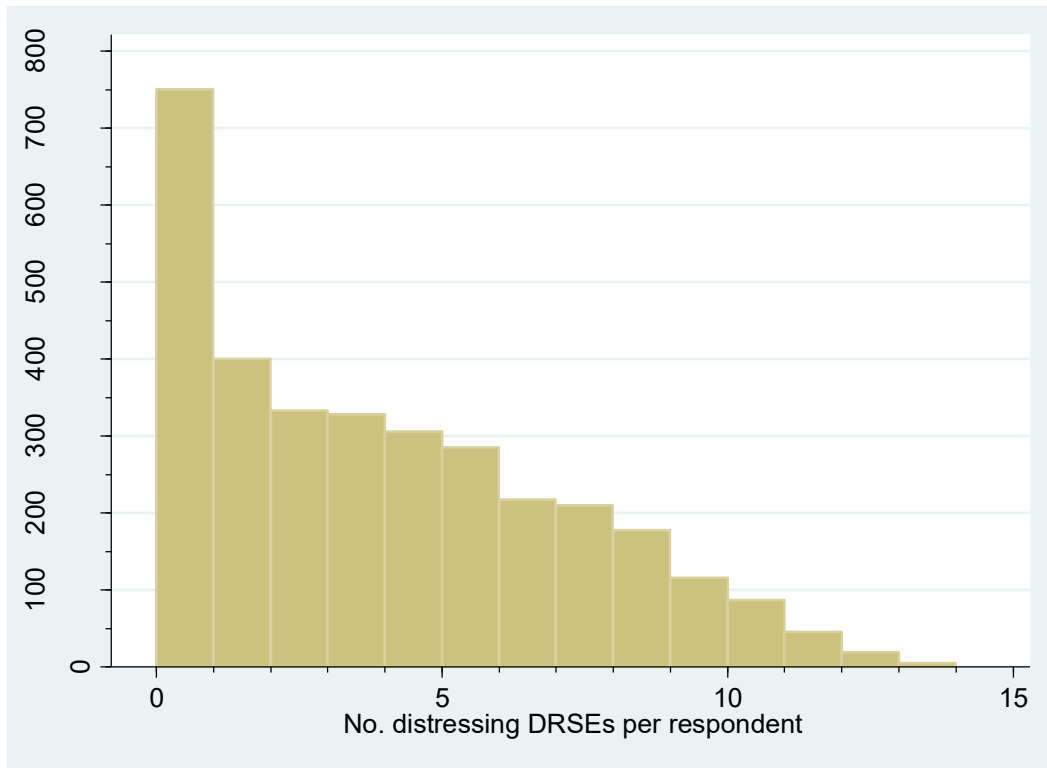
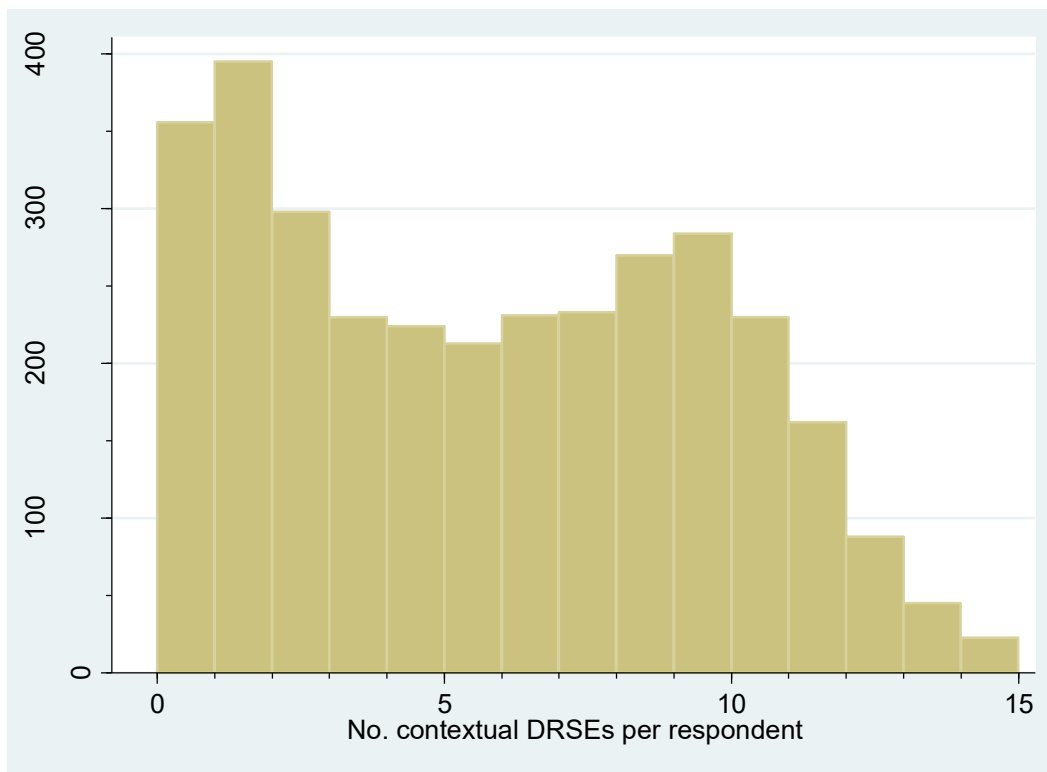


Figure 13: Contextual DRSE histogram



Frequencies, percentages, and population proportion estimates of categorical versions of DRSE variables are listed in Table 11 and those of individual DRSEs are listed in Table 12.

Table 11: Categorical DRSE variable summary statistics

		N (%)	Proportion [95% CI]
All DRSE			
	None	289 (8.8%)	0.088 [0.079, 0.098]
	Low: 1-3	670 (20.4%)	0.204 [0.191, 0.218]
	Medium: 4-7	573 (17.46 %)	0.175 [0.162, 0.188]
	High: 8+	1749 (53.3%)	0.533 [0.516, 0.55]
Distressing DRSE			
	None	751 (22.9%)	0.229 [0.215, 0.244]
	Low: 1-3	1061 (32.3%)	0.323 [0.307, 0.339]
	Medium: 4-7	1015 (30.9%)	0.309 [0.294, 0.325]
	High: 8+	455 (13.9%)	0.139 [0.127, 0.151]
Contextual DRSE			
	None	356 (10.9%)	0.108 [0.098, 0.12]
	Low: 1-3	923 (28.1%)	0.281 [0.266, 0.297]
	Medium: 4-7	899 (27.4)	0.274 [0.259, 0.289]
	High: 8+	1104 (33.6%)	0.336 [0.32, 0.353]

Table 12: Estimated population proportions of “Deployment Experiences” scenarios

Deployment Experiences Variable	Frequency (%)	Proportion [95% CI]	Missing (%)
<i>Distressing DRSEs:</i>			
Saw dead bodies/human remains	1609 (48.8%)	0.488 [0.471, 0.505]	5 (0.2%)
Handled/uncovered human remains	683 (20.7%)	0.207 [0.194, 0.221]	6 (0.2%)
Witnessed accident - serious injury/death	1487 (45.1%)	0.451 [0.434, 0.468]	7 (0.2%)
Saw dead/seriously injured Canadians	1321 (40.1%)	0.401 [0.384, 0.418]	7 (0.2%)
Knew someone seriously injured/killed	1156 (35.1%)	0.351 [0.335, 0.367]	7 (0.2%)
Rules of engagement prevented threat response	925 (28.1%)	0.281 [0.265, 0.296]	5 (0.2%)
Unable to help visibly ill/injured women/children	925 (28.1%)	0.281 [0.266, 0.296]	7 (0.2%)
Felt directly responsible: death of non-combatant	54 (1.6%)	0.016 [0.013, 0.021]	8 (0.2%)
Witnessed friendly fire incident	295 (9%)	0.09 [0.08, 0.1]	8 (0.2%)
Felt responsible for death of Canadian/ally	85 (2.6%)	0.026 [0.021, 0.032]	7 (0.2%)
Unit member casualty	1407 (42.7%)	0.427 [0.41, 0.444]	5 (0.2%)
Buddy shot or hit nearby	480 (14.6%)	0.146 [0.134, 0.158]	13 (0.4%)
Couldn't distinguish combatants from non-combatants	793 (24.1%)	0.241 [0.227, 0.256]	14 (0.4%)
Saw unit member blown up/burned alive	495 (15.1%)	0.15 [0.139, 0.163]	12 (0.4%)
<i>Contextual DRSEs:</i>			
Attacked or ambushed	1646 (50%)	0.5 [0.483, 0.517]	8 (0.2%)
Received small arms fire	1646 (49.9%)	0.499 [0.482, 0.516]	6 (0.2%)
IED/booby trap exploded nearby	2095 (63.5%)	0.635 [0.619, 0.652]	5 (0.2%)
Worked in areas that were mined/IEDs	1697 (51.5%)	0.515 [0.498, 0.532]	7 (0.2%)
Hostile reactions from civilians	2214 (67.2%)	0.672 [0.655, 0.688]	6 (0.2%)
Shot/directed fire at the enemy	1215 (36.9%)	0.369 [0.352, 0.385]	5 (0.2%)
Called in fire on the enemy	479 (14.5%)	0.145 [0.134, 0.158]	7 (0.2%)
Engaged in hand-to-hand combat	33 (1%)	0.01 [0.007, 0.014]	5 (0.2%)
Cleared/searched homes/buildings	1401 (42.5%)	0.425 [0.408, 0.442]	5 (0.2%)
Cleared/searched caves/bunkers	564 (17.1%)	0.171 [0.159, 0.184]	5 (0.2%)
Was wounded/injured	266 (8.1%)	0.081 [0.072, 0.09]	4 (0.1%)
Received incoming artillery/rocket/mortar fire	1917 (58.1%)	0.581 [0.565, 0.598]	5 (0.2%)
Felt directly responsible: death of enemy combatant	342 (10.4%)	0.104 [0.094, 0.115]	7 (0.2%)
"Close call", shot/hit, protected by gear	410 (12.5%)	0.125 [0.114, 0.136]	10 (0.3%)
Participated in IED/mine clearing	1366 (41.6%)	0.415 [0.399, 0.432]	14 (0.4%)
Sniper fire	259 (7.9%)	0.079 [0.07, 0.088]	12 (0.4%)

Sensitivity Analysis

Sensitivity analyses were conducted to compare missing and non-missing respondents with respect to DRSE and ACE variables. Table 13 and Table 14 demonstrate that missing respondents for each outcome were not significantly different in their responses for deployment stressors (“All DRSE”) and childhood adversity (“all ACE types”), respectively.

Table 13: DRSE summary statistics for missing and non-missing outcome respondents

	Outcome response	# respondents	Average number DRSEs (SD)	Range	Median	# missing
“All DRSE”		3281	8.87 (6.59)	0-29	8	21
SF-36 MCS	Missing	14	7.19 (7.08) [95% CI: 3.10-11.28]	0-19	5.05	
	Non-missing	3267	8.88 (6.59)	0-29	8	35
PTSD	Missing at least one PCL-C value	130	8.66 (6.77) [95% CI: 7.49-9.83]	0-23	8.5	
	Non-missing	3151	8.88 (6.59)	0-29	8	151
Depression	Missing at least one PHQ value	56	7.29 (6.77) [95% CI: 5.48-9.10]	0-22	5.5	
	Non-missing	3225	8.90 (6.59) [95% CI: 8.67-9.13]	0-29	8	77
Suicidal Ideation	Missing	14	10.57 (7.77) [95% CI: 5.01-61.13]	0-22	10	
	Non-missing	3267	8.86 (6.59)	0-29	8	35
Anxiety	Missing	55	9.30 (7.15) [95% CI: 7.37-11.23]	0-25.86	8	
	Non-missing	3226	8.86 (6.59)	0-29	8	76

Table 14: ACE summary statistics for missing and non-missing outcome respondents

	Outcome response	# respondents	Average number ACEs (SD)	Range	Median	# missing
“All ACE types”		3086	1.22 (1.48)	0-9	1	216
SF-36 MCS	Missing	12	1.75 (1.22) [95% CI: 0.97-2.53]	0-3	1.5	
	Non-missing	3074	1.22 (1.48)	0-9	1	228
PTSD	Missing at least one PCL-C value	128	1.25 (1.47) [95% CI: 0.99-1.51]	0-6	1	
	Non-missing	2958	1.21 (1.48)	0-9	1	344
Depression	Missing at least one PHQ value	52	1.31 (1.44) [95% CI: 0.91-1.71]	0-5	1	
	Non-missing	3034	1.22 (1.48)	0-9	1	268
Suicidal Ideation	Missing	15	1.93 (2.05) [95% CI: 0.79-3.07]	0-5	1	
	Non-missing	3071	1.22 (1.48)	0-9	1	231
Anxiety	Missing	51	1.61 (1.78) [95% CI: 1.11-2.11]	0-8	1	
	Non-missing	3035	1.21 (1.47)	0-9	1	267

Panic disorder had 19 missing respondents: this outcome was dropped due to low numbers of respondents (see Results - Outcomes section).

B. Regression Results

Research Objective 1: DRSE and mental health

Primary outcome: SF-36 MCS

The proposed groupings of confounders into four models were justified by their behaviour in SF-36 MCS regression models: they changed the estimate of association between the exposure and outcome (summary tables of scale “All DRSE” models one through four in their association with SF-36 MCS are presented in APPENDIX J: Full models of scale “All DRSE” association with each mental health outcome). Of note, similar tables compiled for categorical DRSE and ACE exposures (scale and categorical variables) also supported the inclusion of all covariates selected (they are not presented for brevity). The DRSE model covariates that were most often statistically significant across all outcomes were language (English versus French), sex (male versus female), and sleep problems at recruitment (yes or no). Mother’s education was occasionally significant, as was being a smoker, being overweight or obese, low social support, being a parent, and being widowed/divorced/separated.

Figure 14 presents the adjusted estimates of association for DRSE variables and Table 15 summarizes them for all outcomes. Fully adjusted “All DRSE” models showing all covariate estimates are summarized for each outcome in APPENDIX K: Covariate estimates in DRSE models for each mental health outcome. The summative scale “All DRSE” variable was statistically significant in all model iterations. It was found that for each DRSE experienced, one would expect a CAF member’s SF-36 MCS score to be changed by -0.291 (95% CI: -0.351, -0.232; $p < 0.001$). Distressing DRSEs changed expected SF-36 MCS by -0.806 (95% CI: -0.986, -0.627; $p < 0.001$).

Figure 14: Deployment stressors and mental health quality of life

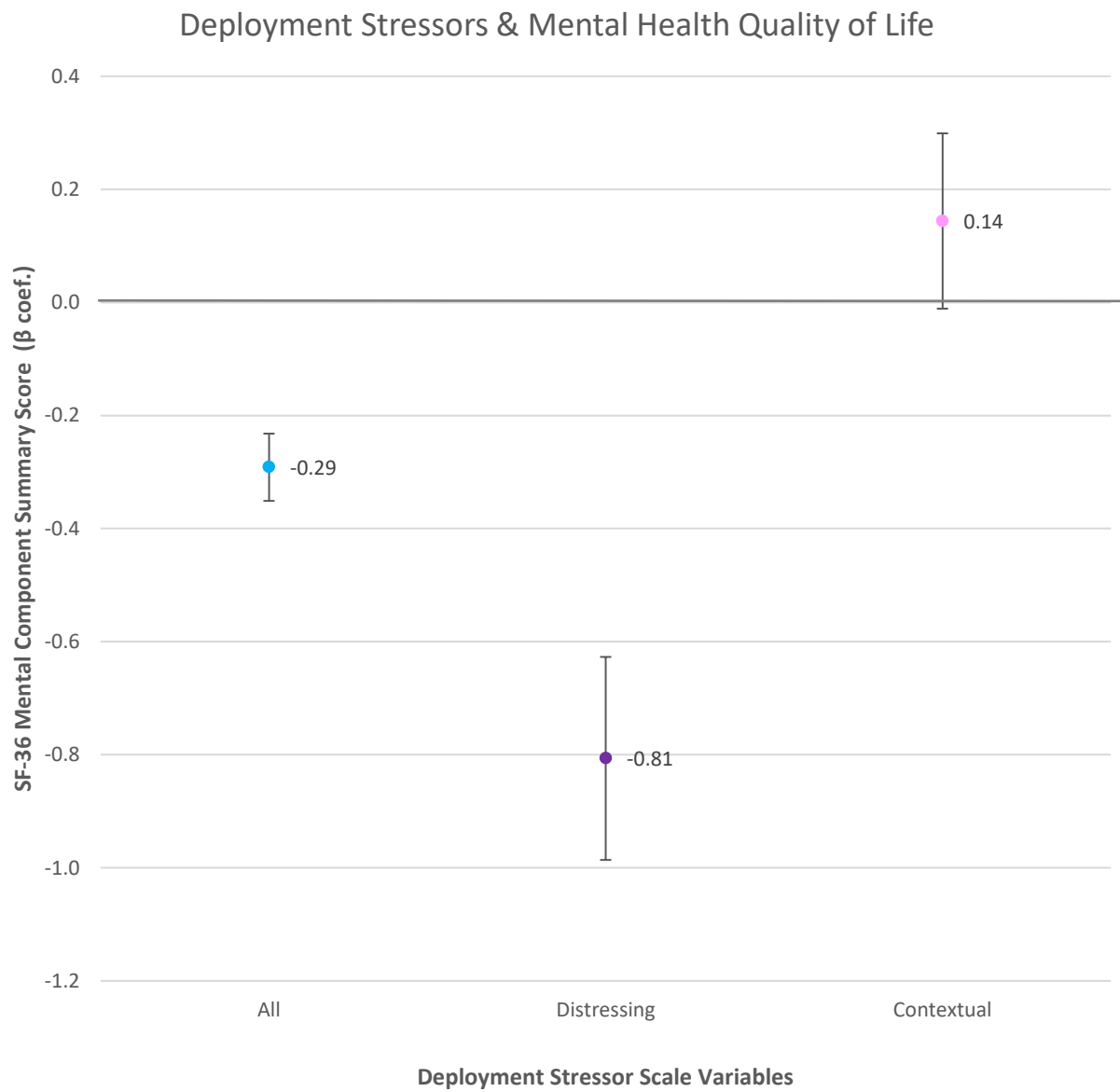


Table 15: Adjusted estimates of association between DRSE and mental health outcomes

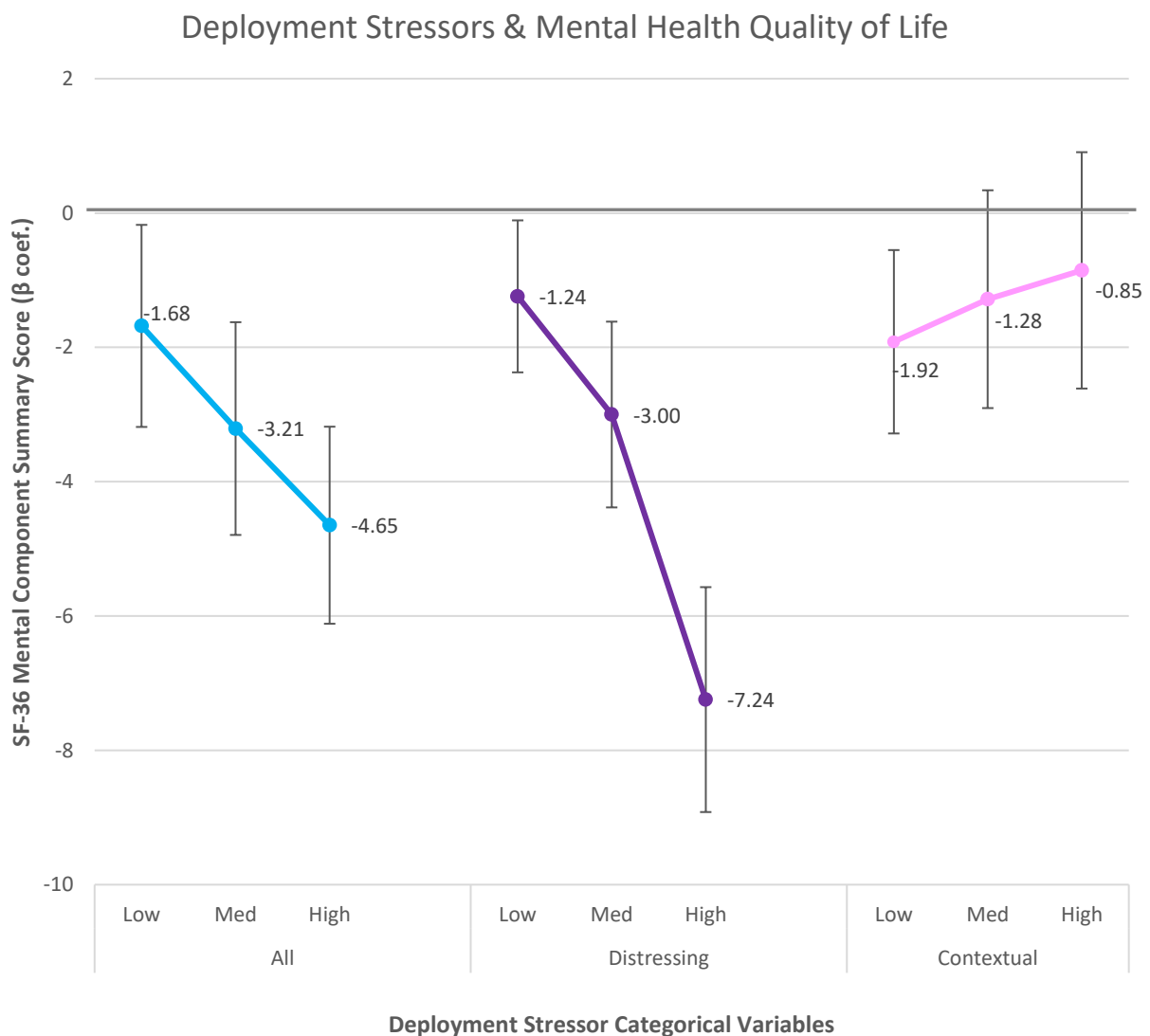
		SF-36 MCS linear (beta coef)	PTSD multinomial logistic (RRR) <i>Likely PTSD</i> <i>Very Likely PTSD</i>	Depression ordinal logistic (OR) <i>Possible & Probable</i>	Suicidal Ideation logistic (OR)	Anxiety (excl. panic) logistic (OR)	
All DRSE	Scale	-0.291*** [-0.351,-0.232]	1.130*** [1.106,1.155]	1.208*** [1.152,1.268]	1.102*** [1.074,1.132]	1.095*** [1.049,1.144]	1.104*** [1.059,1.152]
All DRSE	None (base)						
	Low (1-3 DRSE)	-1.681* [-3.185,-0.176]	3.680* [1.236,10.959]	1.042 [0.181,6.013]	0.812 [0.342,1.929]	0.468 [0.076,2.897]	0.664 [0.132,3.340]
	Medium (4-7 DRSE)	-3.209*** [-4.793,-1.625]	6.437*** [2.143,19.333]	2.105 [0.364,12.181]	1.991 [0.861,4.606]	2.453 [0.506,11.898]	2.193 [0.499,9.645]
	High (8-28 DRSE)	-4.648*** [-6.115,-3.181]	16.059*** [5.507,46.829]	8.136* [1.601,41.338]	3.469** [1.573,7.649]	3.358 [0.735,15.347]	4.243* [1.037,17.360]
Distressing DRSE	Scale	-0.806*** [-0.986,-0.627]	1.241*** [1.169,1.318]	1.722*** [1.511,1.964]	1.274*** [1.184,1.371]	1.330*** [1.181,1.497]	1.274*** [1.123,1.445]
Contextual DRSE	Scale	0.144 [-0.011,0.299]	1.037 [0.982,1.096]	0.863* [0.765,0.975]	0.965 [0.901,1.034]	0.911 [0.812,1.021]	0.967 [0.858,1.089]
Distressing DRSE	None (base)						
	Low (1-3 DRSE)	-1.241* [-2.372,-0.109]	1.561 [0.907,2.686]	2.008 [0.536,7.528]	1.47 [0.793,2.723]	3.233* [1.001,10.442]	3.082 [0.981,9.684]
	Medium (4-7 DRSE)	-3.000*** [-4.383,-1.617]	3.460*** [1.892,6.325]	6.559* [1.556,27.641]	2.924** [1.454,5.881]	6.055** [1.654,22.160]	3.864* [1.058,14.117]
	High (8-14 DRSE)	-7.244*** [-8.919,-5.570]	7.305*** [3.794,14.066]	62.360*** [13.821,281.362]	8.153*** [3.797,17.508]	27.555*** [6.872,110.496]	9.794** [2.465,38.908]
Contextual DRSE	None (base)						
	Low (1-3 DRSE)	-1.917** [-3.282,-0.551]	3.487** [1.416,8.590]	1.636 [0.306,8.747]	1.371 [0.632,2.975]	1.662 [0.347,7.966]	1.23 [0.300,5.040]
	Medium (4-7 DRSE)	-1.283 [-2.904,0.339]	3.528* [1.332,9.346]	1.343 [0.209,8.637]	1.421 [0.588,3.437]	0.946 [0.177,5.060]	1.117 [0.231,5.406]
	High (8-15 DRSE)	-0.853 [-2.613,0.906]	4.079** [1.510,11.017]	0.903 [0.133,6.118]	1.056 [0.417,2.673]	0.535 [0.093,3.095]	1.266 [0.248,6.467]

95% confidence intervals in brackets

* p < 0.05, ** p < 0.01, *** p < 0.001

Similar trends were observed with models of categorical DRSE variables (see Figure 15). The higher the category of exposure to “All DRSE”, the lower the expected SF-36 MCS score. The most pronounced negative association was found in the high “Distressing DRSE” category, with a β coefficient of -7.244 (95% CI: -8.919, -5.570; $p < 0.001$). The low category of “Contextual DRSE” significantly lowered SF-36 MCS was significant; however medium and high categories were not significant.

Figure 15: Categorical deployment stressors and mental health quality of life



Secondary Outcomes

PTSD

Of the three PTSD outcomes discussed, the three category PTSD variable (unlikely PTSD, likely PTSD (30 cut-off), and very likely PTSD (50 cut-off)), was chosen for final analysis. It provided more detail than using a 50 cut-off alone, and allowed for comparisons with previous research done on similar populations (as opposed to using the DSM-based scoring system). Similar estimates of association with exposures were found among the three kinds of PTSD variables during initial stages of regression modelling (see Table 16). The proportional odds tests revealed that the three PTSD categories were not ordinal – multinomial logistic regression models were used in further modeling.

Table 16: Scale “All DRSE” and PTSD outcomes, by PCL-C scoring method

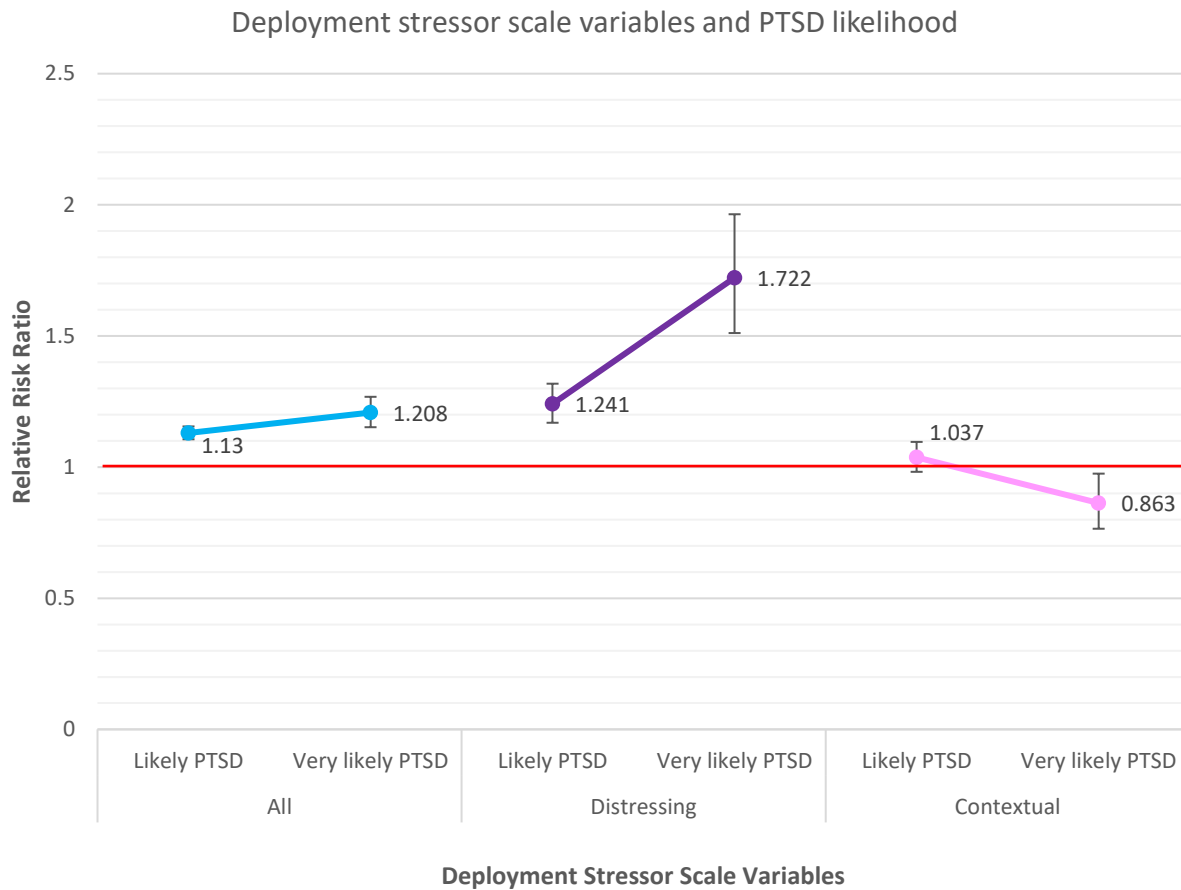
	Model 1	Model 2	Model 3	Model 4
50 cut-off (OR)	1.135*** [1.094,1.177]	1.158*** [1.111,1.207]	1.171*** [1.119,1.225]	1.177*** [1.124,1.233]
30&50 cut-offs (RRR)				
30-50 "likely PTSD"	1.116*** [1.097,1.136]	1.129*** [1.107,1.152]	1.127*** [1.104,1.151]	1.130*** [1.106,1.155]
50+ "very likely PTSD"	1.154*** [1.112,1.198]	1.185*** [1.135,1.237]	1.199*** [1.145,1.256]	1.208*** [1.152,1.268]
DSM scoring (OR)	1.142*** [1.110,1.175]	1.163*** [1.126,1.201]	1.172*** [1.132,1.214]	1.178*** [1.136,1.221]

95% confidence intervals in brackets

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

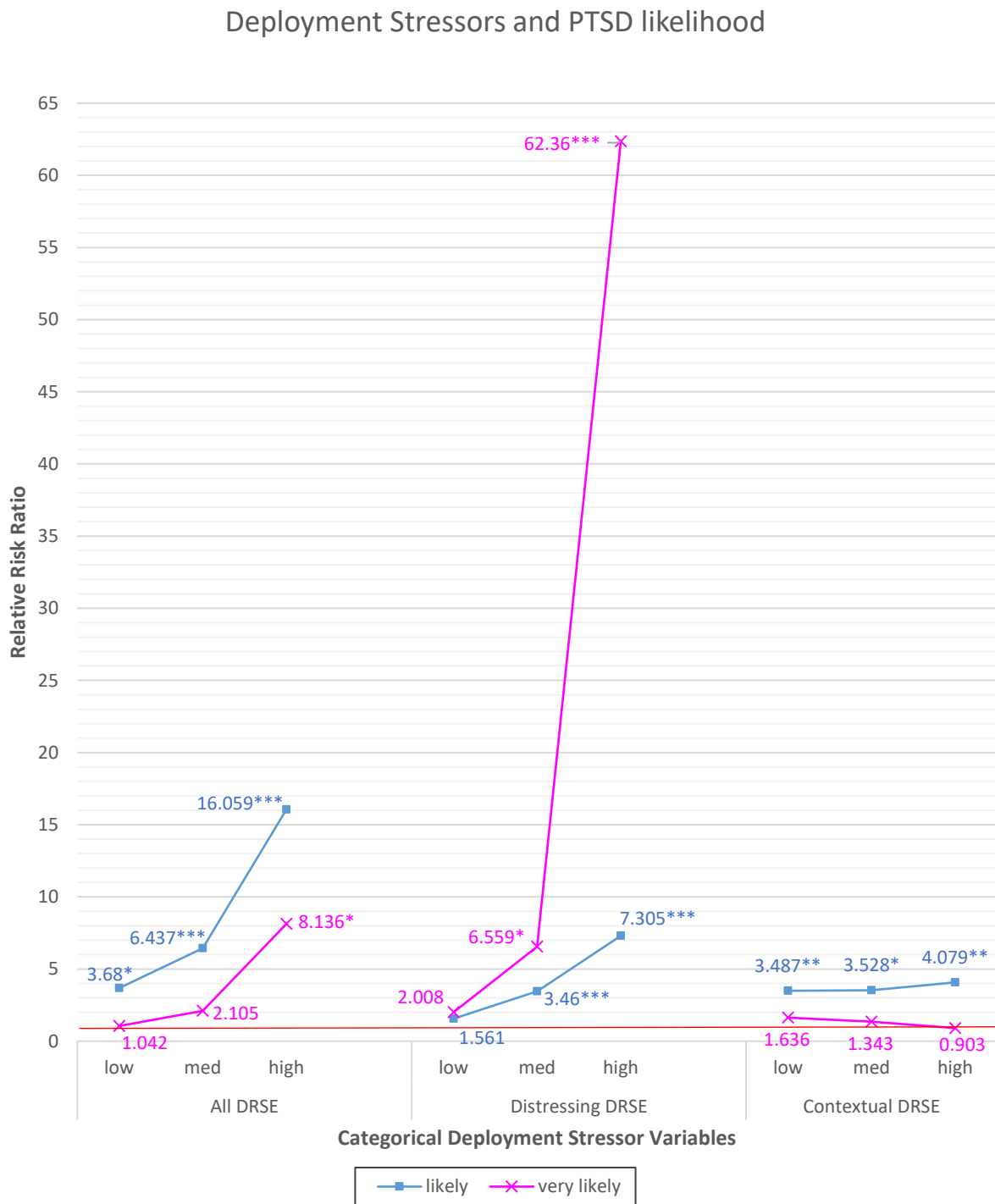
As shown in Figure 16 (and Table 15), the “Distressing DRSE” scale variable had higher RRRs than the “All DRSE” scale variable, while “Contextual DRSE” categories had small RRRs and were mostly not significant.

Figure 16: Deployment stressor scale variables and PTSD likelihood



The highest association was found between the high category of “Distressing DRSE” and “very likely PTSD” (RRR 62.360, 95% CI:13.82,281.36; $p < 0.001$) (see Figure 17). The “Distressing DRSE” variable was more associated with “very likely PTSD” than with “likely PTSD”, while the “All DRSE” and “Contextual DRSE” variables were more associated with “likely PTSD.” As one moves into higher categories of “Contextual DRSE”, the association with “very likely PTSD” went down (and was not significant), whereas the association with “likely PTSD” rose significantly.

Figure 17: Categorical deployment stressors and PTSD likelihood



Depression, Suicidal Ideation and Anxiety

The three-category depression variable based on 10 and 15 cut-offs (“unlikely depression”, “possible depression”, and “probable depression”) was selected for final analysis after comparing its behaviour in initial regression models with the other depression variables. Estimates of association with exposures were found to be quite similar among the three kinds of depression variables during initial stages of regression modelling; the DSM method of scoring produced slightly lower estimates (see Table 17).

Table 17: “All DRSE” and depression outcomes, by PHQ scoring method

	Model 1	Model 2	Model 3	Model 4
10 & 15 cutoffs	1.082*** [1.060,1.105]	1.100*** [1.074,1.127]	1.102*** [1.075,1.130]	1.102*** [1.074,1.132]
10 cutoff	1.082*** [1.059,1.104]	1.099*** [1.073,1.126]	1.102*** [1.074,1.129]	1.101*** [1.073,1.131]
DSM (ODD & MDD)	1.073*** [1.051,1.095]	1.083*** [1.058,1.108]	1.085*** [1.060,1.112]	1.084*** [1.056,1.111]

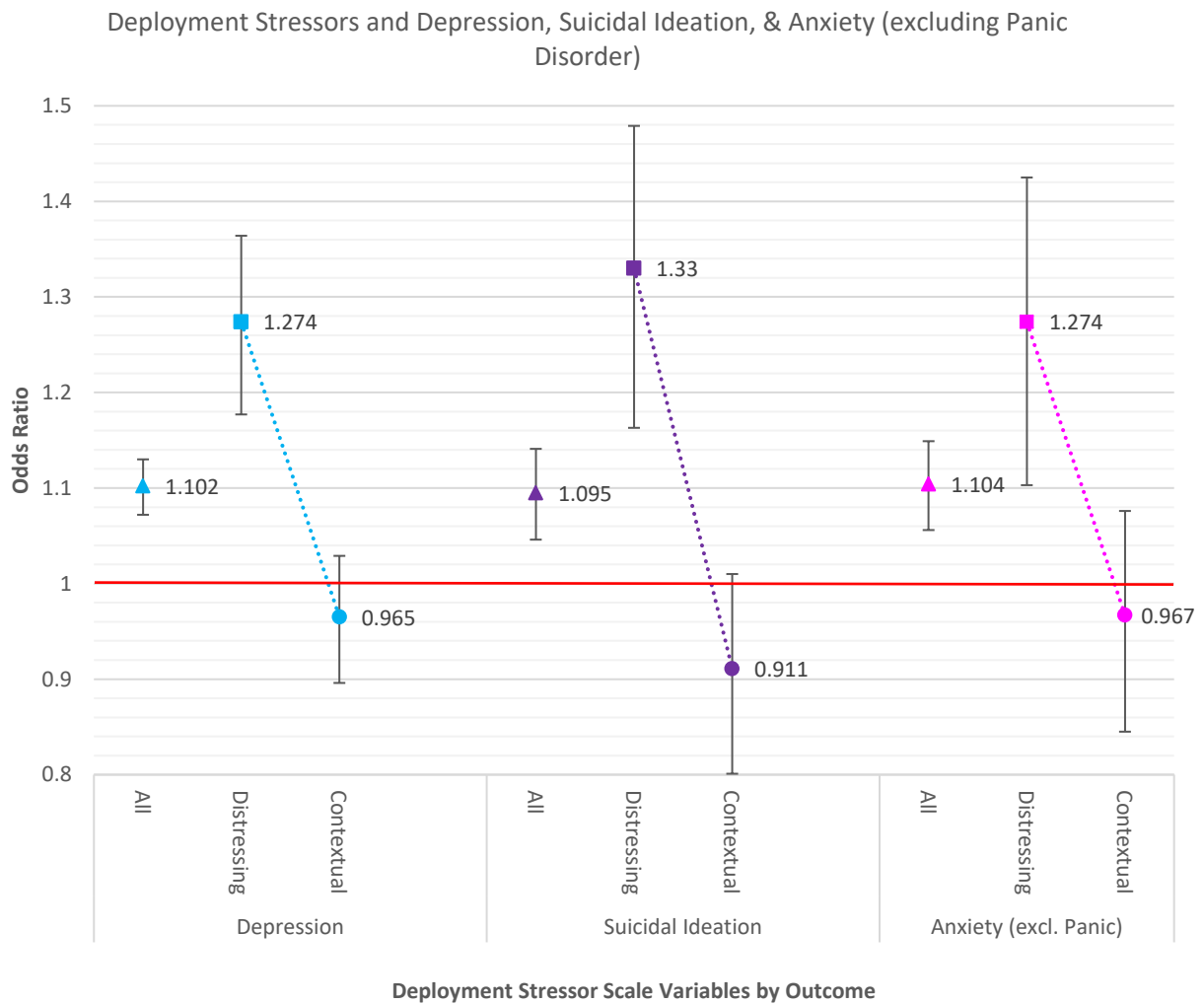
OR; 95% confidence intervals in brackets

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The 10/15 cut-off variable provided more detail than using the dichotomous 10 cut-off variable. The DSM-based scoring of the PHQ-9 depression screen, which yielded categories of “unlikely depression”, “other depressive disorder”, and “major depressive disorder”, were deemed too clinical in nature: the difference between “other depressive disorder” and “major depressive disorder” is not necessarily one of severity and was difficult to conceptualize at the population level. The proportional odds tests revealed that the “unlikely”, “possible”, and “probable” categories were ordinal – ordinal logistic models were used for analyses.

“All DRSE” and “Distressing DRSE” scale variables were significantly associated with depression, suicidal ideation, and anxiety (excluding panic disorder) (see Table 15 and Figure 18). “Contextual DRSE” as a scale variable was not statistically significant.

Figure 18: DRSE and depression, suicidal ideation, & anxiety disorders (other than panic)



As shown in Table 15 (and Figure 19, Figure 20, and Figure 21), the “All DRSE” categorical variable had fewer significant associations with depression, suicidal ideation, and anxiety than the “Distressing DRSE” variable, while “Contextual DRSE” categories were not significant or had weakly significant negative associations. The highest associations were found in the high category of “Distressing DRSE”, and the highest association overall was found in suicidal ideation (OR 27.555 (95% CI: 6.872,110.496; $p<0.001$)). Confidence intervals between distressing and contextual variables did not overlap for depression, suicidal ideation, and anxiety.

Figure 19: Categorical deployment stressors and depression

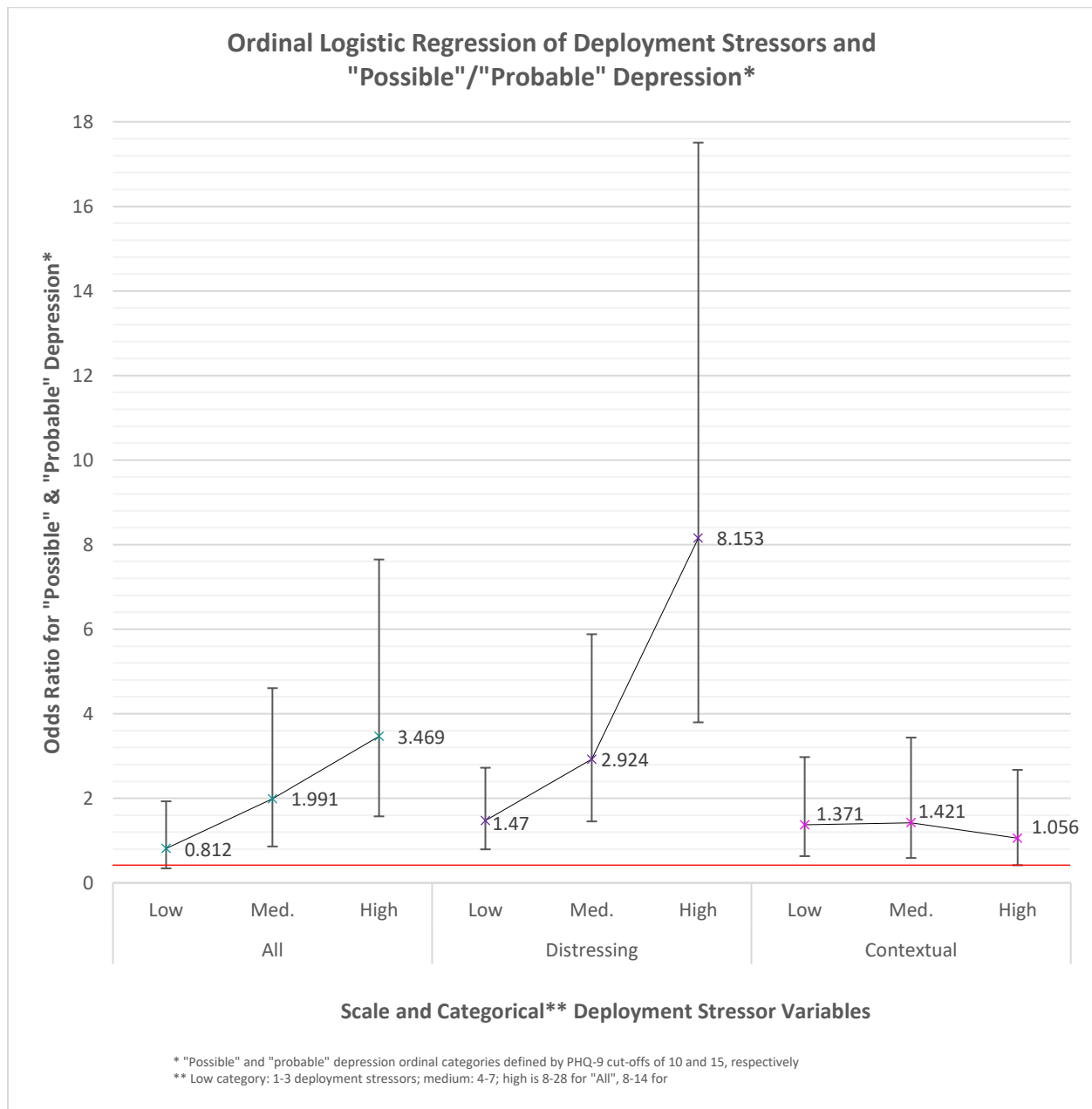


Figure 20: Categorical deployment stressors and suicidal ideation

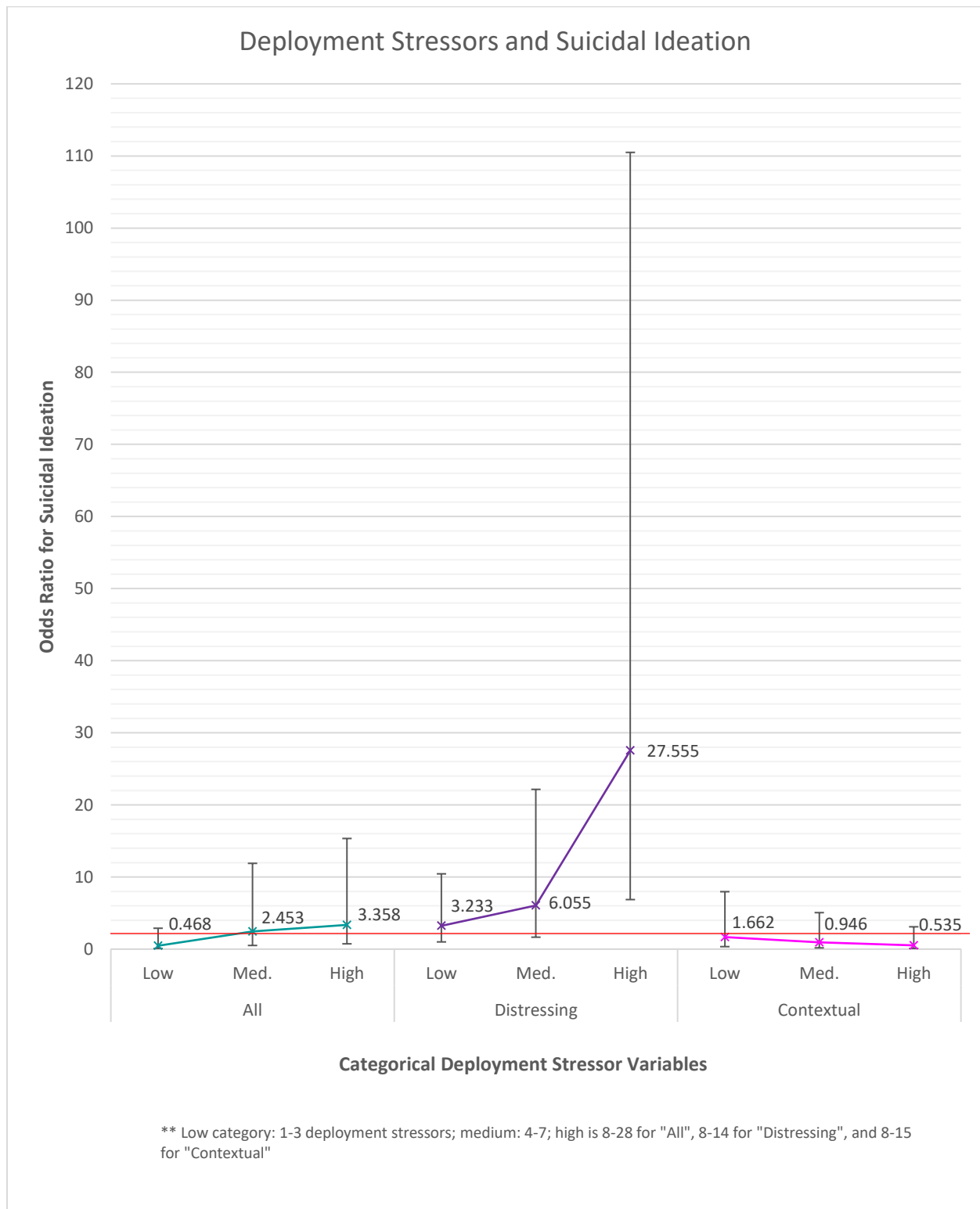
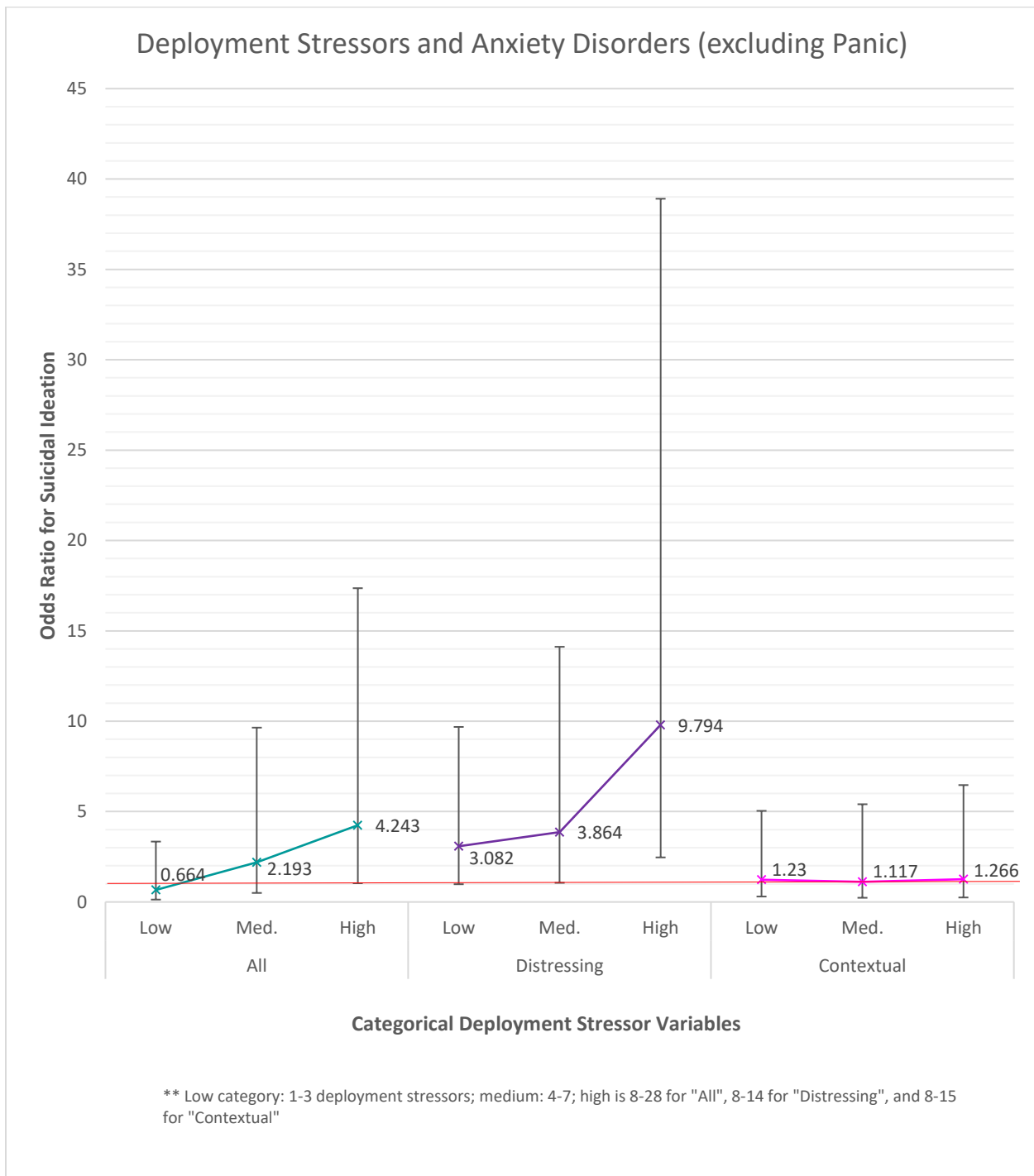


Figure 21: Categorical deployment stressors and anxiety disorders (excluding panic)



Research Objective 2: ACE and mental health

Analysis of individual ACE variables

When each binary ACE variable was regressed individually without other ACEs accounted for within the model, ACEs were often significant (see APPENDIX L: Adjusted estimates of association for individual ACE models for summary tables). With SF-36 MCS as the dependent variable, not being raised by parents or grandparents (non-linear kinship) lowered SF-36 MCS score by -4.205 (95% CI: -6.903, -1.507; $p=0.002$), physical neglect by -1.851 (95% CI: -3.420, -0.282; $p=0.021$), emotional neglect by -2.126 (95% CI: -3.683, -0.569; $p=0.007$), physical abuse by -2.201 (95% CI: -2.980, -1.421; $p=0.000$), emotional abuse by -2.332 (95% CI: -3.324, -1.339; $p<0.001$), IPV by -2.285 (95% CI: -3.596, -0.974; $p=0.001$), household mental illness by -1.914 (95% CI: -3.006, -0.821; $p=0.001$), and household alcohol problem by (-1.987 (95% CI: -2.977, -0.997; $p=0.000$). Being adopted, frequently moving, suffering sexual abuse were not significant when modelled individually.

Individual ACE variable analyses had limited utility in addressing some of the research objectives involving stress sensitization and stress inoculation. Instead, further analysis proceeded with summative scales and categorical ACE variables.

Summative scales and categorical ACE analyses

As mentioned earlier, model two of the ACE analyses were considered to be fully adjusted (because models three and four contain covariates that may be on the causal pathway); nonetheless, models three and four were also tested (but not presented) and in general, they

attenuated estimates of association, although minimally. ACE estimates presented in this section are adjusted using model two covariates. Covariate estimates for each ACE model are presented by outcome in APPENDIX M: Covariate estimates in ACE models for each mental health outcome. Of note, language was consistently statistically significant across outcomes, sex was often significant, however, mother's education was not.

Table 18 presents the adjusted estimates of association for summative ACE variables and all mental health outcomes. "Types of question 77 ACE" scale variable had a beta coefficient of -0.960 (95% CI: -1.235, -0.686; $p < 0.001$). "All types of ACE" scale variable had a smaller β_1 coefficient of -0.873 (95% CI: -1.222, -0.623; $p < 0.001$).

Table 18: The association of ACE variables and mental health outcomes

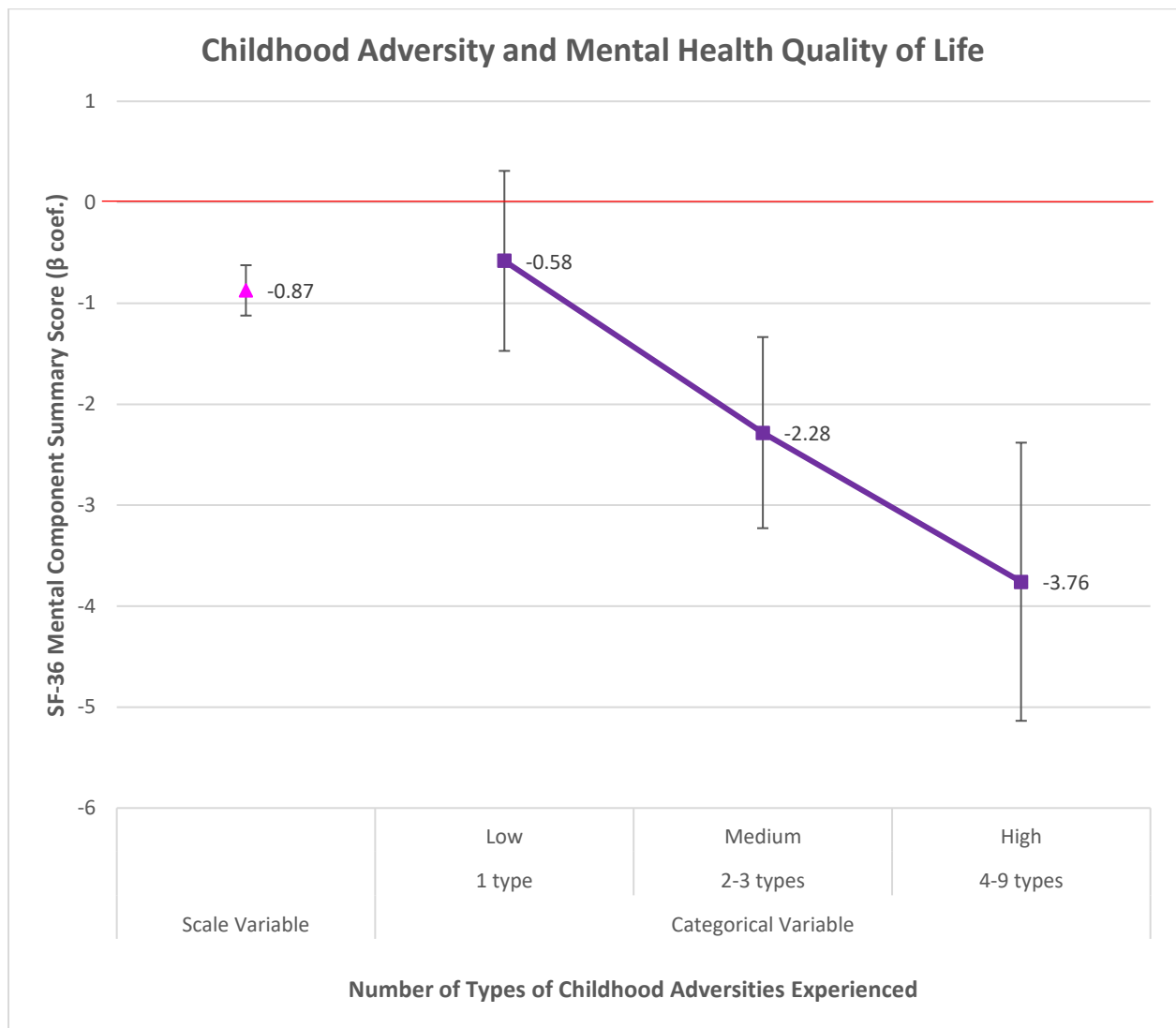
		SF-36 MCS	PTSD		Depression	Suicidal Ideation	Anxiety (excl. panic)
		linear (beta coef)	multinomial logistic (RRR)		ordinal logistic (OR)	logistic (OR)	logistic (OR)
			<i>Likely PTSD</i>	<i>Very Likely PTSD</i>	<i>Possible & Probable</i>		
Types of q77 ACE	Scale	-0.960*** [-1.235,-0.686]	1.200*** [1.107,1.301]	1.420*** [1.235,1.634]	1.355*** [1.235,1.486]	1.304*** [1.118,1.520]	1.294*** [1.113,1.505]
Types of q77 ACE	None (base)						
	Low (1 ACE)	-0.84 [-1.741,0.061]	1.441* [1.059,1.960]	1.578 [0.758,3.283]	1.736** [1.144,2.635]	1.173 [0.558,2.467]	2.029* [1.005,4.097]
	Medium (2-3 ACE)	-2.775*** [-3.725,-1.825]	2.070*** [1.539,2.785]	3.263*** [1.727,6.165]	2.695*** [1.823,3.984]	2.787** [1.507,5.151]	3.311*** [1.734,6.321]
	High (4-8 ACE)	-3.873*** [-5.411,-2.336]	1.794* [1.124,2.865]	4.707*** [2.170,10.209]	4.214*** [2.557,6.943]	3.218** [1.374,7.539]	2.506 [0.953,6.587]
q77 ACE intensity		-0.277*** [-0.349,-0.204]	1.061*** [1.038,1.084]	1.090*** [1.048,1.134]	1.089*** [1.061,1.117]	1.074*** [1.030,1.121]	1.074*** [1.030,1.120]
q77 ACE intensity	None (base)						
	Low (1-5)	-1.352** [-2.316,-0.387]	1.322 [0.900,1.943]	1.182 [0.482,2.900]	1.469 [0.845,2.554]	1.396 [0.579,3.370]	1.783 [0.653,4.870]
	Medium (6-11)	-2.570*** [-3.610,-1.531]	2.206*** [1.504,3.236]	2.289 [0.968,5.415]	2.666*** [1.555,4.572]	2.271 [0.952,5.418]	3.409* [1.288,9.022]
	High (12-33)	-4.785*** [-6.087,-3.483]	2.887*** [1.878,4.438]	4.376** [1.807,10.597]	5.064*** [2.885,8.888]	3.927** [1.577,9.782]	4.348** [1.547,12.222]
All types of ACE	Scale	-0.873*** [-1.122,-0.623]	1.189*** [1.105,1.279]	1.368*** [1.205,1.552]	1.309*** [1.204,1.424]	1.268*** [1.103,1.457]	1.273*** [1.111,1.459]
Types of ACE	None (base)						
	Low (1 ACE)	-0.581 [-1.472,0.311]	1.266 [0.920,1.741]	1.916 [0.922,3.984]	1.683* [1.101,2.572]	0.724 [0.325,1.612]	1.366 [0.654,2.856]
	Medium (2-3 ACE)	-2.282*** [-3.228,-1.335]	2.005*** [1.479,2.719]	2.703** [1.334,5.477]	2.171*** [1.430,3.297]	2.189* [1.173,4.085]	2.593** [1.340,5.017]
	High (4-9 ACE)	-3.759*** [-5.136,-2.381]	2.110*** [1.396,3.189]	4.912*** [2.268,10.638]	4.158*** [2.588,6.680]	2.909** [1.343,6.300]	2.469* [1.051,5.800]
ACE intensity		-0.250*** [-0.316,-0.185]	1.057*** [1.037,1.078]	1.080*** [1.043,1.119]	1.077*** [1.053,1.102]	1.065** [1.026,1.106]	1.067*** [1.028,1.108]
ACE intensity	None (base)						
	Low (1-5)	-1.188* [-2.255,-0.121]	1.01 [0.659,1.548]	1.533 [0.508,4.626]	1.411 [0.753,2.647]	1.129 [0.404,3.158]	2.12 [0.613,7.328]
	Medium (6-11)	-2.512*** [-3.633,-1.392]	1.962** [1.297,2.967]	2.901 [0.994,8.467]	2.547** [1.381,4.696]	2.627 [0.994,6.947]	3.33 [0.983,11.282]
	High (12-37)	-4.700*** [-5.990,-3.409]	2.667*** [1.717,4.141]	4.777** [1.616,14.126]	4.541*** [2.436,8.465]	3.517* [1.279,9.671]	6.249** [1.838,21.240]

95% confidence intervals in brackets

* p < 0.05, ** p < 0.01, *** p < 0.001

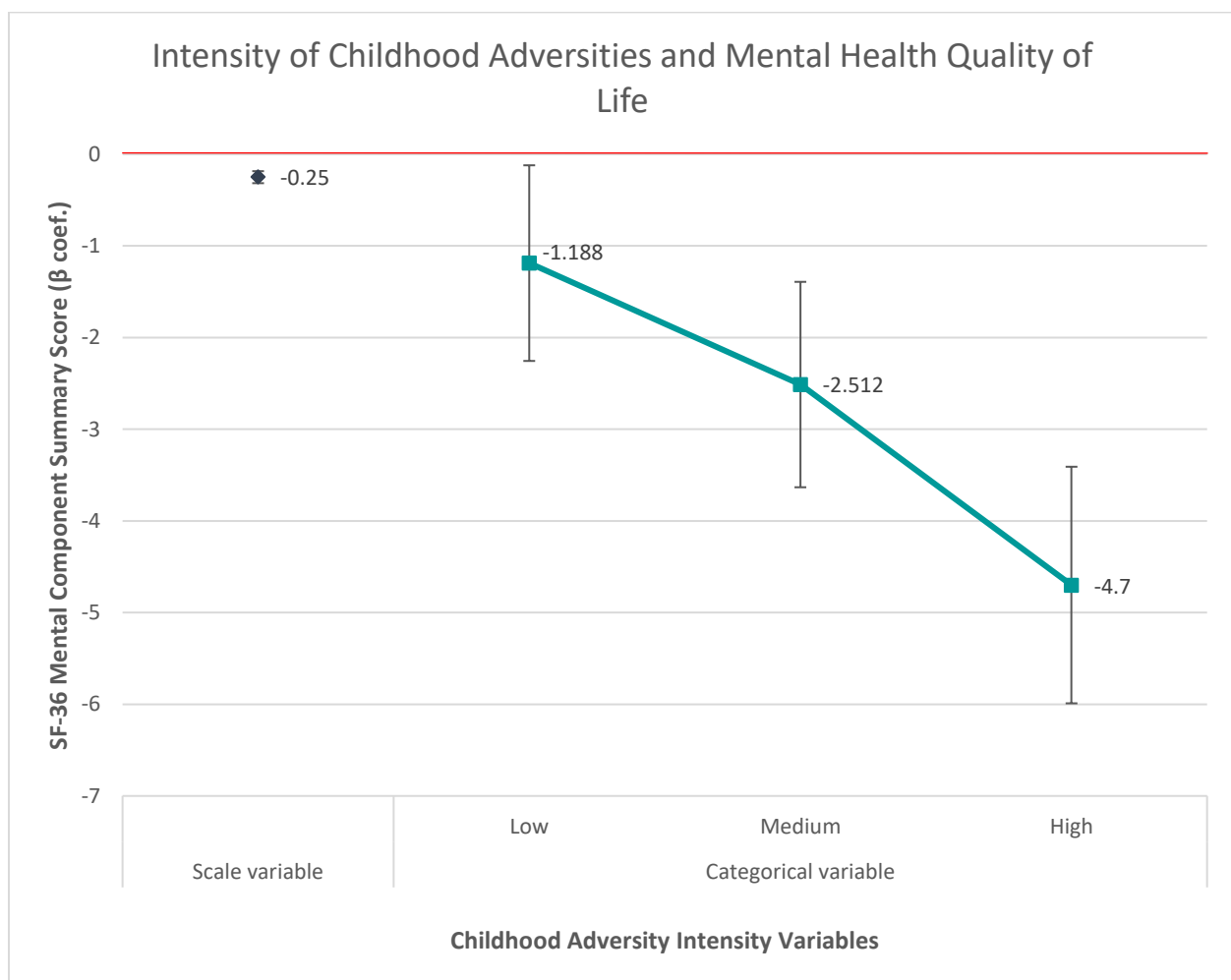
The association between childhood adversity and mental health quality of life is demonstrated in Figure 22, where childhood adversity is represented using scale or categorical variables derived from on the cumulative number of types of childhood adversities reported (including the novel additional household dysfunction ACEs put forth in this thesis).

Figure 22: Cumulative childhood adversity (including novel ACEs) and SF-36 MCS



The same direction of association is demonstrated in Figure 23, except childhood adversity here is represented by the intensity of “all ACEs”, including the additional household dysfunction ACEs put forth by this thesis. Low, medium, and high levels of “All ACE intensity” reduced SF-36 MCS score, respectively by -1.188 (95% CI: -2.255, -0.121; $p=0.029$), -2.512 (95% CI: -3.633, -1.392; $p<0.001$), and -4.700 (95% CI: -5.990, -3.409; $p<0.001$). Other types of low ACE categories were not significant.

Figure 23: Intensity of childhood adversity (including novel ACEs) and SF-36 MCS



Direct comparison between cumulative types of ACE (“ACE types”) and “ACE intensity” variables are problematic due to difference in scale. Figures depicting side by side estimates are contained in APPENDIX N: ACE “types” and “intensity” supplemental figures, in addition to comparison of “question 77” ACEs (from the RAP questionnaire) to the “all ACE” variable (which additionally includes household dysfunction ACEs: non-linear kinship, residential instability, and adoption).

Figure 24 portrays the association between cumulative types of childhood adversity and PTSD-likelihood (“likely” and “very likely”), while comparing “question 77” ACE and “all ACE” variables (scale and categorical versions).

Figure 24: Number of types of childhood adversity and PTSD

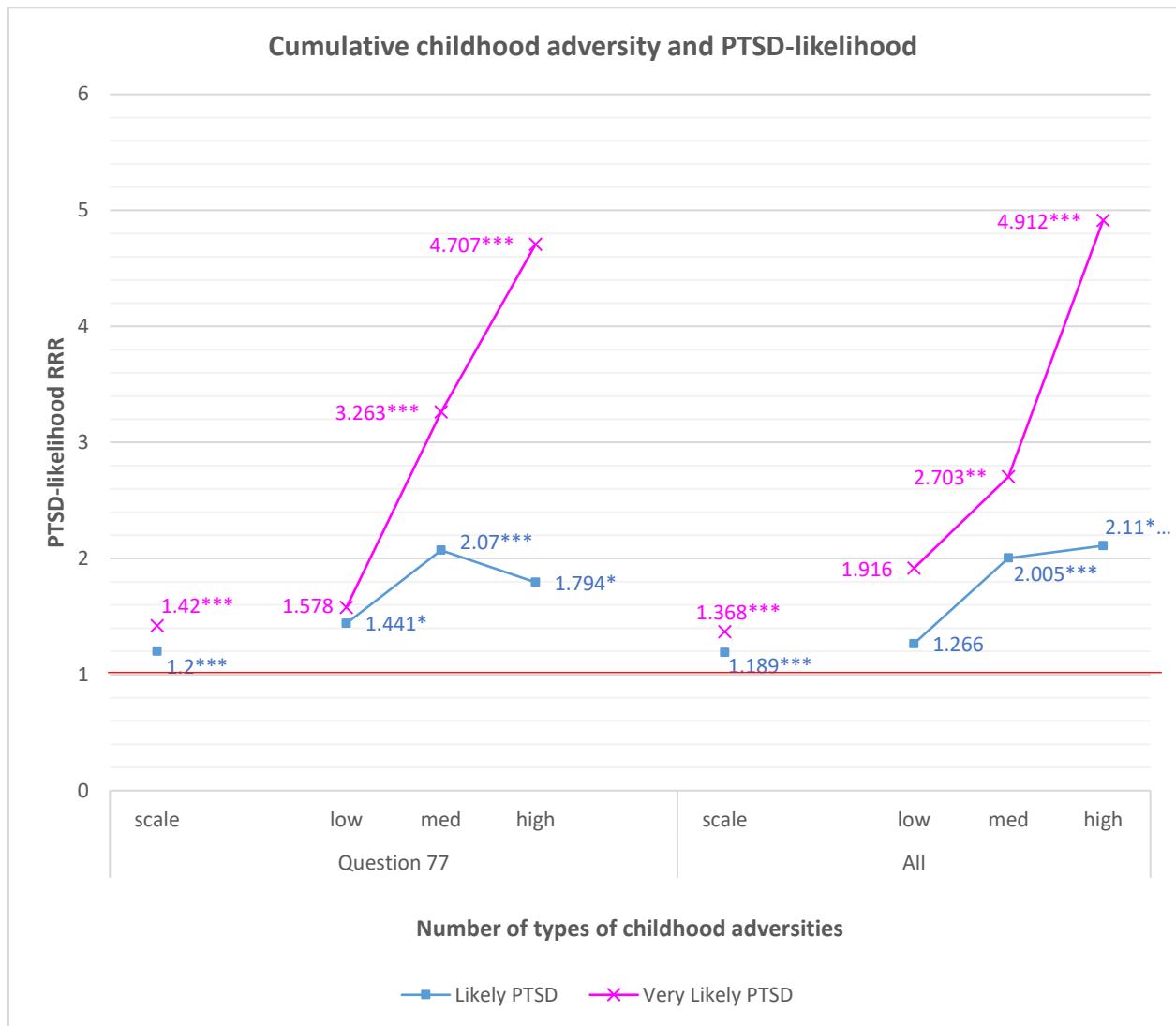


Figure 25 displays the association between the intensity of childhood adversity and PTSD-likelihood, for both “question 77” ACE and “all ACE” variables (scale and categorical versions).

Figure 25: Intensity of childhood adversity and PTSD-likelihood

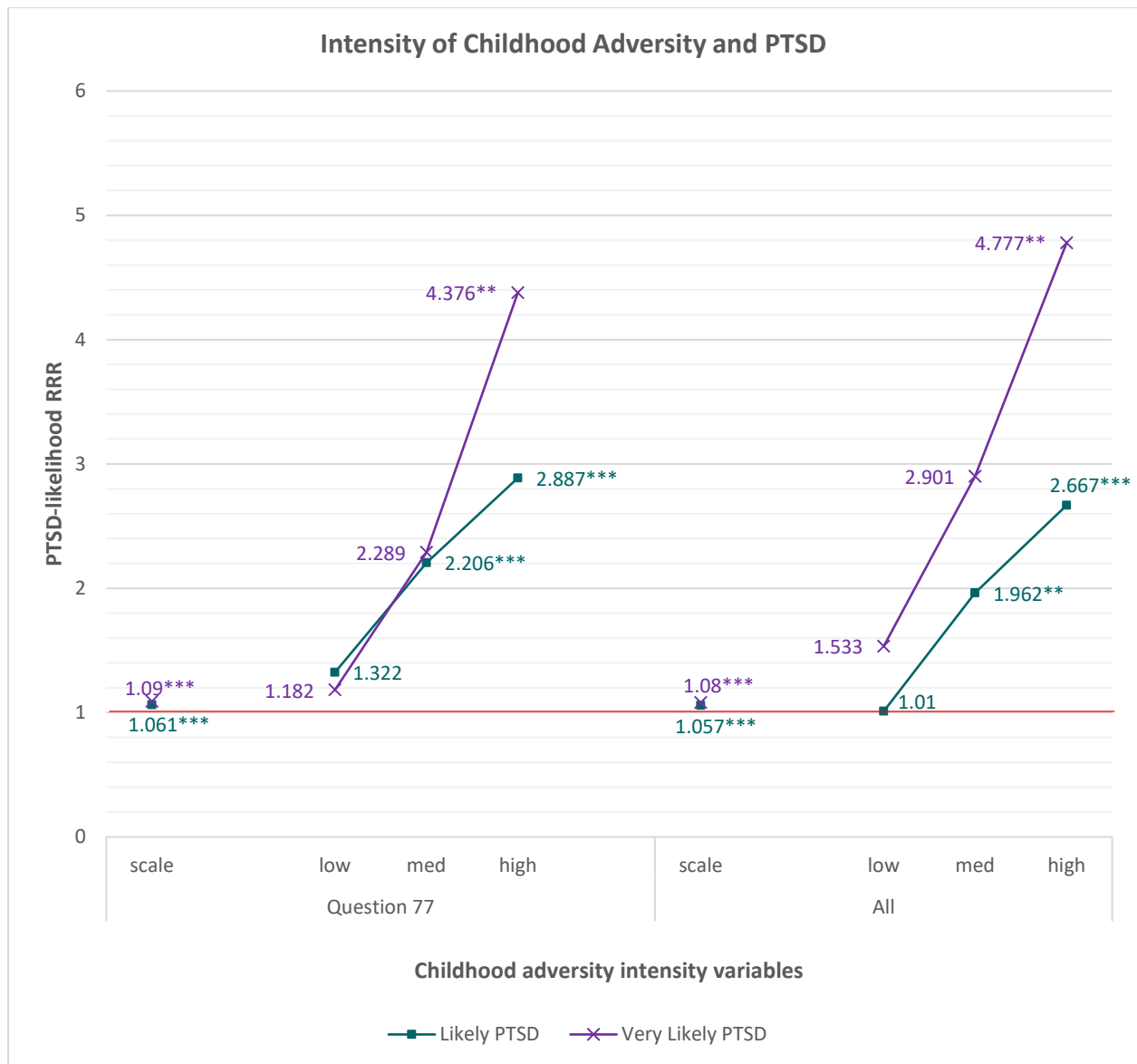


Figure 26 describes the association between cumulative types of childhood adversities experienced and three mental health outcomes: depression (possible and probable versus unlikely), suicidal ideation, and anxiety (excluding panic). The associations for all three mental health outcomes are quantified by directly comparable odds ratios.

Figure 26: Number of childhood adversities and depression, suicidal ideation, and anxiety

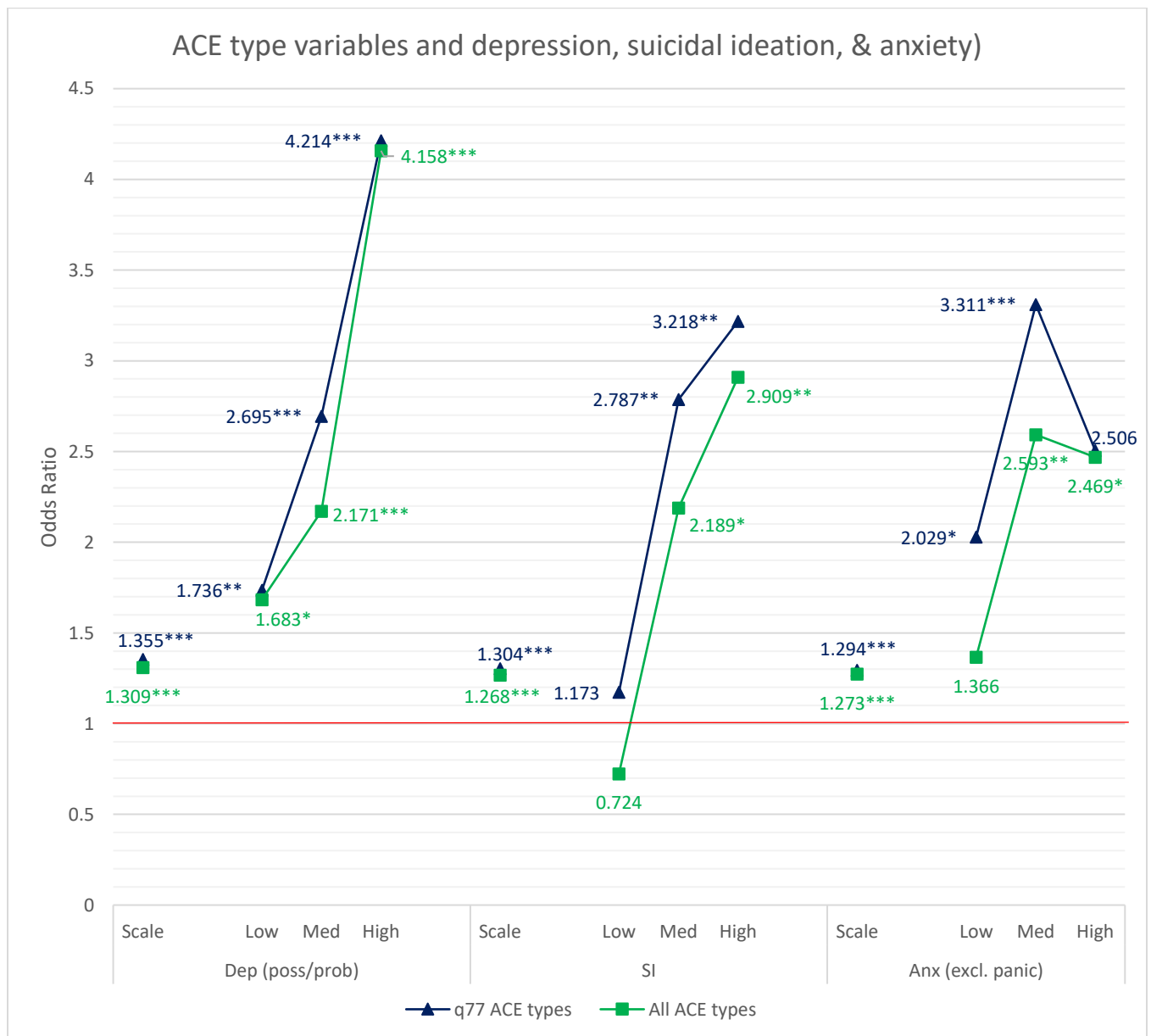
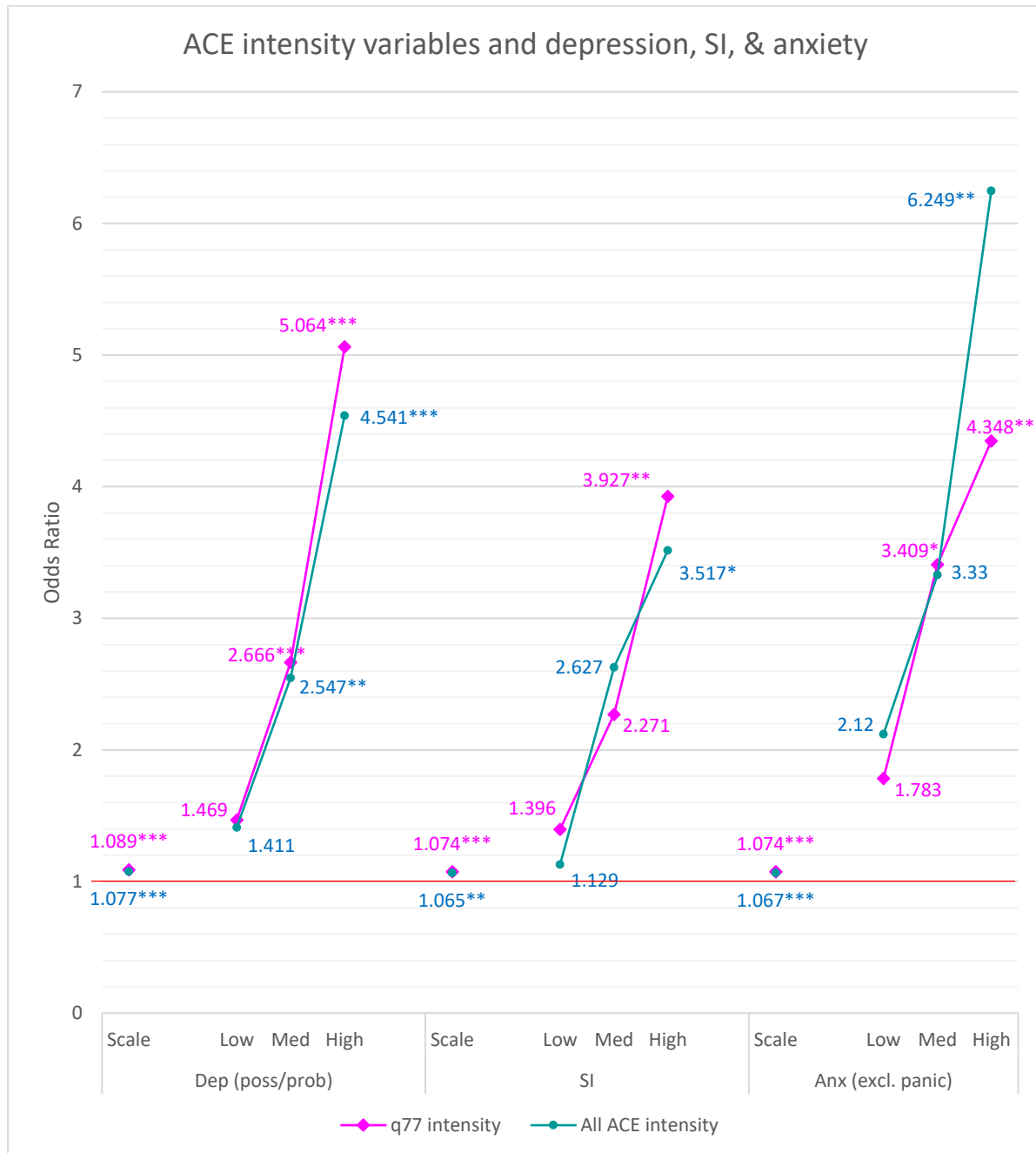


Figure 27 describes the association between the intensity of childhood adversities and the same three mental health outcomes: depression (possible and probable versus unlikely), suicidal ideation, and anxiety (excluding panic).

Figure 27: Intensity of childhood adversity and depression, suicidal ideation, and anxiety



Non-linear investigation

Polynomial models were found to be inappropriate to explain the relationship between ACEs and mental health outcomes. Quadratic ACE terms were tested and were not significant.

Research Objective 3: ACE-DRSE effect modification

With four exposure variables, eight ACE variables, and five outcomes, there would have been 160 models to test for interaction terms. To minimize the number of models tested, the number of ACE variables was reduced to four, and SF-36 MCS was tested as the primary outcome (secondary outcomes were later tested for validation). The selection of ACE variables was guided by the principle that including all ACE information possible optimizes the representation of the broad concept of childhood adversity within models; in any case, differences between question 77 ACE variables and “All ACE” variables were for the most part minimal. For SF-36 MCS, choosing “All ACE” was the conservative choice given that these variables had slightly lower point estimates of associations than question 77 ACE variables. Therefore, further analyses proceeded with four “All ACE” variables: scale and categorical versions of “ACE types” and “ACE intensity”.

Table 19 presents the ACE-DRSE interaction terms tested for association with this thesis’ primary mental health outcome, SF-36 MCS.

Table 19: Fully adjusted ACE-DRSE interaction terms

	& ACE types scale	& ACE intensity scale	& Categorical ACE types	& Categorical ACE intensity
All DRSE scale	-0.051** [-0.086,-0.015]	-0.009* [-0.019,-0.000]	High: -0.289** [-0.487,-0.092]	not significant
Distressing DRSE scale	-0.121** [-0.195,-0.047]	-0.025* [-0.044,-0.006]	High: -0.716*** [-1.126,-0.306]	not significant
All DRSE categorical	not significant	not significant	not significant	not significant
Distressing DRSE categorical	Medium DRSE: -0.889** [-1.561,-0.217] High DRSE: -0.979* [-1.753,-0.204]	High DRSE: -0.232* [-0.437,-0.027]	Medium DRSE X high ACE: -5.524** [-9.280,-1.769]; High DRSE X high ACE: -5.785** [-10.073, -1.498]	not significant

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

“All DRSE” and “Distressing DRSE” significantly interacted with all ACE variables, except for categorical “ACE intensity”, which had no significant interactions. Categorical “Distressing DRSE” significantly interacted with ACE scale and categorical variables, except for categorical “ACE intensity.” Categorical “All DRSE” did not significantly interact with any ACE variable.

In the absence of distressing DRSEs (i.e., when “Distressing DRSE” equals zero), “ACE types” and “ACE intensity” scales had no association with SF-36 MCS (see Table 20 & Table 21).

When “ACE types” equalled zero, “Distressing DRSE” significantly changed expected SF-36 MCS score by -0.647 (95% CI: -0.853, -0.440; $p < 0.001$), while “Contextual DRSEs” were not significant. When “ACE intensity” equalled zero, “Distressing DRSE” significantly changed expected SF-36 MCS score by 0.634 (95% CI: -0.855, -0.412; $p < 0.001$).

Table 20: Scale “Distressing DRSE” and scale “ACE types” interaction models

		Model 1	Model 2	Model 3	Model 4
Distressing DRSE scale		-0.674*** [-0.867,-0.480]	-0.617*** [-0.820,-0.415]	-0.639*** [-0.846,-0.433]	-0.647*** [-0.853,-0.440]
ACE types scale		-0.404* [-0.752,-0.057]	-0.257 [-0.631,0.118]	-0.123 [-0.512,0.266]	-0.119 [-0.509,0.270]
Distressing DRSE	X ACE types scale	-0.107** [-0.176,-0.038]	-0.131*** [-0.204,-0.059]	-0.126*** [-0.200,-0.052]	-0.121** [-0.195,-0.047]
Contextual DRSE scale		0.240*** [0.098,0.383]	0.160* [0.008,0.313]	0.159* [0.003,0.314]	0.159 [-0.000,0.317]
Language	English (base)				
	French		0.969* [0.223,1.715]	1.008* [0.238,1.777]	1.065** [0.290,1.840]
Sex	Male (base)				
	Female		-2.910*** [-4.141,-1.679]	-3.316*** [-4.598,-2.034]	-3.369*** [-4.697,-2.041]
Mother's Education	No high school (base)				
	High school complete		0.957* [0.031,1.884]	0.992* [0.048,1.936]	0.863 [-0.087,1.812]
	Post-secondary complete		0.147 [-0.845,1.138]	0.172 [-0.839,1.182]	-0.067 [-1.094,0.960]
Smoking status	Never smoked (base)				
	Ex-smoker			-0.597 [-1.513,0.319]	-0.31 [-1.240,0.620]
	Current smoker			-0.556 [-1.463,0.352]	-0.253 [-1.175,0.668]
BMI	Normal/underweight (base)				
	Overweight			-0.267 [-1.048,0.514]	-0.099 [-0.889,0.691]
	Obese			-2.056** [-3.474,-0.638]	-1.755* [-3.180,-0.329]
Physical activity	Active (base)				
	Moderately active			-0.379 [-1.307,0.548]	-0.427 [-1.353,0.500]
	Inactive			-0.336 [-1.321,0.649]	-0.387 [-1.371,0.597]
Sleep problems	Normal sleep (base)				
	Disturbed sleep			-1.295*** [-2.025,-0.565]	-1.342*** [-2.072,-0.612]
Social support	High (base)				
	Medium			-0.288 [-1.165,0.589]	-0.3 [-1.180,0.579]
	Low			-0.817 [-1.743,0.110]	-1.012* [-1.952,-0.073]
Education	No high school (base)				
	High school complete			0.196 [-0.789,1.180]	0.199 [-0.787,1.186]
	Post-secondary complete			0.98 [-0.228,2.188]	0.963 [-0.346,2.272]
Parental Status	Not a parent (base)				
	Parent				-1.068* [-2.125,-0.012]
Marital status	Single (base)				
	Married				-0.144 [-1.073,0.784]
	Widow/divorce/separated				-2.778** [-4.610,-0.945]
Years in the military	less than 2.5 years (base)				
	2.5 - 5 years				-0.961 [-2.412,0.489]
	Over 5 years				-1.206 [-2.835,0.424]
Branch	Army (base)				
	Navy				-0.713 [-2.890,1.464]
	Air Force				0.933 [-0.477,2.343]
Rank	Officer (base)				
	NCM				-1.054 [-2.462,0.355]
Deployment length	6+ mos (base)				
	Short (≤ 5 mos)				0.413 [-0.594,1.419]
Age post-deployment	24 years or less (base)				
	25 to 34 years				-1.073* [-1.934,-0.212]
	35 years or more				0.518 [-1.064,2.100]
Observations		3054	2735	2662	2653
Adjusted R2		0.059	0.072	0.08	0.09
AIC		22380.297	20014.957	19487.553	19408.179
BIC		22410.418	20068.182	19605.289	19590.566

Beta coefficients with 95% confidence intervals in brackets

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 21: Scale “Distressing DRSE” and scale “ACE intensity” interaction models

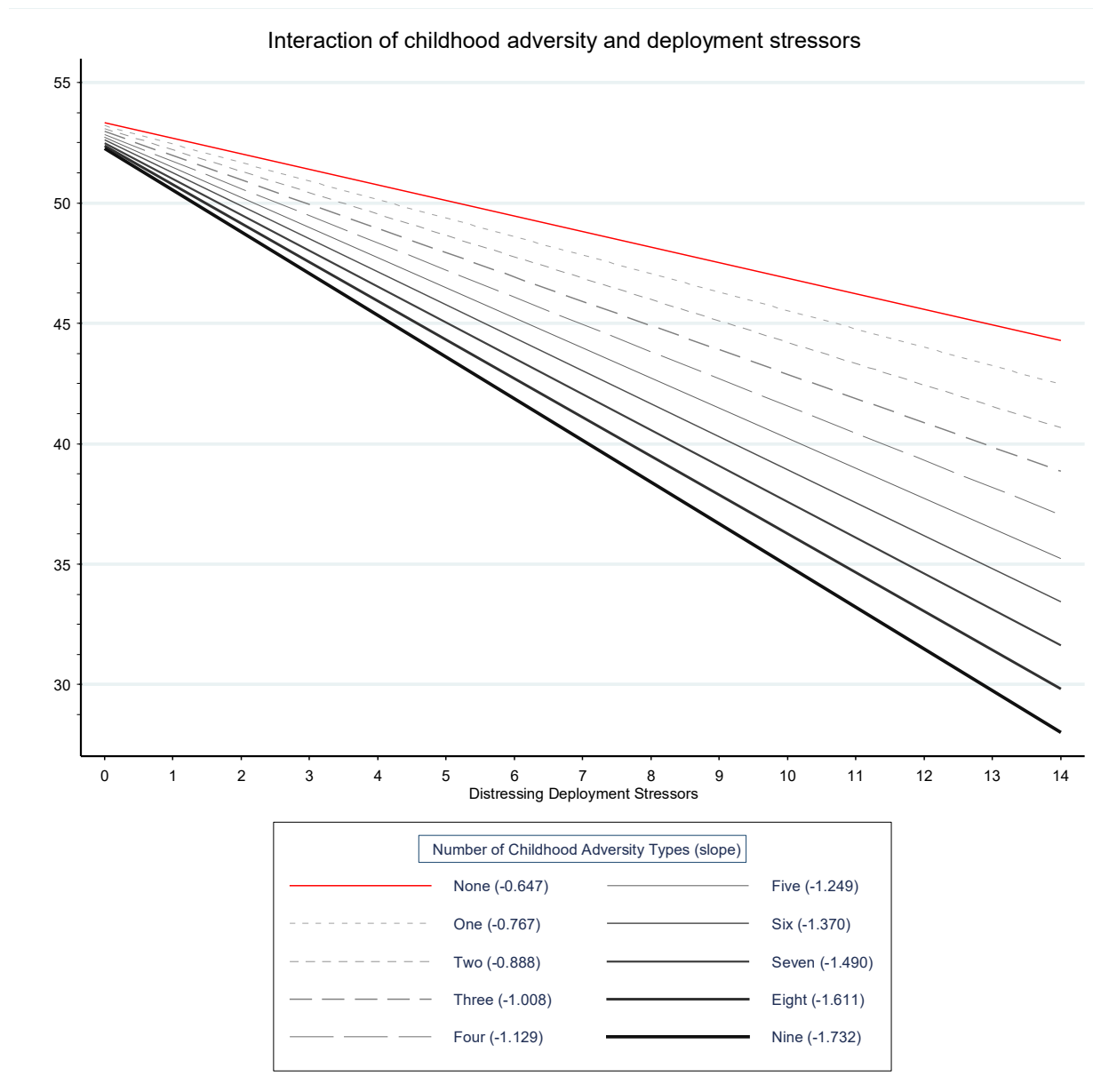
		Model 1	Model 2	Model 3	Model 4
Distressing DRSE scale		-0.647*** [-0.854,-0.439]	-0.589*** [-0.806,-0.373]	-0.621*** [-0.843,-0.400]	-0.634*** [-0.855,-0.412]
ACE intensity scale		-0.130** [-0.221,-0.040]	-0.106* [-0.203,-0.008]	-0.073 [-0.174,0.029]	-0.073 [-0.175,0.029]
Distressing DRSE	X ACE intensity scale	-0.025** [-0.043,-0.007]	-0.030** [-0.048,-0.011]	-0.027** [-0.046,-0.007]	-0.025* [-0.044,-0.006]
Contextual DRSE scale		0.244*** [0.102,0.387]	0.162* [0.009,0.314]	0.156* [0.001,0.312]	0.155 [-0.004,0.314]
Language	English (base)				
	French		0.887* [0.138,1.635]	0.928* [0.153,1.702]	0.989* [0.210,1.769]
Sex	Male (base)				
	Female		-2.925*** [-4.154,-1.695]	-3.286*** [-4.568,-2.005]	-3.336*** [-4.663,-2.008]
Mother's Education	No high school (base)				
	High school complete		0.926 [-0.001,1.852]	0.968* [0.023,1.913]	0.841 [-0.109,1.792]
	Post-secondary complete		0.103 [-0.888,1.094]	0.146 [-0.865,1.157]	-0.088 [-1.116,0.939]
Smoking status	Never smoked (base)				
	Ex-smoker			-0.568 [-1.485,0.348]	-0.285 [-1.215,0.645]
	Current smoker			-0.502 [-1.410,0.405]	-0.205 [-1.126,0.717]
BMI	Normal/underweight (base)				
	Overweight			-0.268 [-1.049,0.513]	-0.1 [-0.890,0.690]
	Obese			-2.045** [-3.463,-0.627]	-1.751* [-3.177,-0.325]
Physical activity	Active (base)				
	Moderately active			-0.388 [-1.315,0.539]	-0.435 [-1.361,0.492]
	Inactive			-0.337 [-1.322,0.648]	-0.392 [-1.376,0.593]
Sleep problems	Normal sleep (base)				
	Disturbed sleep			-1.269*** [-2.000,-0.538]	-1.317*** [-2.048,-0.586]
Social support	High (base)				
	Medium			-0.21 [-1.089,0.669]	-0.224 [-1.106,0.658]
	Low			-0.634 [-1.573,0.305]	-0.838 [-1.790,0.114]
Education	No high school (base)				
	High school complete			0.152 [-0.833,1.137]	0.159 [-0.828,1.146]
	Post-secondary complete			0.93 [-0.279,2.138]	0.935 [-0.375,2.244]
Parental Status	Not a parent (base)				
	Parent				-1.051 [-2.108,0.006]
Marital status	Single (base)				
	Married				-0.138 [-1.068,0.791]
	Widow/divorce/separated				-2.768** [-4.601,-0.935]
Years in the military	less than 2.5 years (base)				
	2.5 - 5 years				-0.957 [-2.408,0.494]
	Over 5 years				-1.218 [-2.848,0.411]
Branch	Army (base)				
	Navy				-0.721 [-2.899,1.456]
	Air Force				0.953 [-0.456,2.362]
Rank	Officer (base)				
	NCM				-1.004 [-2.413,0.405]
Deployment length	6+ mos (base)				
	Short (≤5 mos)				0.383 [-0.624,1.389]
Age post-deployment	24 years or less (base)				
	25 to 34 years				-1.086* [-1.947,-0.225]
	35 years or more				0.483 [-1.098,2.064]
Observations		3054	2735	2662	2653
Adjusted R2		0.06	0.073	0.08	0.089
AIC		22377.096	20011.726	19488.348	19409.34
BIC		22407.217	20064.951	19606.084	19591.727

Beta coefficients with 95% confidence intervals in brackets

* p < 0.05, ** p < 0.01, *** p < 0.001

The predicted values of adjusted SF-36 MCS scores are shown in Figure 28 for each level of ACE, where “Distressing DRSE” is the primary exposure.

Figure 28: ACE & “Distressing DRSE” scale variable interaction



As shown in Table 22, “Distressing DRSE” scale variable was significant when categorical ACE-DRSE interaction terms were included in the model. In the absence of ACEs (when “ACE types” equals zero), “Contextual DRSE” scale had a small but significant positive value (0.161 (95% CI: 0.002,0.320; $p=0.47$)).

Table 22: “Distressing DRSE” scale and categorical “ACE types” interaction models

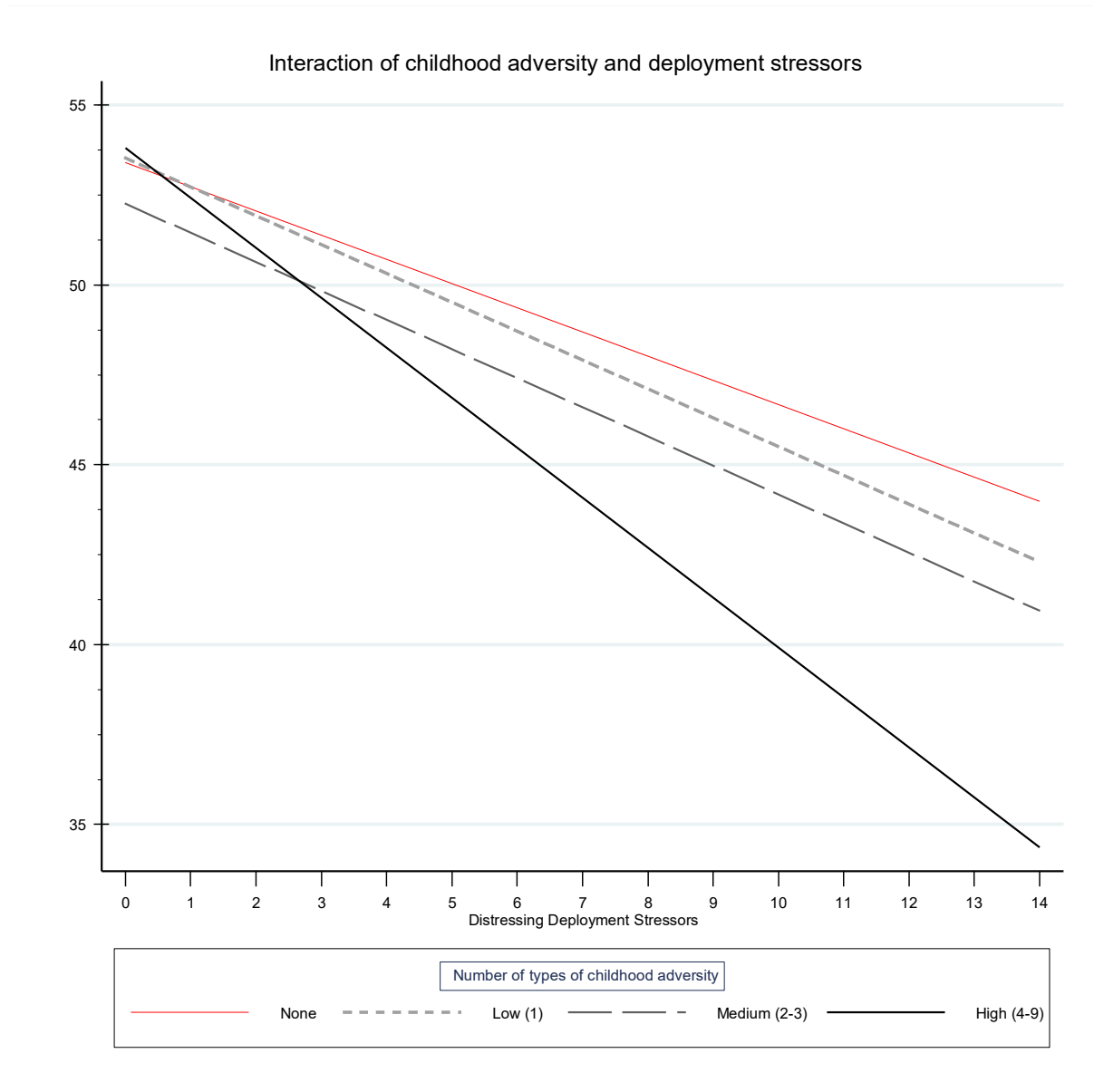
		Model 1	Model 2	Model 3	Model 4
Distressing DRSE scale		-0.653*** [-0.868,-0.438]	-0.624*** [-0.849,-0.399]	-0.656*** [-0.885,-0.426]	-0.673*** [-0.902,-0.443]
ACE types	none				
	low: 1 type	0.105 [-1.136,1.346]	0.082 [-1.232,1.397]	0.165 [-1.165,1.495]	0.125 [-1.202,1.452]
	med: 2-3 types	-1.257 [-2.575,0.060]	-1.185 [-2.583,0.214]	-1.035 [-2.469,0.400]	-1.14 [-2.577,0.298]
	high: 4-9 types	-1.359 [-3.314,0.596]	-0.353 [-2.453,1.747]	0.319 [-1.850,2.488]	0.401 [-1.767,2.570]
Distressing DRSE scale X:	X no ACE				
	X low ACE types	-0.191 [-0.456,0.073]	-0.159 [-0.435,0.117]	-0.149 [-0.428,0.131]	-0.129 [-0.408,0.150]
	X medium ACE types	-0.246 [-0.524,0.033]	-0.242 [-0.532,0.049]	-0.17 [-0.466,0.126]	-0.136 [-0.432,0.160]
	X high ACE types	-0.572** [-0.953,-0.192]	-0.745*** [-1.147,-0.342]	-0.741*** [-1.152,-0.330]	-0.716*** [-1.126,-0.306]
Contextual DRSE scale		0.244*** [0.101,0.387]	0.164* [0.012,0.317]	0.162* [0.006,0.317]	0.161* [0.002,0.320]
Language	English (base)				
	French		0.984** [0.237,1.732]	1.015** [0.244,1.787]	1.076** [0.299,1.852]
Sex	Male (base)				
	Female		-2.921*** [-4.154,-1.688]	-3.327*** [-4.610,-2.043]	-3.377*** [-4.706,-2.048]
Mother's Education	No high school (base)				
	High school complete		0.997* [0.069,1.926]	1.028* [0.082,1.973]	0.896 [-0.055,1.847]
	Post-secondary complete		0.178 [-0.814,1.171]	0.196 [-0.815,1.207]	-0.048 [-1.076,0.979]
Smoking status	Never smoked (base)				
	Ex-smoker			-0.614 [-1.531,0.304]	-0.322 [-1.253,0.609]
	Current smoker			-0.555 [-1.463,0.353]	-0.248 [-1.170,0.675]
BMI	Normal/underweight (base)				
	Overweight			-0.263 [-1.045,0.518]	-0.095 [-0.886,0.696]
	Obese			-2.071** [-3.491,-0.651]	-1.770* [-3.198,-0.343]
Physical activity	Active (base)				
	Moderately active			-0.396 [-1.324,0.533]	-0.443 [-1.370,0.485]
	Inactive			-0.349 [-1.336,0.638]	-0.401 [-1.387,0.584]
Sleep problems	Normal sleep (base)				
	Disturbed sleep			-1.315*** [-2.046,-0.584]	-1.365*** [-2.097,-0.634]
Social support	High (base)				
	Medium			-0.271 [-1.150,0.608]	-0.284 [-1.165,0.597]
	Low			-0.804 [-1.732,0.125]	-1.001* [-1.941,-0.060]
Education	No high school (base)				
	High school complete			0.204 [-0.782,1.189]	0.209 [-0.779,1.196]
	Post-secondary complete			1.008 [-0.200,2.217]	0.986 [-0.323,2.296]
Parental Status	Not a parent (base)				
	Parent				-1.090* [-2.149,-0.032]
Marital status	Single (base)				
	Married				-0.154 [-1.085,0.776]
	Widow/divorce/separated				-2.756** [-4.591,-0.922]
Years in the military	less than 2.5 years (base)				
	2.5 - 5 years				-0.978 [-2.431,0.474]
	Over 5 years				-1.239 [-2.872,0.393]
Branch	Army (base)				
	Navy				-0.691 [-2.871,1.488]
	Air Force				0.923 [-0.488,2.334]
Rank	Officer (base)				
	NCM				-1.096 [-2.507,0.315]
Deployment length	6+ mos (base)				
	Short (≤5 mos)				0.404 [-0.604,1.411]
Age post-deployment	24 years or less (base)				
	25 to 34 years				-1.053* [-1.915,-0.190]
	35 years or more				0.502 [-1.081,2.085]
	Observations	3054	2735	2662	2653
	Adjusted R2	0.056	0.07	0.079	0.088
	AIC	22391.966	20025.109	19495.847	19416.372
	BIC	22446.184	20101.99	19637.131	19622.293

Beta coefficients with 95% confidence intervals in brackets

* p < 0.05, ** p < 0.01, *** p < 0.001

The predicted linear relationship between “Distressing DRSE” and predicted SF-36 MCS values are shown in Figure 29, separated by the level of ACE type category.

Figure 29: Categorical ACE & DRSE scale interaction



As shown in Table 23, when “ACE types” equals zero, “Distressing DRSE” medium and high categories are significant, the latter changing SF-36 MCS by -6.326 (95% CI: -8.610,-4.043; $p<0.001$). The low category of “Contextual DRSE” was significant (-1.999 (95% CI: -3.398,-0.600; $p=0.005$).

Table 23: Categorical “Distressing DRSE” and categorical “ACE types” interaction models

		Model 1	Model 2	Model 3	Model 4
Distressing DRSE	none				
	low (1-3)	-0.886 [-2.376,0.604]	-0.993 [-2.568,0.582]	-0.915 [-2.517,0.687]	-1.083 [-2.692,0.526]
	med (4-7)	-1.604 [-3.306,0.099]	-1.925* [-3.722,-0.128]	-1.943* [-3.768,-0.118]	-2.111* [-3.939,-0.283]
	high (8+)	-5.917*** [-8.053,-3.782]	-5.775*** [-8.014,-3.535]	-6.132*** [-8.418,-3.847]	-6.326*** [-8.610,-4.043]
ACE types categories	no ACE				
	low: 1 type	-0.667 [-2.399,1.065]	-0.739 [-2.580,1.103]	-0.504 [-2.366,1.358]	-0.585 [-2.440,1.269]
	med: 2-3 types	-1.241 [-3.078,0.597]	-1.392 [-3.349,0.565]	-1.07 [-3.061,0.922]	-1.223 [-3.220,0.773]
	high: 4-9 types	-0.563 [-3.225,2.098]	0.183 [-2.656,3.021]	1.315 [-1.641,4.271]	1.324 [-1.630,4.277]
Low distressing DRSE X:	low ACE	1.245 [-1.007,3.497]	1.27 [-1.123,3.663]	1.069 [-1.348,3.487]	1.172 [-1.238,3.581]
	med ACE	-0.646 [-3.036,1.745]	-0.482 [-3.012,2.049]	-0.642 [-3.218,1.933]	-0.438 [-3.020,2.144]
	high ACE	-2.68 [-6.262,0.903]	-2.963 [-6.781,0.856]	-3.643 [-7.558,0.271]	-3.437 [-7.342,0.467]
Med. distressing DRSE X:	low ACE	-0.554 [-2.845,1.737]	-0.134 [-2.544,2.276]	-0.311 [-2.751,2.129]	-0.195 [-2.631,2.240]
	med ACE	-1.728 [-4.143,0.687]	-1.029 [-3.579,1.522]	-1.062 [-3.641,1.516]	-0.847 [-3.428,1.734]
	high ACE	-4.694** [-8.153,-1.235]	-4.994** [-8.667,-1.321]	-5.610** [-9.375,-1.845]	-5.524** [-9.280,-1.769]
High distressing DRSE X:	low ACE	-1.426 [-4.293,1.440]	-1.201 [-4.206,1.804]	-1.123 [-4.166,1.921]	-0.858 [-3.894,2.178]
	med ACE	-1.471 [-4.481,1.538]	-1.617 [-4.761,1.527]	-0.729 [-3.931,2.473]	-0.439 [-3.644,2.767]
	high ACE	-4.623* [-8.621,-0.624]	-5.998** [-10.190,-1.806]	-6.184** [-10.482,-1.887]	-5.785** [-10.073,-1.498]
Contextual DRSE	none				
	low	-1.405* [-2.664,-0.146]	-1.959** [-3.298,-0.619]	-1.913** [-3.277,-0.549]	-1.999** [-3.398,-0.600]
	med	-0.622 [-2.102,0.858]	-1.503 [-3.094,0.087]	-1.249 [-2.868,0.370]	-1.329 [-2.994,0.335]
	high	0.142 [-1.469,1.752]	-0.782 [-2.507,0.942]	-0.747 [-2.503,1.009]	-0.863 [-2.667,0.940]
Language	English (base)				
	French		1.039** [0.288,1.789]	1.047** [0.273,1.821]	1.085** [0.307,1.864]
Sex	Male (base)				
	Female		-2.998*** [-4.240,-1.756]	-3.342*** [-4.633,-2.050]	-3.405*** [-4.739,-2.071]
Mother's Education	No high school (base)				
	High school complete		0.965* [0.036,1.893]	1.007* [0.061,1.953]	0.881 [-0.071,1.832]
	Post-secondary complete		0.126 [-0.867,1.120]	0.148 [-0.865,1.161]	-0.082 [-1.112,0.948]
Smoking status	Never smoked (base)				
	Ex-smoker			-0.633 [-1.550,0.285]	-0.348 [-1.279,0.583]
	Current smoker			-0.526 [-1.435,0.383]	-0.227 [-1.151,0.696]
BMI	Normal/underweight (base)				
	Overweight			-0.206 [-0.988,0.577]	-0.041 [-0.833,0.751]
	Obese			-1.952** [-3.375,-0.528]	-1.633* [-3.065,-0.202]
Physical activity	Active (base)				
	Moderately active			-0.306 [-1.237,0.625]	-0.352 [-1.282,0.579]
	Inactive			-0.42 [-1.409,0.568]	-0.469 [-1.457,0.518]
Sleep problems	Normal sleep (base)				
	Disturbed sleep			-1.394*** [-2.127,-0.662]	-1.440*** [-2.173,-0.707]
Social support	High (base)				
	Medium			-0.161 [-1.041,0.719]	-0.169 [-1.052,0.713]
	Low			-0.71 [-1.639,0.219]	-0.891 [-1.832,0.050]
Education	No high school (base)				
	High school complete			0.027 [-0.959,1.013]	0.025 [-0.964,1.013]
	Post-secondary complete			0.941 [-0.268,2.151]	0.886 [-0.424,2.196]
Parental Status	Not a parent (base)				
	Parent				-1.149* [-2.208,-0.089]
Marital status	Single (base)				
	Married				-0.069 [-1.001,0.863]
	Widow/divorce/separated				-2.639** [-4.477,-0.800]

Years in the military	less than 2.5 years (base)				
	2.5 - 5 years				-0.975 [-2.430,0.480]
	Over 5 years				-1.162 [-2.799,0.475]
Branch	Army (base)				
	Navy				-1.443 [-3.687,0.801]
	Air Force				0.893 [-0.524,2.311]
Rank	Officer (base)				
	NCM				-1.106 [-2.525,0.312]
Deployment length	6+ mos (base)				
	Short (≤ 5 mos)				0.383 [-0.634,1.400]
Age post-deployment	24 years or less (base)				
	25 to 34 years				-1.030* [-1.894,-0.167]
	35 years or more				0.527 [-1.059,2.114]
	Observations	3054	2735	2662	2653
	Adjusted R2	0.057	0.071	0.08	0.089
	AIC	22399.33	20032.614	19503.212	19423.603
	BIC	22513.79	20168.633	19703.364	19688.358

Beta coefficients with 95% confidence intervals in brackets

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Across SF-36 MCS interaction models, significant covariates included: French language (positive impact), female sex, obesity, disturbed sleep, being a parent (in most models), being widowed/divorced/separated, and being 24-35 years old.

Validation with secondary outcomes

PTSD and anxiety models did not have significant interaction terms in fully adjusted models.

Suicidal ideation models yielded two significant interactions: the high “ACE intensity” category significantly interacted with “All DRSE” scale (AOR=0.785 (95% CI: 0.640, 0.962; $p=0.020$)) and “Distressing DRSE” scale (AOR=0.690 (95% CI: 0.500, 0.960; $p=0.028$)). In depression, the high “ACE intensity” category significantly interacted with “All DRSE” scale (AOR=0.904 (95% CI: 0.819, 0.996; $p=0.042$)), and the medium “ACE types” category significantly interacted with “All DRSE” scale (AOR=0.987 (95% CI: 0.924, 1.055; $p=0.027$)). Categorical by categorical interactions did not have enough respondents per cell for analysis across all categorical and binary outcomes.

Discussion

It is estimated that one in seven of Canadians deployed in support of the mission in Afghanistan have since been diagnosed with mental disorders attributed to their deployment⁷¹; roughly one in six of respondents in the current study screened positive for mental disorders. Poor mental health has had a substantial effect on individual lives and careers, on military operations, and military and veteran health care systems.⁷⁶ This thesis provides insight into an important piece of the puzzle about how mental health is undermined in deployed military personnel: it isolates the mental health impact of the deployment stressors that matter most, accounts for a broad range of childhood adversities, and is the first known longitudinal study of deployed CAF personnel that provides evidence that deployment stressors and childhood adversity interact multiplicatively to amplify risk of poor mental health.

A. Study population

Proportion of mental health issues

In all active CAF, there is an estimated 6.8-8.2% prevalence of depression (2004-2014), 8.2% (2008/9) and 10.4% (2013/2014) of PTSD, and 3.9% of suicidal ideation (in last 12 months) in 2013/2014 (3.1% in 2008/9).¹⁸³ However, the prevalence of clinically significant mental disorders at the beginning of deployment is presumed to be minimal, as consequence of pre-deployment screening for mental health issues.¹⁸³

45% of Regular Force members were deployed in support of the mission in Afghanistan (from 2001-2013), according to a summary of the Canadian Forces Mental Health Survey (2013)¹⁸⁴, which had a 79.8% response rate for Regular Forces (8393 respondents). This summary found that deployed personnel had higher rates of any mental illness, depression, PTSD, generalized

anxiety disorder, and panic disorder than those who had not been deployed. Rates of PTSD and panic disorder were twice as high among those who were deployed compared to those who were not.

Of all 16 193 personnel who completed the EPDS (i.e., not only those in the linked dataset), 10.2% screened positive for any mental illness, according to an analysis by Zamorski et al. (2014)⁷⁶; however, this figure was calculated using a 50 cut-off of the PCL-C for PTSD screening, and for depression, the DSM-diagnostic scoring of the PHQ-9 was used (which produced similar proportions as the 10 & 15 cut-offs used by this thesis). This in part explains the discrepancy with respect to this thesis' estimate of 15.5% for any mental illness; however, given that mental illnesses tend to be more prevalent in NCM than officers¹⁸³, among other different characteristics of the linked dataset population, the rate of mental illness is likely truly higher in the linked dataset population. Zamorski's PTSD point prevalence was 2.8%, comparable to this study's point prevalence of 2.34% (using the 50 cut-off of the PCL-C questionnaire). Zamorski's study found a frequency of 3.2% for major depressive disorder and 3.3% for other depressive disorder, while this study found that major depressive disorder occurred at a frequency of 3.92% and other depressive disorder at 2.92% (the total screens are similar, 6.5% and 6.83%, respectively). Both studies estimate of suicidal ideation were similar: 2.4% for the EPDS and 2.31% for the linked dataset. Similar anxiety and panic estimates were found as well: "Generalised anxiety disorder" (anxiety disorders other than panic) was 1.9% in the EPDS, and 2.34% in the linked dataset; panic disorder was present at 1.8% in the EPDS and 1.58% in the linked dataset. The EPDS study identified high risk groups to be those who have

had past mental health issues and heavy combat exposure. They found that deployment duration and number of previous deployments had no relation with mental health problems.

A 2013 study⁷¹ reviewing medical records of 30 513 CAF personnel deployed to the mission in Afghanistan estimated that 13.5% had mental health problems which were linked to their deployment, over a median follow up of 1364 days. This study found that 8.9% of personnel were diagnosed with PTSD, 12.3% with any anxiety disorder, 8.4% with depressive disorder (8.8% with any mood disorder), and 19.0% with any mental disorder (including somatoform, adjustment, and substance-related disorders). Because these are clinical diagnoses (i.e., not positive-screens from self-report questionnaires) that accumulated over several years, these estimates of incidence are not directly comparable with this thesis' point estimates in the immediate post-deployment period.

A study on 77047 U.S. military personnel from 2001-2003 found a baseline SF-36 MCS score of 52.8.¹⁸⁵ This is similar to this thesis' average SF-36 MCS score of 50.3, which is also in keeping with the standard average of 50 set by the creators of the MCS.¹³³ A baseline average SF-36 MCS score for all active CAF was not found in the literature.

DRSE estimates of prevalence

Comparisons between the prevalence of deployment stressors in linked dataset to those measured in other studies are difficult due to differences in measurement, and exposure to deployment-related stressors depends on the country's role within the combat zone and the nature of the conflict. One study of the general EPDS population⁷⁶ used the identical deployment experiences

questionnaire used in the linked dataset. However, the EPDS study divided deployment stressors into tertiles (where the first tertile includes zero deployment stressors), whereas this thesis standardized cut-offs for numbers of exposures to enable comparisons between different deployment stressor variables.

ACE estimates of prevalence

The finding that 58.3% of those in the linked dataset experienced one or more ACEs is difficult to compare to other estimates of ACE in military and other populations, due to differences in the number of ACEs captured, the method of capture, and the type of military population studied (for example, veterans, or a sample of all active military personnel). The linked dataset contains a select population that has different characteristics than the general population of deployed personnel, from the general CAF population, and from veterans.

Afifi et al.'s⁵² study of the 2013 Canadian Forces Mental Health Survey (CFMHS) found that child abuse exposure (defined by physical abuse, IPV exposure, and/or sexual abuse) was prevalent among 47.7% in a sample of all CAF Regular Forces personnel, compared to 33.1% of the CGP. The linked dataset estimate is lower: this study estimated the prevalence of physical abuse, IPV exposure, and/or sexual abuse to be 20.3% (95% CI: 19.0%, 21.8%). Given the relationship between childhood adversity and mental disorders, it is possible that the lower prevalence of these childhood adversities in the linked dataset is related to the absence of detectable mental illness at the time of deployment resulting from pre-deployment screening.

A smaller study¹⁰¹ of 217 US Iraq and Afghanistan veterans (who did not respond to low-intensity PTSD treatment) included additional household dysfunction ACEs - including substance abuse in the family, parental divorce or separation, family mental illness, incarceration of family member, in addition to abuse and neglect - found that 83.4% of veterans reported at least one ACE. A relatively high prevalence of childhood adversity would be expected in a population that is resistant to conventional mental health treatment.¹⁸⁶ Another study examining sample of all U.S. veterans since 1973¹⁸⁷ found that 73.4% of men and 69.3% of women reported at least one ACE, including child abuse and household factors (household mental illness and substance use, parental separation or divorce, and incarcerated household member).

Physical abuse had a prevalence of 46.1% in Afifi et al.'s study⁵² (compared to 27.3% in the CGP), and Carroll et al.'s study¹⁰¹ of U.S. veterans found a prevalence of 35.5%, all of which are much higher than the prevalence of physical abuse in the linked dataset (16.5%). Afifi et al. estimated IPV to have a prevalence of 9.0% (compared to 8.6% in the CGP), and Carroll et al.'s study found a prevalence of 19.4%; while the prevalence in the linked dataset matches the CGP (8.6%). Sexual abuse was reported in 1.2-2.2% of Regular Forces in Afifi et al.'s study, depending on gender and household income, compared to 4.3-12.7% in the CGP (or 10.1% overall by another study in 2014 by Afifi et al.¹⁴), while Carroll et al.'s study found a prevalence of 16.1%. The linked dataset estimate lies in between, with 2.9% reporting sexual abuse.

Blosnich et al.'s study¹⁸⁷ of US veterans since 1973 found higher rates of household mental illness (27.5% for females, 23.3% for males) compared to the linked dataset (13.4%), household

alcohol abuse (33.9% for females, 34.3% for males, compared to 16.2% in the linked dataset), and IPV (26.5% for females, 27.3% for males, compared to 8.6% in the linked dataset).

Another study¹⁸⁸ of the CAF Regular Forces used an iterative proportional fitting procedure to examine the 2013 Canadian Forces Mental Health Survey (for CAF estimates) and the Canadian Community Health Survey-Mental Health (for CGP estimates), and this resulted in overall higher child abuse prevalence estimates from those found in Afifi et al.'s study⁵².

All ACEs occurred in isolation infrequently (see Figure 10); in particular, the novel ACEs of residential instability and adoption occurred the most often in isolation (20% and 16%, respectively), suggesting that they are less associated with other ACEs. Despite this, co-occurrence of these ACEs with other ACEs is much higher than co-occurrence of ACEs in the entire study population; 58% of the study population experienced one or more ACEs, however 80% of those who experienced residential instability and 84% of adoptees experienced at least one other ACE. Not being raised by parent(s) or grandparent(s) was concurrent with other ACEs in 95% of respondents. Such findings provide further support that residential instability and adoption are correctly classified as ACEs. The low frequency of isolated ACEs mirror findings of other ACE studies that ACEs are often concurrent with other ACEs.¹⁰⁶

B. Research question one: DRSE and mental health

The original summative deployment stressor variable derived from the EPDS deployment experiences questionnaire was significantly associated with poor mental health outcomes, both when analyzed as a scale variable and a categorical variable, mirroring the general findings of other studies.^{4,70,172,189} When the summative scale was divided into “distressing” and “contextual” scales, the effect of the universally distressing deployment stressors was isolated, producing the strongest associations with poor mental health across all outcomes; while the contextual variables were often not significant. Contextual deployment stressor scale variables produced non-significant protective point estimates for measures of association for SF-36 MCS, depression, suicidal ideation, and anxiety. However, one significant protective estimate was found for “very likely PTSD”, but only when analysed as a scale variable. Such findings support the theory that contextual deployment stressors are not necessarily traumatic, and they potentially provide an opportunity to develop coping strategies, gain skills of mastery, thereby increasing resilience (for example, via stress inoculation).¹⁷² In addition, contextual deployment stressors might also evoke feelings of job satisfaction for certain trades.

Categorical deployment stressor variables presented new trends in the case of PTSD. Mirroring the analysis of its scale version, stronger associations were found between all deployment stressor categories and “likely PTSD” than with “very likely PTSD” - only the high category was significantly associated with “very likely PTSD.” However, the different trend was found when the effect of distressing deployment stressors was isolated: point estimates of the risk for “very likely PTSD” was higher than the risk for “likely PTSD.” This difference was statistically significant in the case of the high category of “Distressing DRSE.” The implication is that the

experience of universally distressing deployment stressors puts one at higher risk for severe post-traumatic symptom presentations, but relatively lower risk for milder constellations of symptoms. On the other hand, contextual deployment stressors increase risk for milder post-traumatic symptom presentations, are not significantly associated with severe post-traumatic symptom presentations, and are possibly protective (when analysed as a scale variable).

In the case of SF-36 MCS, however, the low category of contextual deployment stressors significantly worsened mental health, whereas the medium and high categories had no association with mental health quality of life. The point estimates for all three categories were not significantly different from one another; nonetheless, it is possible that those who have experienced multiple types of contextual deployment stressors are exposed to these scenarios because of their role in the military, which they had prepared for and had expected, while those reporting a low level of contextual deployment stressors may unexpectedly have encountered these scenarios without the relevant preparation because of their intended role.

The odds ratios for depression, suicidal ideation and anxiety (other than panic) variables displayed similar trends with regards to deployment stressor scale variables. The original summative deployment stressor scale variable consistently had a positive association with screen-positive mental disorders, while distressing stressor scale associations were of a higher magnitude and contextual stressors were not significant. Suicidal ideation had the highest point estimate associations with distressing deployment stressors among mental health outcomes that used odds ratios, but were not significantly different from those of depression and anxiety (excluding panic).

Categorical variable analysis revealed that those reporting high amounts of all deployment stressors had increased odds of depression and anxiety ($p=0.044$), but not suicidal ideation. On the other hand, isolating the effect of distressing deployment stressors revealed positive associations with suicidal ideation with all three categories, and in fact, the highest AOR for all logistic models was found with the high category of distressing deployment stressors and suicidal ideation. Distressing deployment stressors were associated with all three outcomes, but only for the medium and high categories in the case of depression and anxiety (excluding panic disorder).

Conclusions

The deployment experiences scale typically used to measure stressful experiences during deployment is effective at demonstrating that such experiences are related to adverse mental health outcomes; however, separating out experiences that are distressing depending on their context from those that are universally distressful enable the characterization of this relationship to a higher level of detail. Universally distressing deployment experiences are very stressful for anyone who experiences them, regardless of their role in the military or the context of the scenario. Universally distressing deployment stressors uniquely pose the greatest risk for adverse mental health outcomes, whereas context-dependent deployment stressors are largely not significantly associated with adverse mental health outcomes and are possibly protective against more severe PTSD presentations. Low, medium, and high categories of distressing deployment stressors put one at higher risk for severe PTSD symptom constellations (“very likely” PTSD) compared to moderate PTSD symptom constellations (“likely PTSD”); whereas contextual

deployment stressors put one at higher risk for moderate symptoms compared to severe symptoms. The highest risk for dichotomous mental health outcomes was found for suicidal ideation, in those who report the highest levels of distressing scenarios.

In general, the more distressing deployment stressors reported, the higher the risk for poorer mental health quality of life, depression, suicidal ideation, and anxiety. Distressing deployment stressors are particularly highly distressing in part to the moral injury they typically foster, where one's beliefs about their own "goodness or the goodness of the world" have been violated.¹⁹⁰ Morally injurious scenarios involve transgressive acts that are grossly disturbing and violent, and preparation for such experiences would be problematic to achieve on a broad scale. Litz et al.⁸⁷ writes that "potentially morally injurious events, such as perpetrating, failing to prevent, or bearing witness to acts that transgress deeply held moral beliefs and expectations may be deleterious in the long-term, emotionally, psychologically, behaviorally, spiritually, and socially." A sense of helplessness and loss of control also have been found to contribute to high levels of guilt, which in turn have been demonstrated to lead to pathological levels of post-traumatic stress symptoms.^{191,192}

C. Research Objective 2: ACE and mental health

Childhood adversity significantly increased risk for poor mental health outcomes, and the higher the level of childhood adversity experienced, the stronger the association - mirroring findings of other ACE studies.^{5,22,23,52,101,123} Scale and categorical ACE variables produced consistent findings in this regard: point estimates of low, medium, and high categories of ACE variables linearly increased risk of poor mental health outcomes, with the exception of “likely PTSD” and anxiety (only for “ACE types”).

Low levels of childhood adversity were mildly associated, if at all, with poor mental health; three quarters of analyses of low categories of ACE variables were not statistically significant. The difference between low and high categories was statistically significant in many models (for example, SF-36 MCS, “ACE intensity” and “likely PTSD”, and half of depression models). As well, tests for polynomial models did not provide any evidence for stress inoculation. Such results do not support the stress inoculation hypothesis; rather, they provide evidence for stress sensitization, reproducing the findings of other studies.^{10,15,16,18,19,193,194}

The direction of the association between childhood adversity and mental health did not differ regardless of how childhood adversity was classified (whether by summing types or by incorporating intensity information; whether or not the additional household dysfunction variables were included; and, whether scale or categorical variables were used). The inclusion of the additional household and environmental ACEs produced estimates that were not significantly different from those produced by “Question 77” ACE variables. For most outcomes, the additional ACEs attenuated point estimates of associations; however, in anxiety and PTSD

models, the addition of these household dysfunction ACEs increased point estimates. These finding weakly suggest that the additional household and environmental ACEs might be more intricately linked with anxiety and PTSD psychopathology than with other mental health symptoms.

This study provides further detail on the relationship between childhood adversity and different levels of severity of post-traumatic symptoms. Using 30 and 50 cut-offs of the PCL-C screen for PTSD revealed that childhood adversity produces higher point estimates of risk for severe constellations of post-traumatic symptoms (“very likely” PTSD) compared to moderate constellations of post-traumatic symptoms (“likely” PTSD); however, these differences in point estimates were not statistically significant.

Conclusions

Childhood adversity is strongly associated with increased risk for all adverse mental health outcomes analysed in this thesis. The higher the level of childhood adversity experienced - whether tallied by the number of types experienced or by the intensity of adversity experienced - the higher the estimates of association with mental health outcomes. This study did not find any evidence for stress inoculation with low levels of childhood adversity; rather, the findings provide evidence for stress sensitization.

D. Research Objective 3: ACE-DRSE effect modification

Regression modelling using linked RHQ-EPDS dataset revealed that the number of childhood adversities experienced changes the relationship between stressful deployment experiences and mental health quality of life. This finding is in keeping with trends found in other international studies^{20–26,195} that, although not designed to test for multiplicative interaction, support the concept of vulnerability to poor mental health due to childhood adversity in deployed military personnel, and one cross-sectional study on CAF in 2002.⁵ Models specifically designed to test for effect modification of the association between deployment stressors and mental health by childhood adversity produced significant interaction terms, where the slope of the association between deployment stressors and mental health quality of life became more negative as values on the ACE scales increased. This suggests that the more childhood adversities experienced, the more pronounced the negative effect deployment stressors has on mental health, suggesting that stress sensitization occurred in the study population.

When the effect of distressing deployment stressors was isolated from the deployment experiences scale, stronger interactions terms resulted, suggesting that these stressors are superior in detecting the subjective traumatic experience of CAF members. Clinically significant changes in mental health quality of life - where emotional problems cause significantly more frequent psychological distress, and social and role disability¹²⁷- were predicted by this study's interaction models at relatively low levels of deployment stressors and childhood adversity. In context of the study population, the average number of distressing deployment stressors experienced was 3.6, and 58.3% of respondents reported experiencing at least one type of childhood adversity. When all other variables were held constant, the interaction model predicted

a clinically significant change of three points on the SF-36 MCS score with 4.6 distressing deployment stressors, in the absence of any childhood adversity. With one type of childhood adversity experienced and four types of distressing deployment stressors, the predicted change to the quality of life score is -3.191. These findings suggest that a large fraction of the study population experienced clinically significant changes in their mental health quality of life that were associated with highly distressing deployment experiences, whose effect was amplified by a history of childhood adversity.

In categorical ACE variable analysis, the high ACE category produced a significant negative change in the slope of deployment stressor scales, suggesting that, in particular, high levels of childhood adversity magnify the negative effect deployment stressors have on mental health quality of life. Likewise, models including categorical deployment stressors found that it is the medium and high levels of distressing deployment stressors that interact with high levels of childhood adversity. This interaction was larger in magnitude when distressing deployment stressors were tested: medium and high categories of “Distressing DRSE” yielded the largest negative effects. These findings are supportive of stress sensitization by childhood adversity in the study population.

The “Contextual DRSE” variable was often insignificant in interaction models (in one case, it was minimally protective, when scale distressing deployment stressor was tested for interaction with categorical ACE). When “Contextual DRSE” was analysed as a categorical variable, the low category had a significantly negative effect, which could be in part because low frequency of contextual scenarios might occur in those who are not trained for such circumstances. However,

the estimate for the low category was not significantly different from the medium and high categories, suggesting that overall, contextual deployment stressors have a negligible association with mental health when distressing stressors and childhood adversity are accounted for.

Significant interaction terms were found in depression and suicidal ideation models; ACE did not modify the association between DRSE and PTSD, nor between DRSE and anxiety. It is possible that this might have due to power concerns, the magnitude of interaction for these outcomes might be smaller and more difficult to detect.

Conclusions

Individuals with a history of childhood adversity are more susceptible to the negative mental health impacts of stressful experiences during deployment to a combat zone. The effect modification of the association between deployment stressors and mental health by childhood adversity is more profound when the effect of universally distressing deployment stressors is separated from deployment stressors that are context-dependent.

E. Strengths and Limitations

This thesis is one of the first prospective, longitudinal analyses of mental health in active CAF members post-deployment that considers the influence of ACEs.¹⁷ In addition to providing a stronger level of evidence than cross-sectional, retrospective studies can offer, this study avoids memory bias toward mood-congruent material. The collection of ACE data was collected at recruitment and as such, it predated deployment-related stress and mental health post-deployment; therefore, deployment stressors and mental health outcomes could not have exerted any influence on respondents' recollection of ACEs.¹⁹⁶ In addition, ACE data collected at recruitment reduced recall bias in comparison to cross-sectional studies. Although severe abuse tends to be remembered and reported well, and false positive reports are rare, less severe ACEs tend to be underreported.¹⁹⁷ The study design also allowed pre-recruitment lifestyle confounders to be accounted for, which would be difficult to achieve in a cross-sectional study.

A major strength of this study is that its primary outcome is mental health quality of life, an outcome not often considered in military mental health research. The SF-36 MCS can be thought of as a measure of general mental health status that takes into account physical, mental, and social dimensions of life.^{128,198} SF-36 MCS results consistently mirrored those for clinical mental illnesses, such as PTSD, depression, and anxiety. Additionally, the use of SF-36 MCS enables comparisons with other quality of life studies, opens up interpretations for social relevance of differences in health status and outcomes, and it can help facilitate future research in health economic evaluation because it allows for the estimation of costs.¹⁹⁹ This study's findings are in keeping with other quality of life studies done on military populations that found deployment factors to have a negative influence.^{199,200}

Due to the way in which the linked-dataset was created, there is an overrepresentation of combat arms in the study population compared to all military personnel deployed in support of the mission in Afghanistan. Given that this particular subgroup is known to be at highest risk for mental illnesses after deployment⁷⁶, this study provides insight into important risk factors for this high risk group.

This study captures three household dysfunction and psychologically distressing ACEs (residential instability, non-linear kinship guardianship, and adoption), which have been considered by other ACE studies^{8,96,97}, but not in military studies. Ideally, ACE researchers aim to account for as many ACEs within their studies as possible, as the broadest representation of ACEs within a study results in the least biased estimates of association.^{90,120} Other commonly used questionnaires, such as the Children's Trauma Questionnaire, contain more detailed neglect and family dysfunction questions, such as divorce, and other sources of chronic low grade stressors in the home (such as tension or conflict between parents, yelling/swearing, spanking, and parental modelling of lack of resilience).^{10,201,202} RHQ variables on parental death during childhood could not be used because they had been inputted incorrectly in early years during the data entry stage, such that responses were indecipherable. In addition, this thesis could not control for other lifetime trauma – such data existed within the dataset but could not be released due to confidentiality concerns. For example, occurrence of sexual assault either during deployment or during active military service was not accounted for, although sexual assault has been reported as higher in the CAF than the Canadian general population.^{203,204}

The depth of the RHQ data allowed not only for tallying of eleven types of ACEs, but it also allowed for the creation of a unique ACE severity scale that accounted for frequency or intensity of seven ACEs (and weighted the remaining four ACEs). A higher level of detail was captured in the “ACE intensity” scales, allowing for more nuanced findings. ACE severity results overall mirrored results using variables that tallied the number of ACEs.

The “deployment experiences” questionnaire in the EPDS is a relatively large collection of commonly reported deployment stressors in comparison to many other studies of military populations^{56,58,63,199,205–208}, and thus it is a broad representation of potentially traumatic experiences during deployment. This thesis uniquely isolated the effect of those deployment stressors that are universally distressing regardless of one’s role in the military, while also accounting for other deployment-related experiences that can possibly be stressful, depending on one’s training and expectations. To identify universally disturbing scenarios, validators used clinical, qualitative (real-life experiences), and theoretical understanding of the psychological mechanisms behind reactions to traumatic exposures to inform their choices (in particular, the concept of moral injury was raised). There was high agreement among validators; an advantage of this study was the availability of highly qualified validators, with known insight into the experiences of combat arms CAF members in Kandahar through their mental health, clinical, and/or military work. Nonetheless, future research could consider techniques such as factor analysis and propensity scores to elucidate the interrelatedness and groupings of the scenarios in the deployment experiences questionnaire within the EPDS in relation to mental health outcomes.

A strength of this study is that it provides risk association measures for a range of mental health outcomes that are relevant to military organizations, mental health researchers, and health economists, using validated and reliable scales that are commonly used. The EPDS data enabled the comparison of PTSD and depression using three different scoring methods.^{126,127,129,136,137,148} Due to the variety of types of outcome variables, it was necessary to use different estimates of association in regression modelling. Direct comparisons of magnitude were not possible; i.e., the magnitudes of beta coefficients, relative risk ratios, and odds ratios cannot be directly compared. Nonetheless, there was broad agreement among patterns of statistical significance. Odds ratios were directly compared for depression, suicidal ideation, and anxiety disorders (other than panic).

Most respondents submitted their filled EPDS questionnaire within three to six months, and 97% within a year. Depending on when exactly the EPDS was completed, many mental disorders may not have had time to develop and meet diagnostic criteria (for example, PTSD), while others may have already resolved or would resolve shortly afterwards, with or without treatment (for example, Acute Stress Disorder¹⁴⁵). On the other hand, a strength of the EPDS is that it minimizes recall bias²⁰⁹ by screening for mental disorders in the immediate time period following deployment.

Although questionnaires used in this study are highly reliable, they are subject to bias by nature of being self-reports of symptoms; for example, the EPDS questionnaire did not screen with psychiatric diagnostic interviews. Also, in either case, symptoms commonly understood to be signs of poor mental health are typically prone to underreporting in active military populations,

due to pervasive stigma in military culture.⁵¹ Such sources of bias would attenuate estimates of association.

This study cannot definitively report whether the exposure (deployment-related stress) preceded mental health outcomes. However, those who are deployed are a select population that has been deemed mentally and physically fit for deployment after yearly screening and final pre-deployment screening. Common reasons not to be deployed due to yearly screening include musculoskeletal injury and mental health issues. In the time period preceding deployment, personnel are again screened based on more detailed medical standards, among other items such as standards of training.¹⁸³ Active mental disorders that noticeably affect one's ability to perform well in one's duties would preclude deployment; by definition, in order to meet diagnostic criteria for most mental disorders, a degree of functional impairment must occur.¹⁴⁵ The population selected for deployment are therefore less likely to suffer from clinically significant symptoms of mental disorders, and therefore can be considered a resilient subpopulation of the CAF. In addition, military service itself is theorized to increase resilience, despite having higher proportions of personnel reporting childhood adversities compared to the general population.^{52,103} Estimates of association between exposures and poor mental health outcomes are thus likely to be attenuated by negative bias due to selection of a resilient population.

The study population size of the linked database was moderate: 3302 respondents were included in final analyses. Panic disorder was dropped as an outcome due to low numbers of positive screens. Categorical by categorical interactions were not possible to calculate in the case of most categorical and dichotomous outcomes.

An advantageous feature of the linked dataset is that both questionnaires were censuses, rather than samples of the population, thus the study avoids sampling bias. Nonetheless, non-response bias remained an issue: an undetermined proportion of those who returned home from the mission in Afghanistan in time to submit their EPDS 2008-2011 and who were also recruited since 2003 chose not to complete the RHQ or EPDS for unspecified reasons. The response rate relevant to this study would be the proportion of CAF members who participated after being eligible for both questionnaires in the correct time frame. This rate could not be calculated because EDPS service numbers were linked to RHQ data to create the linked dataset: because the database was created from those who completed both the EPDS and RHQ, it was not possible to ascertain the number of recruits who did not participate in the RHQ and/or the EPDS despite being recruited since 2003 and returning home from deployment in the right time frame.

Using the overall completion rate of the RHQ of 70-75% underestimates RHQ-EPDS participation rate, because it includes individuals outside of the target study population that were less likely to participate in the RHQ - including those who failed basic military training⁷⁹, left the military early, and were not selected for deployment (see Figure 2). Therefore, the RHQ response rate of the linked dataset cohort is likely higher than that estimated by overall response RHQ response rate.

Similarly, RHQ-EPDS respondents differ from the general EPDS population. The general EPDS population includes deployed CAF members who were recruited before 2003 who were never offered the RHQ. As shown in Table 5, the linked dataset study cohort was younger (91% the

linked dataset respondents were 35 years of age and under, compared to 63.2% of the general EPDS population) and in the earlier stages of their careers (78% served 5 years or less, compared to 32.4% in the general EPDS).⁷⁶ Linked dataset respondents were more likely to work on ground outside of the protection of the base: 88% of linked dataset respondents were in the Army (as opposed to the Navy or Air Force), while Army personnel comprised 79.6% of the general EPDS population, and 50% of all active CAF.^{76,183} 9.7% of linked dataset respondents were officers, versus 14.4% in the general EPDS population and 24.8% in all active CAF (for the most part, officers have received post-secondary education and are less likely to work outside of the base). The dataset contained a higher proportion of single personnel (54.7% versus 36.9% of the general EPDS population, and 22.1% of all active CAF).^{76,183} A lower proportion of widowed/divorced/separated personnel was contained in the linked dataset (4.2% versus 7.6% in the general EPDS population, and 9.3% in all active CAF).^{76,183}

These demographic differences are in keeping with expected characteristics of a relatively young cohort of CAF who are in the early stages of their careers, the majority of which who were NCM combat arms who worked outside of the protection of the base while deployed on the mission in Afghanistan. As such, their EPDS participation rate might be different from the general EPDS participation rate.

The results of this study can be used to inform Canadian and other similar military organizations about risk factors for poor mental health outcomes in military personnel deployed to combat zones. Although the results of this study are generalizable to other military populations that do not screen for current and past history of chronic mental health issues, it is not generalizable to

the general population or to militaries whose structures differ significantly from that of the Canadian Armed Forces. The linked dataset study population differs from the Canadian general public (CGP) in that females were underrepresented (9.6% compared to 50.4% in the CGP²¹⁰, and 13.4% in the CAF¹⁸³); there was a higher proportion of French respondents (36.6% versus 22% in the CGP²¹¹, and 28.2% in the CAF¹⁸³); smoking rates were higher at recruitment (23.8% compared to 14.6% in the CGP²¹² (17.9% and 18.5% for age groups 20-24 and 25-34, respectively)), but similar to CAF Regular Forces (23.0% in 2008/9); obesity rates at recruitment were lower (7.0% compared to 26.4% in the CGP²¹² (21.1% for those aged 18-34), and 25% in the CAF in 2013/2014¹⁸³); physical activity rates at recruitment were higher (61.8% were active compared to 22.2% in the CGP²¹²), but lower than in CAF Regular Forces due to fitness requirements (78.7% in 2008/9); and respondents had higher rates of high school completion at recruitment (17.9% compared to 12.8% in the CGP²¹²).

Implications

An increased understanding of the risk factors for poor mental health among military personnel and how they interact can help military organizations to improve mental health promotion and mental illness prevention in high risk groups. The CAF has devoted considerable resources over the last fifteen years to improve preparation of personnel for the stresses faced during deployment, improve prevention and treatment of mental health issues, and remove barriers to treatment.^{77,213,214} The Road to Mental Readiness training program²¹⁵ embeds extensive resilience and mental health training throughout individuals' careers and includes destigmatization efforts. Treatment services have been augmented, for example, through increasing the number of mental health providers and making available multidisciplinary centres for assessment and treatment of mental health issues related to military service. Adjustments have been made to increase the likelihood that those who are on modified duties on account of mental health issues will stay in the military and qualify for later deployment safely.

In addition to the personal suffering of military personnel and their families, poor mental health among military staff poses a broad range of difficulties for military organizations. For example, the safety and success of military operations can hinge on having mentally healthy military personnel.^{71,216} In addition, military organizations are responsible for providing health care to their population; not only do growing mental health needs of the military population place an increased burden on the military health care system, but the increased physical health problems that are often comorbid with mental illnesses also need to be taken into account.^{217,218,214}

From a utilitarian perspective, military organizations also gain from a mentally healthy workforce through increased productivity²¹⁹, and reduced absenteeism²²⁰ and turnover.^{71,217} Poor mental health has been shown to have an impact on military occupational fitness, impacting attrition and medical release, for example. Those who have mental disorders that persistently impact their ability to meet the military's stringent fitness standards can result in release from service for medical reasons.⁷⁷ Such personnel are a lost resource to the military and potentially generate costs to Veteran Affairs Canada through increased needs for health services and benefits.

This thesis is an important step towards identifying those at greatest risk of developing mental health issues and contributes to scientific understanding of resilience, as well as informing the design and validation of resilience-building interventions. For example, in the Road to Mental Readiness training program, stress management training could be optimized to encourage CAF members to become self-aware of personal risk factors, notably childhood adversity, and the steps they can take to help mitigate these risks. Resiliency interventions could be developed for those who self-identify as having had childhood adversity - given the high prevalence of childhood adversity, such interventions could be offered universally, and in doing so, this would avoid potential marginalization and stigmatization.

In addition, there is potential for modification of the de-briefing process and post-deployment screening with the knowledge that childhood adversities amplify the negative effect deployment stressors have on mental health. The evidence provided in this thesis can help inform policies that support military personnel to have better self-awareness regarding the impact of childhood

adversity on risk for mental health problems, with corresponding mental health promotion strategies and services. On an individual level, it is often the case in military culture that one's sense of self-worth and identity are damaged if one acknowledges they are experiencing mental health issue^{143,144}; awareness that childhood adversities may have affected their resilience could possibly shift blame from the internal to external, and awareness that successful treatments exist for such issues can provide hope. Dissemination of such knowledge might possibly aid in destigmatization of mental health issues in the military.

The findings of this thesis can also be applied in the clinical treatment setting, by providing evidence about the prevalence and impact of childhood adversities in those returning from deployment to combat zones. Psychotherapeutic interventions for active CAF members and veterans, such as cognitive behavioural therapy^{221,222}, have potential to be optimized to take into account the high prevalence and impact of childhood adversities in those presenting with poor mental health post-deployment. For example, in cognitive behavioural therapy, examination of childhood adversities can help patients modify maladaptive beliefs about themselves²²³, which has known therapeutic value in the treatment of many types of mental health issues.²²⁴

APPENDIX A: EPDS – “Deployment Experiences” Questionnaire

Respondents are asked, “During your most recent deployment, did you experience:”, and can respond “No” or “Yes” to:

1. Being attacked or ambushed
2. Receiving small arms fire
3. Seeing dead bodies or human remains
4. Handling or uncovering human remains
5. Witnessing an accident which resulted in serious injury or death
6. Seeing dead or seriously injured Canadians
7. Knowing someone seriously injured or killed
8. Improvised explosive device (IED)/booby trap exploded near you
9. Working in areas that were mined or had IEDs
10. Having hostile reactions from civilians
11. Being in threatening situations where you were unable to respond because of rules of engagement
12. Shooting or directing fire at the enemy
13. Calling in fire on the enemy
14. Engaging in hand-to-hand combat
15. Clearing/searching homes or buildings
16. Clearing/searching caves or bunkers
17. Being wounded/injured
18. Seeing ill/injured women or children who you were unable to help
19. Receiving incoming artillery, rocket, or mortar fire
20. Feeling directly responsible for the death of an enemy combatant
21. Feeling directly responsible for the death of a non-combatant
22. Witnessing a friendly fire incident
23. Feeling responsible for the death of Canadian or ally personnel
24. Having a member of your own unit become a casualty
25. Had a close call, was shot or hit but protective gear saved you
26. Had a buddy shot or hit who was near you
27. Having difficulty distinguishing between combatants and noncombatants
28. Participating in IED/mine clearing
29. Sniper fire
30. Seeing a unit member blown up or burned alive

APPENDIX B: ACE questions in the RHQ

11. Were you mostly raised by: Two parents, one parent, grandparent or grandparents, other relatives, foster parents or guardians, **in a group home or institution**, Other

12. Were you adopted as a child? Yes/No/Don't Know

15. Is the father (or significant male) who raised you alive? Yes/**No, he died before I was 10 years old/ No, he died when I was 10 years or older/Don't know**

17. Is the mother (or significant female) who raised you alive? Yes/**No, she died before I was 10 years old/ No, she died when I was 10 years or older/Don't know**

18. Have your biological mother or father ever had: **f. alcohol/drug problems**

19. Was your biological mother or father ever diagnosed with mental or emotional problems? (Yes/No/Don't Know)

20. Check which of the following was (were) the cause(s) of the problem? (Select all that apply.) Depression/Anxiety/Manic-Depressive Illness/Schizophrenia/Other/Don't Know

70. Where did you live most of the time as a child? **Moved around a lot to different communities**

77) The following are statements about you when you were growing up, before you were 17 years old. Please choose the ONE answer that comes closest to the way you felt.

- a) There was someone to take care of you and protect you. (Never true, Rarely true, Sometimes true, Often true, Very often true)
- b) You felt loved. (Never true, Rarely true, Sometimes true, Often true, Very often true)
- c) How often did a parent or adult living in your home swear at you, insult you, or put you down? (Never, Once/twice, Sometimes, Often, Very Often)
- d) How often did a parent or other adult living in your home push, grab, shove, slap, or throw something at you? (Never, Once/twice, Sometimes, Often, Very Often)
- e) How often did a parent or other adult living in your home push, grab, shove, slap, or throw something at each other? (Never, Once/twice, Sometimes, Often, Very Often)
- f) How often did an adult ever touch you sexually or try to make you touch them sexually? (Never, Once/twice, Sometimes, Often, Very Often)
- g) Did you live with someone who was depressed or mentally ill? (Yes, No)
- h) Did you live with someone who was a problem drinker or alcoholic? (Yes, No)

78) Did any of the following events EVER happen to you? (FILL IN YES OR NO)

- a) You were in an accident where you could have been killed but were not badly hurt.
- b) You were in an accident where you were injured and had to spend at least one night in the hospital.
- c) You saw a close family member or friend being badly injured or killed.
- d) You saw a stranger being badly injured or killed.

- e) You were seriously attacked, beaten up, or assaulted.
- f) You were threatened with a knife, gun, club, or other weapon.
- g) You were raped (someone forced you to have sex when you did not want them to).

APPENDIX C: EPDS – PCL-C PTSD screen

The EPDS PCL-C preamble states: “Below is a list of problems and complaints that service members and veterans sometimes have in response to stressful life experiences. Please read each one carefully, put an “X” in the box to indicate how much you have been bothered by that problem in the last month.”

Participants can respond: “Not at all”; “A little bit”; “Moderately”; “Quite a bit”; “Extremely” to:

1. Repeated, disturbing memories, thoughts, or images of a stressful experience from the past?
 2. Repeated, disturbing dreams of a stressful experience from the past?
 3. Suddenly acting or feeling as if a stressful experience were happening again (as if you were reliving it)?
 4. Feeling very upset when something reminded you of a stressful experience from the past?
 5. Having physical reactions (e.g., heart pounding, trouble breathing, or sweating) when something reminded you of a stressful experience from the past?
 6. Avoid thinking about or talking about a stressful experience from the past or avoid having feelings related to it?
 7. Avoid activities or situations because they remind you of a stressful experience from the past?
 8. Trouble remembering important parts of a stressful experience from the past?
 9. Loss of interest in things that you used to enjoy?
 10. Feeling distant or cut off from other people?
 11. Feeling emotionally numb or being unable to have loving feelings for those close to you?
 12. Feeling as if your future will somehow be cut short?
 13. Trouble falling or staying asleep?
 14. Feeling irritable or having angry outbursts?
 15. Having difficulty concentrating?
 16. Being "super alert" or watchful or on guard?
 17. Feeling jumpy or easily startled?
18. Did the stressful experience(s) in the past that you referred to above occur ... (check all that apply if you were referring to more than one stressful experience):
- a) As part of your private life (meaning prior to military service or while off duty).
 - b) As part of your military service while deployed
 - c) As part of your military service while on duty and not deployed.
 - d) Not applicable (no stressful experiences).

APPENDIX D: EPDS – PHQ-9 Depression Screen

2. Over the last 2 weeks, how often have you been bothered by any of the following problems?
- a) Little interest or pleasure in doing things
 - b) Feeling down, depressed, or hopeless
 - c) Trouble falling or staying asleep, or sleeping too much
 - d) Feeling tired or having little energy
 - e) Poor appetite or overeating
 - f) Feeling bad about yourself, or that you are a failure, or have let yourself or your family down
 - g) Trouble concentrating on things, such as reading the newspaper or watching television
 - h) Moving or speaking so slowly that other people could have noticed. Or the opposite, being so fidgety and restless that you have been moving around a lot more than usual.
 - i) Thoughts that you would be better off dead, or of hurting yourself in some way

Respondents may choose one of the following 4 categories:

- 1. Not at all
- 2. Several days
- 3. More than half the days
- 4. Nearly every day

APPENDIX E: EPDS – PHQ-9 Anxiety Screen

Respondents are asked: “Over the last 4 weeks, how often have you been bothered by any of the following problems?” There is a list of 7 items to which they may respond, “Not at all”, “Several days”, and “More than half the days”:

1. “Feeling nervous, anxious, on edge, or worrying a lot about different things
2. Feeling restless so that it is hard to sit still.
3. Getting tired very easily.
4. Muscle tension, aches, or soreness.
5. Trouble falling asleep or staying asleep.
6. Trouble concentrating on things, such as reading a book or watching TV.
7. Becoming easily annoyed or irritable”

APPENDIX F: EPDS – PHQ-9 Panic Screen

Questions about anxiety

- a. In the last 4 weeks, have you had an anxiety attack - suddenly feeling fear or panic?

Yes/No If you checked "NO", go to question [#3].

- b. Has this ever [to you] happened before?

Yes/No

- c. Do some of these attacks come suddenly out of the blue - that is, in situations where you don't expect to be nervous or uncomfortable?

Yes/No

- d. Do these attacks bother you a lot or are you worried about having another attack?

Yes/No

2. Think about your last bad anxiety attack.

- a. Were you short of breath?

Yes/No

- b. Did your heart race, pound, or skip?

Yes/No

- c. Did you have chest pain or pressure?

Yes/No

- d. Did you sweat?

Yes/No

- e. Did you feel as if you were choking?

Yes/No

- f. Did you have hot flashes or chills?

Yes/No

- g. Did you have nausea, an upset stomach, or the feeling that you were going to have diarrhea?

Yes/No

- h. Did you feel dizzy, unsteady, or faint?

Yes/No

- i. Did you have tingling or numbness in parts of your body?

Yes/No

- j. Did you tremble or shake?

Yes/No

- k. Were you afraid you were dying?

Yes/No

APPENDIX G: Possible confounders

Table 24: Linked dataset potential confounder questions

Confounder	Data Source	Question	Possible Responses
Age	EPDS	Age	Number
Deployment length	EPDS DEMOGRAPHIC 5	Length of recent deployment	Less than 2 months 2-5 months 6-8 months 9 months or more
Duty Status	EPDS DEMOGRAPHIC 2	Duty Status	Regular Reserves Civilian
Element	EPDS DEMOGRAPHIC 1	Branch of Service	Land Sea Air Civilian
Father's Education	RHQ 14	How far did the father (or significant male) who raised you go in school?	Some primary school Completed primary school Some secondary or high school Completed secondary or high school Some community/tech college/CEGEP Completed community/tech college/CEGEP Some university courses Completed university degree Don't know Not applicable
History of Sexually Transmitted disease	RHQ 76	Have you ever been told by a doctor or nurse that you had a sexually transmitted disease (STD) – like Chlamydia, gonorrhea, genital herpes, or syphilis?	No Yes Don't know
Language	EPDS DEMOGRAPHIC 11	Language	English French Other
Marital Status	EPDS DEMOGRAPHIC 6	Marital Status	Married/living with partner Divorced Single (never married) Separated Widowed
Mother's Education	RHQ 16	How far did the mother (or significant female) who raised you go in school?	Some primary school Completed primary school Some secondary or high school Completed secondary or high school Some community/tech college/CEGEP Completed community/tech college/CEGEP Some university courses Completed university degree Don't know Not applicable
Number of Children	EPDS DEMOGRAPHIC 7	No. dependent children	Number
Number of Previous Deployments	EPDS DEMOGRAPHIC 4	Number of previous deployments	Number

Obesity	RHQ 39 &40 &41	39: Height 40: Weight 41: Do you consider yourself	Number Number Overweight Underweight Just about right
Physical Activity	RHQ 42	In the three months prior to the start of recruit training, did you participate in any of the following activities? If yes, how many times did you participate, and how much time on average did you spend on each occasion?	?
Place of Birth	RHQ 69	Where were you born?	Canada US British Isles Western Europe Eastern Europe Central/South America Caribbean Asia Africa Other
Rank	EPDS	Rank	Non-commissioned candidates Officer candidates
Sex	EPDS DEMOGRAPHIC 10	Sex	Male Female
Sleep at recruitment	RHQ 9	Past year: trouble going to sleep or staying asleep	Most of the time Sometimes Never
Smoking Status	RHQ 25	What is your current smoking status?	Never smoked Ex-smoker Current smoker
Social support at recruitment	RHQ 59	Prior to joining the military, about how many close friends and close relatives did you have, that is people you felt at ease with and can talk to about what was on your mind?	Number
	RHQ 60	People sometimes look to others for companionship, assistance, or other types of support. How often is each of the following kinds of support available to you if you need it?	19 item Social Support Scale: Items are summed to create four subscales of social support: 1. affection (0-12) 2. emotional or informational (0-32) 3. positive social interaction (16) 4. tangible support (0-16)
Years of military service	EPDS DEMOGRAPHIC 3	Number of years with military	Years and Months

APPENDIX H: References supporting confounder selection

Table 25: Confounder literature review

Covariate	Reference
Language	Bachynski et al. (2012) ²²⁵ ; Black et al (2004) ⁶⁷ ; Buckman et al. (2013) ²²⁶ ; Interian et al (2014) ²²⁷ ; Jordan et al. (1991) ⁶⁵ ; Kaplan et al. (2007) ²²⁸ ; Lapierre et al. (2007) ²²⁹ ; LeardMann et al. (2013) ²³⁰ ; McLaughlin et al. (2010) ¹⁰ ; Reger et al. (2015) ²³¹ ; Riddle et al. (2007) ²¹⁹ ; Sareen et al. (2007) ⁵⁵ ; Schoenbaum et al. (2014) ²³² ; Smith et al (2007) ¹⁸⁵ ; Wells et al. (2010) ⁶⁹
Sex	Bachynski et al. (2012) ²²⁵ ; Black et al (2004) ⁶⁷ ; Buckman et al. 2013 ²²⁶ ; Erickson et al. (2014) ²³³ ; Hoge et al. (2006) ⁵⁶ ; Jordan et al. (1991) ⁶⁵ ; Kaplan et al. (2007) ²²⁸ ; Lapierre et al. (2007) ²²⁹ ; LeardMann et al. (2013) ²³⁰ ; Macera et al. (2014) ²³⁴ ; McLaughlin et al. (2010) ¹⁰ ; Reger et al. (2015) ²³¹ ; Riddle et al. (2007) ²¹⁹ ; Sareen (2014) ²³⁵ ; Sareen et al. (2007) ⁵⁵ ; Schoenbaum et al. (2014) ²³² ; Smith et al. (2007) ¹⁸⁵
Mother's education	Springer et al. (2007) ¹⁶⁷
Smoking status	Black et al (2004) ⁶⁷ ; Goodwin et al (2013) ²³⁶ ; Lu et al. (2008) ²³⁷ ; Rasmusson et al. (2006) ²³⁸ ; Roy-Byrne et al. (2006) ²³⁹ ; Smith et al. (2008) ²⁴⁰ ; Wells et al. (2010) ⁶⁹ ; Zvolensky et al. (2005) ²⁴¹
Body-Mass Index (BMI)	Gariepy et al (2010) ²⁴² ; Kaplan et al. (2007) ²²⁸ ; Petry et al. (2008) ²⁴³ ; Scott et al. (2008) ²⁴⁴
Physical activity	Kaplan et al. (2007) ²²⁸ ; LeardMann et al. (2011) ²⁴⁵ ; Penedo & Dahn (2005) ²⁴⁶
Sleep problems	Bryant et al (2010) ²⁴⁷ ; Ford & Kamerow (1989) ²⁴⁸ ; Gehrman et al. (2013) ²⁴⁹ ; Mellman et al. (1995) ²⁵⁰ ; Richardson et al. (2014) ²⁵¹
Social support	Hobfoll et al. (2008) ²⁵² ; Interian et al. (2014) ²²⁷ ; Langhinrichsen-Rohling et al. (2011) ²⁵³ ; Lusk et al. (2015) ²⁵⁴ ; Maguen et al. (2008) ²⁵⁵ ; Nelson et al. (2011) ⁵¹ ; Pietrzak et al. (2010) ²⁵⁶ ; Vogt et al. (2011) ²⁵⁷
Education	Interian et al. (2014) ²²⁷ ; Smith et al. (2007) ¹⁸⁵
Risky sexual behaviour	Felitti et al. (1998) ⁹⁰ ; Repetti et al. (2002) ¹⁷¹
Parental Status	Hopkins-Chadwick & Ryan-Wenger (2009) ²⁵⁸ ; Interian et al. (2014) ²²⁷ ; Janke-Stredronsky et al. (2016) ²⁵⁹ ; Kaplan et al. (2007) ²²⁸ ; Klose & Jacobi (2004) ²⁶⁰ ; Langhinrichsen-Rohling et al. (2011) ²⁵³ ; Lapierre et al. (2007) ²²⁹ ; Maguen et al. (2008) ²⁵⁵ ; Schoenbaum et al. (2014) ²³²
Marital status	Black et al. (2004) ⁶⁷ ; Hoge et al. (2006) ⁵⁶ ; Interian et al. (2014) ²²⁷ ; Kaplan et al. (2007) ²²⁸ ; Lapierre et al. (2007) ²²⁹ ; LeardMann et al. (2013) ²³⁰ ; Reger et al. (2015) ²³¹ ; Riddle et al. (2007) ²¹⁹ ; Sareen (2014) ²³⁵ ; Sareen et al. (2007) ⁵⁵ ; Schoenbaum et al. (2014) ²³² ; Smith et al. (2007) ¹⁸⁵ ; Wells et al. (2010) ⁶⁹
Years in the military	Langhinrichsen-Rohling et al. (2011) ²⁵³ ; Lapierre et al. (2007) ²²⁹ ; LeardMann et al. (2013) ²³⁰ ; Reger et al. (2015) ²³¹ ; Riddle et al. (2007) ²¹⁹ ; Schoenbaum et al. (2014) ²³² ; Smith et al. (2007) ¹⁸⁵
Branch	Black et al. (2004) ⁶⁷ ; Hoge et al. (2006) ⁵⁶ ; LeardMann et al. (2013) ²³⁰ ; Macera et al. (2014) ²³⁴ ; Reger et al. (2015) ²³¹ ; Riddle et al. (2007) ²¹⁹ ; Smith et al. (2007) ¹⁸⁵ ; Wells et al. (2010) ⁶⁹
Rank	Black et al. (2004) ⁶⁷ ; Hoge et al. (2006) ⁵⁶ ; Interian et al. (2014) ²²⁷ ; Lapierre et al. (2007) ²²⁹ ; LeardMann et al. (2013) ²³⁰ ; Macera et al. (2014) ²³⁴ ; Reger et al. (2015) ²³¹ ; Riddle et al. (2007) ²¹⁹ ; Sareen et al. (2007) ⁵⁵ ; Schoenbaum et al. (2014) ²³² ; Smith et al. (2007) ¹⁸⁵ ; Wells et al. (2010) ⁶⁹
Deployment length	Adler et al. (2005) ¹⁷² ; Interian et al. (2014) ²²⁷ ; LeardMann et al. (2013) ²³⁰ ; Lusk et al. (2015) ²⁵⁴ ; Macera et al. (2014) ²³⁴ ; Maguen et al. (2008) ²⁵⁵ ; Schoenbaum et al. (2014) ²³² ; Wells et al. (2010) ⁶⁹
Age post-deployment	Black et al. (2004) ⁶⁷ ; Bachynski et al. (2012) ²²⁵ ; Buckman et al. (2013) ²²⁶ ; Hoge et al. (2006) ⁵⁶ ; Jordan et al. (1991) ⁶⁵ ; Kaplan et al. (2007) ²²⁸ ; Lapierre et al. (2007) ²²⁹ ; LeardMann et al. (2013) ²³⁰ ; Macera et al. (2014) ²³⁴ ; McLaughlin et al. (2010) ¹⁰ ; Reger et al. (2015) ²³¹ ; Riddle et al. (2007) ²¹⁹ ; Sareen (2014) ²³⁵ ; Sareen et al. (2007) ⁵⁵ ; Schoenbaum et al. (2014) ²³² ; Smith et al. (2007) ¹⁸⁵ ; Wells et al. (2010) ⁶⁹

APPENDIX I: Analysis of missing PCL-C data

Two PTSD variables were provided without documentation of their computation:

1. “pclscore”: the sum of values from 17 PCL-C items
2. “pcldiagD”: a “yes/no” variable indicating whether or not someone has probable PTSD based on a 50 cut-off

There were 10 missing “pcldiagD” respondents. However, there were a total of 135 respondents who had one or more missing PCL items. 114 “pcldiagD” respondents with one missing PCL item were not labelled as missing; nine respondents missing 2-4 items were also not labelled as missing; one respondent missing 7 PCL items was counted as missing, yet another respondent with 8 missing PCL items was labelled as a negative screen.

There were 11 missing “pcldiagD” values: there is no discernable pattern to how these were labelled as missing, as shown in Table AI:

Table 26: “pcldiagD” missing values

PCL score	#missing values	Possible missed positive screen
0	17	Unknown
0	17	Unknown
0	17	Unknown
0	17	Unknown
21	7	Possible at 30 cut-off
46	1 (pclcq3)	Yes
46	1 (pclcq3)	Yes
46	1 (pclcq9)	Yes
47	1 (pclcq9)	Yes
47	1 (pclcq15)	Yes
48	1 (pclcq17)	Yes

There were six respondents that were coded as missing in “pcldiagD” that were very close to the 50 cut-off and were potentially missed positive screens.

Given the unknown methods used in the creation of “pcldiagD”, PTSD variables were scored as described in the [Statistical Methods – Treatment of Missing Data](#) section of this thesis.

APPENDIX J: Full models of scale “All DRSE” association with each mental health outcome

Table 27: Scale “All DRSE” and SF-36 MCS (linear regression models 1-4)

		Model 1	Model 2	Model 3	Model 4
DRSE scale		-0.238*** [-0.288,-0.189]	-0.276*** [-0.331,-0.222]	-0.282*** [-0.338,-0.226]	-0.291*** [-0.351,-0.232]
Language	English (base)				
	French		1.413*** [0.692,2.134]	1.347*** [0.605,2.090]	1.339*** [0.592,2.087]
Sex	Male (base)				
	Female		-3.472*** [-4.680,-2.264]	-3.840*** [-5.093,-2.587]	-3.793*** [-5.094,-2.493]
Mother's Education	No high school (base)				
	High school complete		1.131* [0.229,2.034]	1.037* [0.119,1.955]	0.885 [-0.039,1.809]
	Post-secondary complete		0.363 [-0.601,1.327]	0.239 [-0.746,1.224]	-0.049 [-1.050,0.953]
Smoking status	Never smoked (base)				
	Ex-smoker			-0.946* [-1.848,-0.045]	-0.591 [-1.505,0.324]
	Current smoker			-0.75 [-1.629,0.129]	-0.408 [-1.302,0.486]
BMI	Normal/underweight (base)				
	Overweight			-0.224 [-0.990,0.542]	-0.032 [-0.805,0.741]
	Obese			-2.153** [-3.546,-0.760]	-1.822* [-3.220,-0.423]
Physical activity	Active (base)				
	Moderately active			-0.46 [-1.378,0.457]	-0.505 [-1.420,0.411]
	Inactive			-0.241 [-1.201,0.718]	-0.268 [-1.226,0.690]
Sleep problems	Normal sleep (base)				
	Disturbed sleep			-1.539*** [-2.253,-0.826]	-1.586*** [-2.299,-0.873]
Social support	High (base)				
	Medium			-0.386 [-1.254,0.482]	-0.438 [-1.307,0.432]
	Low			-0.994* [-1.889,-0.099]	-1.214** [-2.119,-0.310]
Education	No high school (base)				
	High school complete			0.21 [-0.753,1.174]	0.193 [-0.772,1.158]
	Post-secondary complete			0.997 [-0.190,2.184]	1.054 [-0.231,2.339]
Parental Status	Not a parent (base)				
	Has children				-1.392** [-2.427,-0.358]
Marital status	Single (base)				
	Married				-0.188 [-1.101,0.725]
	Widow/divorce/separated				-3.124*** [-4.946,-1.302]
Years in the military	less than 2.5 years (base)				
	2.5 - 5 years				-0.459 [-1.884,0.965]
	Over 5 years				-0.665 [-2.267,0.937]
Branch	Army (base)				
	Navy				-1.072 [-3.232,1.088]
	Air Force				0.503 [-0.886,1.892]
Rank	Officer (base)				
	NCM				-0.908 [-2.295,0.480]
Deployment length	6+ mos (base)				
	Short (≤ 5 mos)				0.296 [-0.696,1.288]
Age post-deployment	24 years or less (base)				
	25 to 34 years				-1.091* [-1.936,-0.245]
	35 years or more				0.54 [-1.016,2.096]
Observations		3267	2896	2799	2790
Adjusted R2		0.026	0.043	0.057	0.068
AIC		24037.723	21260.187	20534.508	20449.166
BIC		24049.907	21296.013	20635.437	20615.312

Beta coefficient with 95% confidence intervals in brackets

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 28: Scale “All DRSE” and PTSD-likelihood (multinomial regression models 1-4)

		Model 1	Model 2	Model 3	Model 4
Likely PTSD (30)					
All DRSE scale		1.116*** [1.097,1.136]	1.129*** [1.107,1.152]	1.127*** [1.104,1.151]	1.130*** [1.106,1.155]
Language	English (base)				
	French		0.475*** [0.359,0.628]	0.497*** [0.371,0.664]	0.498*** [0.371,0.668]
Sex	Male (base)				
	Female		2.280*** [1.482,3.507]	2.566*** [1.627,4.046]	2.508*** [1.546,4.070]
Mother's Education	No high school (base)				
	High school complete		0.802 [0.586,1.099]	0.812 [0.587,1.124]	0.863 [0.622,1.199]
	Post-secondary complete		0.872 [0.626,1.216]	0.927 [0.657,1.308]	1.038 [0.730,1.476]
Smoking status	Never smoked (base)				
	Ex-smoker			1.205 [0.876,1.658]	1.1 [0.792,1.526]
	Current smoker			1.576** [1.175,2.113]	1.457* [1.079,1.968]
BMI	Normal/underweight (base)				
	Overweight			1.320* [1.010,1.725]	1.292 [0.985,1.697]
	Obese			2.171*** [1.400,3.366]	2.047** [1.313,3.190]
Physical activity	Active (base)				
	Moderately active			0.975 [0.707,1.346]	0.981 [0.710,1.357]
	Inactive			0.739 [0.509,1.073]	0.746 [0.513,1.083]
Sleep problems	Normal sleep (base)				
	Disturbed sleep			1.355* [1.053,1.742]	1.370* [1.063,1.765]
Social support	High (base)				
	Medium			0.995 [0.732,1.353]	1.018 [0.746,1.390]
	Low			1.043 [0.765,1.422]	1.087 [0.793,1.491]
Education	No high school (base)				
	High school complete			1.083 [0.777,1.511]	1.088 [0.778,1.521]
	Post-secondary complete			0.634* [0.404,0.995]	0.691 [0.429,1.114]
Parental Status	Not a parent (base)				
	Parent				1.354 [0.944,1.942]
Marital status	Single (base)				
	Married				1.105 [0.795,1.536]
	Widow/divorce/separated				1.326 [0.714,2.461]
Years in the military	less than 2.5 years (base)				
	2.5 - 5 years				1.139 [0.668,1.943]
	Over 5 years				1.328 [0.729,2.419]
Branch	Army (base)				
	Navy				0.773 [0.267,2.239]
	Air Force				1.043 [0.585,1.859]
Rank	Officer (base)				
	NCM				2.217* [1.123,4.379]
Deployment length	6+ mos (base)				
	Short (≤ 5 mos)				1.11 [0.761,1.620]
Age post-deployment	24 years or less (base)				
	25 to 34 years				1.029 [0.770,1.374]
	35 years or more				1.042 [0.580,1.872]
Very likely PTSD (50)					
All DRSE scale		1.154*** [1.112,1.198]	1.185*** [1.135,1.237]	1.199*** [1.145,1.256]	1.208*** [1.152,1.268]
Language	English (base)				
	French		0.243*** [0.119,0.497]	0.237*** [0.114,0.492]	0.214*** [0.101,0.452]
Sex	Male (base)				
	Female		4.998*** [2.238,11.163]	6.014*** [2.532,14.284]	6.142*** [2.396,15.744]
Mother's Education	No high school (base)				
	High school complete		0.557 [0.304,1.019]	0.595 [0.321,1.104]	0.66 [0.350,1.243]
	Post-secondary complete		0.508* [0.262,0.987]	0.546 [0.276,1.084]	0.642 [0.317,1.301]
Smoking status	Never smoked (base)				
	Ex-smoker			1.284 [0.675,2.443]	1.156 [0.598,2.235]
	Current smoker			1.372 [0.751,2.508]	1.247 [0.668,2.327]
BMI	Normal/underweight (base)				
	Overweight			0.833 [0.465,1.489]	0.796 [0.440,1.441]
	Obese			1.387 [0.520,3.701]	1.387 [0.510,3.770]
Physical activity	Active (base)				
	Moderately active			0.557 [0.241,1.288]	0.525 [0.223,1.236]
	Inactive			1.452 [0.761,2.770]	1.562 [0.813,3.001]

Sleep problems	Normal sleep (base)				
	Disturbed sleep	2.918***	[1.654,5.148]	3.097*** [1.736,5.526]	
Social support	High (base)				
	Medium	1.565	[0.842,2.908]	1.675 [0.890,3.150]	
	Low	0.955	[0.483,1.888]	1.056 [0.524,2.126]	
Education	No high school (base)				
	High school complete	0.617	[0.334,1.138]	0.688 [0.365,1.295]	
	Post-secondary complete	0.416*	[0.175,0.990]	0.469 [0.189,1.168]	
Parental Status	Not a parent (base)				
	Parent			1.462 [0.721,2.961]	
Marital status	Single (base)				
	Married			1.233 [0.624,2.436]	
Years in the military	Widow/divorce/separated			3.089* [1.130,8.447]	
	less than 2.5 years (base)				
	2.5 - 5 years			0.674 [0.262,1.732]	
Branch	Over 5 years			1.529 [0.532,4.393]	
	Army (base)				
	Navy			1.056 [0.125,8.943]	
Rank	Air Force			0.476 [0.099,2.280]	
	Officer (base)				
	NCM			1.944 [0.527,7.173]	
Deployment length	6+ mos (base)				
	Short (≤5 mos)			1.423 [0.681,2.974]	
Age post-deployment	24 years or less (base)				
	25 to 34 years			1.059 [0.580,1.935]	
	35 years or more			0.576 [0.140,2.366]	
	Observations	3276	2901	2804	2795
	AIC	2781.999	2404.723	2309.101	2318.309
	BIC	2806.377	2476.396	2511.02	2650.702

RRR with 95% confidence intervals in brackets

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 29: Scale “All DRSE” and possible/probable depression (ordinal logistic regression models 1-4)

		Model 1	Model 2	Model 3	Model 4
All DRSE scale		1.082*** [1.060,1.105]	1.100*** [1.074,1.127]	1.102*** [1.075,1.130]	1.102*** [1.074,1.132]
Language	English (base)				
	French		0.516*** [0.364,0.731]	0.524*** [0.364,0.752]	0.502*** [0.348,0.724]
Sex	Male (base)				
	Female		3.341*** [2.113,5.281]	3.628*** [2.233,5.894]	3.974*** [2.377,6.644]
Mother's Education	No high school (base)				
	High school complete		0.589** [0.408,0.850]	0.606** [0.415,0.884]	0.621* [0.424,0.910]
	Post-secondary complete		0.619* [0.418,0.919]	0.677 [0.452,1.014]	0.729 [0.482,1.101]
Smoking status	Never smoked (base)				
	Ex-smoker			1.173 [0.795,1.731]	1.091 [0.732,1.625]
	Current smoker			1.327 [0.921,1.911]	1.221 [0.840,1.773]
BMI	Normal/underweight (base)				
	Overweight			0.99 [0.705,1.390]	0.953 [0.675,1.344]
	Obese			1.665 [0.980,2.827]	1.59 [0.929,2.722]
Physical activity	Active (base)				
	Moderately active			1.054 [0.707,1.573]	1.065 [0.712,1.594]
	Inactive			1.048 [0.685,1.603]	1.066 [0.696,1.635]
Sleep problems	Normal sleep (base)				
	Disturbed sleep			1.816*** [1.322,2.494]	1.807*** [1.312,2.489]
Social support	High (base)				
	Medium			1.002 [0.690,1.454]	1.012 [0.694,1.475]
	Low			0.909 [0.616,1.342]	0.941 [0.633,1.398]
Education	No high school (base)				
	High school complete			0.789 [0.534,1.166]	0.812 [0.547,1.203]
	Post-secondary complete			0.602 [0.356,1.015]	0.641 [0.369,1.113]
Parental Status	Not a parent (base)				
	Parent				1.032 [0.665,1.601]
Marital status	Single (base)				
	Married				1.176 [0.790,1.751]
	Widow/divorce/separated				1.255 [0.610,2.582]
Years in the military	less than 2.5 years (base)				
	2.5 - 5 years				0.705 [0.392,1.267]
	Over 5 years				0.955 [0.493,1.851]
Branch	Army (base)				
	Navy				0.94 [0.321,2.751]
	Air Force				0.496 [0.223,1.105]
Rank	Officer (base)				
	NCM				1.775 [0.832,3.786]
Deployment length	6+ mos (base)				
	Short (≤ 5 mos)				1.034 [0.651,1.642]
Age post-deployment	24 years or less (base)				
	25 to 34 years				1.193 [0.829,1.716]
	35 years or more				1.216 [0.603,2.455]
	Observations	3271	2895	2799	2790
	AIC	1840.336	1574.96	1526.386	1535.839
	BIC	1858.615	1616.755	1633.252	1707.919

OR with 95% confidence intervals in brackets

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 30: Scale “All DRSE” and suicidal ideation (logistic regression models 1-4)

		Model 1	Model 2	Model 3	Model 4
All DRSE scale		1.086*** [1.049,1.124]	1.085*** [1.044,1.128]	1.089*** [1.045,1.134]	1.095*** [1.049,1.144]
Language	English (base)				
	French		0.619 [0.349,1.101]	0.644 [0.357,1.160]	0.632 [0.349,1.145]
Sex	Male (base)				
	Female		1.345 [0.516,3.507]	1.653 [0.612,4.465]	1.53 [0.527,4.444]
Mother's Education	No high school (base)				
	High school complete		1.443 [0.704,2.957]	1.481 [0.716,3.061]	1.594 [0.765,3.323]
	Post-secondary complete		1.288 [0.600,2.767]	1.42 [0.655,3.077]	1.65 [0.749,3.631]
Smoking status	Never smoked (base)				
	Ex-smoker			0.867 [0.442,1.703]	0.737 [0.369,1.473]
	Current smoker			0.961 [0.524,1.764]	0.832 [0.447,1.549]
BMI	Normal/underweight (base)				
	Overweight			1.042 [0.588,1.847]	0.94 [0.526,1.679]
	Obese			2.415* [1.119,5.211]	2.168 [0.993,4.736]
Physical activity	Active (base)				
	Moderately active			1.287 [0.680,2.436]	1.352 [0.711,2.571]
	Inactive			1.36 [0.698,2.648]	1.364 [0.698,2.669]
Sleep problems	Normal sleep (base)				
	Disturbed sleep			2.110** [1.230,3.620]	2.125** [1.233,3.664]
Social support	High (base)				
	Medium			1.204 [0.617,2.350]	1.214 [0.617,2.389]
	Low			1.412 [0.736,2.708]	1.474 [0.758,2.868]
Education	No high school (base)				
	High school complete			0.872 [0.457,1.666]	0.918 [0.478,1.763]
	Post-secondary complete			0.538 [0.212,1.366]	0.526 [0.197,1.404]
Parental Status	Not a parent (base)				
	Parent				1.143 [0.537,2.431]
Marital status	Single (base)				
	Married				0.951 [0.481,1.880]
	Widow/divorce/separated				1.474 [0.465,4.671]
Years in the military	less than 2.5 years (base)				
	2.5 - 5 years				0.514 [0.218,1.212]
	Over 5 years				0.601 [0.220,1.638]
Branch	Army (base)				
	Navy				1 [1.000,1.000]
	Air Force				0.767 [0.206,2.846]
Rank	Officer (base)				
	NCM				2.351 [0.518,10.664]
Deployment length	6+ mos (base)				
	Short (≤5 mos)				1.025 [0.471,2.228]
Age post-deployment	24 years or less (base)				
	25 to 34 years				1.859* [1.012,3.417]
	35 years or more				3.431* [1.123,10.486]
	Observations	3267	2891	2795	2704
	AIC	703.236	602.906	595.587	602.412
	BIC	715.419	638.722	696.492	761.779

OR with 95% confidence intervals in brackets

* p < 0.05, ** p < 0.01, *** p < 0.001

Table 31: Scale “All DRSE” and anxiety (logistic regression models 1-4)

		Model 1	Model 2	Model 3	Model 4
DRSE scale		1.100*** [1.062,1.139]	1.092*** [1.050,1.135]	1.090*** [1.047,1.135]	1.104*** [1.059,1.152]
Language	English (base)				
	French		0.312*** [0.158,0.617]	0.344** [0.172,0.689]	0.318** [0.157,0.643]
Sex	Male (base)				
	Female		1.733 [0.704,4.262]	1.532 [0.604,3.886]	1.369 [0.509,3.682]
Mother's Education	No high school (base)				
	High school complete		0.464* [0.244,0.883]	0.535 [0.274,1.046]	0.598 [0.302,1.184]
	Post-secondary complete		0.858 [0.465,1.585]	1.007 [0.526,1.928]	1.196 [0.609,2.349]
Smoking status	Never smoked (base)				
	Ex-smoker			1.091 [0.555,2.143]	0.944 [0.472,1.891]
	Current smoker			1.542 [0.855,2.781]	1.375 [0.747,2.529]
BMI	Normal/underweight (base)				
	Overweight			1.056 [0.612,1.822]	0.975 [0.558,1.704]
	Obese			0.631 [0.189,2.110]	0.571 [0.166,1.962]
Physical activity	Active (base)				
	Moderately active			1.274 [0.664,2.443]	1.226 [0.631,2.383]
	Inactive			1.166 [0.575,2.363]	1.256 [0.617,2.557]
Sleep problems	Normal sleep (base)				
	Disturbed sleep			1.901* [1.116,3.237]	1.991* [1.160,3.419]
Social support	High (base)				
	Medium			0.896 [0.504,1.595]	0.966 [0.537,1.739]
	Low			0.444* [0.222,0.889]	0.511 [0.251,1.041]
Education	No high school (base)				
	High school complete			0.842 [0.437,1.622]	0.865 [0.442,1.690]
	Post-secondary complete			0.71 [0.301,1.677]	0.695 [0.276,1.749]
Parental Status	Not a parent (base)				
	Parent				1.211 [0.607,2.415]
Marital status	Single (base)				
	Married				1.25 [0.631,2.475]
	Widow/divorce/separated				2.241 [0.808,6.211]
Years in the military	less than 2.5 years (base)				
	2.5 - 5 years				0.766 [0.259,2.264]
	Over 5 years				1.988 [0.623,6.347]
Branch	Army (base)				
	Navy				1.81 [0.390,8.391]
	Air Force				0.716 [0.197,2.597]
Rank	Officer (base)				
	NCM				1.906 [0.604,6.009]
Deployment length	6+ mos (base)				
	Short (≤ 5 mos)				1.215 [0.574,2.572]
Age post-deployment	24 years or less (base)				
	25 to 34 years				1.314 [0.698,2.473]
	35 years or more				1.147 [0.353,3.728]
Observations		3226	2854	2760	2751
AIC		686.917	596.574	580.35	583.106
BIC		699.075	632.313	681.041	748.858

OR 95% confidence intervals in brackets

* p < 0.05, ** p < 0.01, *** p < 0.001

APPENDIX K: Covariate estimates in DRSE models for each mental health outcome

Table 32: Fully adjusted scale “All DRSE” & all outcomes

		SF-36 MCS linear (beta coef)	PTSD multinomial logistic (RRR) <i>Likely PTSD</i>	<i>Very Likely PTSD</i>	Depression ordinal logistic (OR) <i>Possible & Probable</i>	Suicidal Ideation logistic (OR)	Anxiety (excl. panic) logistic (OR)
“All DRSE” scale		-0.291*** [-0.351,-0.232]	1.130*** [1.106,1.155]	1.208*** [1.152,1.268]	1.102*** [1.074,1.132]	1.095*** [1.049,1.144]	1.104*** [1.059,1.152]
Language	English (base)						
	French	1.339*** [0.592,2.087]	0.498*** [0.371,0.668]	0.214*** [0.101,0.452]	0.502*** [0.348,0.724]	0.632 [0.349,1.145]	0.318** [0.157,0.643]
Sex	Male (base)						
	Female	-3.793*** [-5.094,-2.493]	2.508*** [1.546,4.070]	6.142*** [2.396,15.744]	3.974*** [2.377,6.644]	1.53 [0.527,4.444]	1.369 [0.509,3.682]
Mother's Education	No high school (base)						
	High school complete	0.885 [-0.039,1.809]	0.863 [0.622,1.199]	0.66 [0.350,1.243]	0.621* [0.424,0.910]	1.594 [0.765,3.323]	0.598 [0.302,1.184]
	Post-secondary complete	-0.049 [-1.050,0.953]	1.038 [0.730,1.476]	0.642 [0.317,1.301]	0.729 [0.482,1.101]	1.65 [0.749,3.631]	1.196 [0.609,2.349]
Smoking status	Never smoked (base)						
	Ex-smoker	-0.591 [-1.505,0.324]	1.1 [0.792,1.526]	1.156 [0.598,2.235]	1.091 [0.732,1.625]	0.737 [0.369,1.473]	0.944 [0.472,1.891]
	Current smoker	-0.408 [-1.302,0.486]	1.457* [1.079,1.968]	1.247 [0.668,2.327]	1.221 [0.840,1.773]	0.832 [0.447,1.549]	1.375 [0.747,2.529]
BMI	Normal/underweight (base)						
	Overweight	-0.032 [-0.805,0.741]	1.292 [0.985,1.697]	0.796 [0.440,1.441]	0.953 [0.675,1.344]	0.94 [0.526,1.679]	0.975 [0.558,1.704]
	Obese	-1.822* [-3.220,-0.423]	2.047** [1.313,3.190]	1.387 [0.510,3.770]	1.59 [0.929,2.722]	2.168 [0.993,4.736]	0.571 [0.166,1.962]
Physical activity	Active (base)						
	Moderately active	-0.505 [-1.420,0.411]	0.981 [0.710,1.357]	0.525 [0.223,1.236]	1.065 [0.712,1.594]	1.352 [0.711,2.571]	1.226 [0.631,2.383]
	Inactive	-0.268 [-1.226,0.690]	0.746 [0.513,1.083]	1.562 [0.813,3.001]	1.066 [0.696,1.635]	1.364 [0.698,2.669]	1.256 [0.617,2.557]
Sleep problems	Normal sleep (base)						
	Disturbed sleep	-1.586*** [-2.299,-0.873]	1.370* [1.063,1.765]	3.097*** [1.736,5.526]	1.807*** [1.312,2.489]	2.125** [1.233,3.664]	1.991* [1.160,3.419]
Social support	High (base)						
	Medium	-0.438 [-1.307,0.432]	1.018 [0.746,1.390]	1.675 [0.890,3.150]	1.012 [0.694,1.475]	1.214 [0.617,2.389]	0.966 [0.537,1.739]
	Low	-1.214** [-2.119,-0.310]	1.087 [0.793,1.491]	1.056 [0.524,2.126]	0.941 [0.633,1.398]	1.474 [0.758,2.868]	0.511 [0.251,1.041]
Education	No high school (base)						
	High school complete	0.193 [-0.772,1.158]	1.088 [0.778,1.521]	0.688 [0.365,1.295]	0.812 [0.547,1.203]	0.918 [0.478,1.763]	0.865 [0.442,1.690]
	Post-secondary complete	1.054 [-0.231,2.339]	0.691 [0.429,1.114]	0.469 [0.189,1.168]	0.641 [0.369,1.113]	0.526 [0.197,1.404]	0.695 [0.276,1.749]
Parental Status	Not a parent (base)						
	Parent	-1.392** [-2.427,-0.358]	1.354 [0.944,1.942]	1.462 [0.721,2.961]	1.032 [0.665,1.601]	1.143 [0.537,2.431]	1.211 [0.607,2.415]
Marital status	Single (base)						
	Married	-0.188 [-1.101,0.725]	1.105 [0.795,1.536]	1.233 [0.624,2.436]	1.176 [0.790,1.751]	0.951 [0.481,1.880]	1.25 [0.631,2.475]
	Widow/divorce/separated	-3.124*** [-4.946,-1.302]	1.326 [0.714,2.461]	3.089* [1.130,8.447]	1.255 [0.610,2.582]	1.474 [0.465,4.671]	2.241 [0.808,6.211]
Years in the military	less than 2.5 years (base)						
	2.5 - 5 years	-0.459 [-1.884,0.965]	1.139 [0.668,1.943]	0.674 [0.262,1.732]	0.705 [0.392,1.267]	0.514 [0.218,1.212]	0.766 [0.259,2.264]
	Over 5 years	-0.665 [-2.267,0.937]	1.328 [0.729,2.419]	1.529 [0.532,4.393]	0.955 [0.493,1.851]	0.601 [0.220,1.638]	1.988 [0.623,6.347]
Branch	Army (base)						
	Navy	-1.072 [-3.232,1.088]	0.773 [0.267,2.239]	1.056 [0.125,8.943]	0.94 [0.321,2.751]	1 [1.000,1.000]	1.81 [0.390,8.391]
	Air Force	0.503 [-0.886,1.892]	1.043 [0.585,1.859]	0.476 [0.099,2.280]	0.496 [0.223,1.105]	0.767 [0.206,2.846]	0.716 [0.197,2.597]
Rank	Officer (base)						

	NCM	-0.908 [-2.295,0.480]	2.217* [1.123,4.379]	1.944 [0.527,7.173]	1.775 [0.832,3.786]	2.351 [0.518,10.664]	1.906 [0.604,6.009]
Deployment length	6+ mos (base)						
	Short (≤5 mos)	0.296 [-0.696,1.288]	1.11 [0.761,1.620]	1.423 [0.681,2.974]	1.034 [0.651,1.642]	1.025 [0.471,2.228]	1.215 [0.574,2.572]
Age post-deployment	24 years or less (base)						
	25 to 34 years	-1.091* [-1.936,-0.245]	1.029 [0.770,1.374]	1.059 [0.580,1.935]	1.193 [0.829,1.716]	1.859* [1.012,3.417]	1.314 [0.698,2.473]
	35 years or more	0.54 [-1.016,2.096]	1.042 [0.580,1.872]	0.576 [0.140,2.366]	1.216 [0.603,2.455]	3.431* [1.123,10.486]	1.147 [0.353,3.728]
Observations		2790		2795	2790	2704	2751
Adjusted R2		0.068		-	-	-	-
AIC		20449.166		2318.309	1535.839	602.412	583.106
BIC		20615.312		2650.702	1707.919	761.779	748.858

95% confidence intervals in brackets

* p < 0.05, ** p < 0.01, *** p < 0.001

Table 33: Fully adjusted categorical “All DRSE” & all outcomes

		SF-36 MCS linear (beta coef)	PTSD multinomial logistic (RRR) <i>Likely PTSD</i> <i>Very Likely PTSD</i>	Depression ordinal logistic (OR) Possible & Probable	Suicidal Ideation logistic (OR)	Anxiety (excl. panic) logistic (OR)
“All DRSE”	None (base)					
	Low (1-3 DRSE)	-1.681* [-3.185,-0.176]	3.680* [1.236,10.959]	1.042 [0.181,6.013]	0.812 [0.342,1.929]	0.664 [0.132,3.340]
	Medium (4-7 DRSE)	-3.209*** [-4.793,-1.625]	6.437*** [2.143,19.333]	2.105 [0.364,12.181]	1.991 [0.861,4.606]	2.193 [0.499,9.645]
	High (8+ DRSE)	-4.648*** [-6.115,-3.181]	16.059*** [5.507,46.829]	8.136* [1.601,41.338]	3.469** [1.573,7.649]	4.243* [1.037,17.360]
Language	English (base)					
	French	1.519*** [0.766,2.272]	0.470*** [0.352,0.629]	0.204*** [0.097,0.428]	0.475*** [0.330,0.684]	0.59 [0.326,1.067]
Sex	Male (base)					
	Female	-3.650*** [-4.962,-2.339]	2.373*** [1.464,3.849]	4.340** [1.736,10.846]	3.700*** [2.220,6.165]	1.511 [0.519,4.399]
Mother's Education	No high school (base)					
	High school complete	0.868 [-0.063,1.799]	0.867 [0.627,1.201]	0.664 [0.358,1.232]	0.633* [0.432,0.925]	1.613 [0.774,3.359]
	Post-secondary complete	-0.091 [-1.100,0.918]	1.072 [0.757,1.518]	0.673 [0.336,1.348]	0.747 [0.495,1.128]	1.711 [0.778,3.763]
Smoking status	Never smoked (base)					
	Ex-smoker	-0.692 [-1.613,0.228]	1.165 [0.843,1.610]	1.188 [0.619,2.282]	1.134 [0.763,1.687]	0.759 [0.380,1.516]
	Current smoker	-0.463 [-1.363,0.437]	1.483** [1.102,1.995]	1.234 [0.667,2.283]	1.239 [0.853,1.799]	0.861 [0.461,1.608]
BMI	Normal/underweight (base)					
	Overweight	0.022 [-0.756,0.800]	1.26 [0.963,1.649]	0.749 [0.418,1.344]	0.938 [0.666,1.322]	0.923 [0.516,1.650]
	Obese	-1.747* [-3.157,-0.338]	1.995** [1.289,3.089]	1.29 [0.481,3.459]	1.592 [0.931,2.723]	2.199* [1.001,4.828]
Physical activity	Active (base)					
	Moderately active	-0.447 [-1.371,0.476]	0.983 [0.714,1.353]	0.524 [0.228,1.205]	1.081 [0.724,1.612]	1.359 [0.715,2.580]
	Inactive	-0.006 [-0.967,0.955]	0.657* [0.454,0.950]	1.196 [0.635,2.250]	0.961 [0.629,1.466]	1.256 [0.645,2.445]
Sleep problems	Normal sleep (base)					
	Disturbed sleep	-1.542*** [-2.260,-0.824]	1.293* [1.007,1.659]	2.839*** [1.610,5.006]	1.754*** [1.276,2.411]	2.066** [1.199,3.561]
Social support	High (base)					
	Medium	-0.317 [-1.194,0.560]	0.938 [0.690,1.275]	1.483 [0.799,2.751]	0.953 [0.655,1.387]	1.132 [0.577,2.222]
	Low	-1.096* [-2.006,-0.185]	1.019 [0.747,1.390]	0.939 [0.474,1.862]	0.89 [0.600,1.319]	1.379 [0.710,2.675]
Education	No high school (base)					
	High school complete	0.263 [-0.708,1.235]	1.044 [0.751,1.452]	0.627 [0.339,1.161]	0.777 [0.526,1.148]	0.858 [0.448,1.644]
	Post-secondary complete	1.069 [-0.225,2.363]	0.701 [0.437,1.124]	0.473 [0.193,1.161]	0.633 [0.365,1.100]	0.509 [0.189,1.367]
Parental Status	Not a parent (base)					
	Parent	-1.345* [-2.386,-0.303]	1.294 [0.906,1.847]	1.361 [0.684,2.709]	0.999 [0.645,1.546]	1.083 [0.508,2.307]
Marital status	Single (base)					
	Married	-0.199 [-1.120,0.722]	1.129 [0.815,1.565]	1.349 [0.689,2.643]	1.218 [0.819,1.812]	1.014 [0.513,2.006]
	Widow/divorce/separated	-3.158*** [-4.996,-1.321]	1.384 [0.747,2.565]	3.265* [1.211,8.803]	1.348 [0.655,2.776]	1.578 [0.496,5.019]
Years in the military	less than 2.5 years (base)					
	2.5 - 5 years	-0.575 [-2.009,0.859]	1.195 [0.705,2.026]	0.722 [0.285,1.830]	0.723 [0.404,1.296]	0.527 [0.223,1.243]
	Over 5 years	-0.714 [-2.328,0.900]	1.38 [0.762,2.502]	1.529 [0.537,4.353]	0.979 [0.506,1.894]	0.602 [0.219,1.652]
Branch	Army (base)					
	Navy	-1.399 [-3.655,0.858]	1.102 [0.364,3.337]	0.773 [0.084,7.080]	0.893 [0.293,2.723]	1.745 [0.331,9.213]
	Air Force	0.583 [-0.824,1.990]	1.064 [0.595,1.902]	0.399 [0.085,1.861]	0.484 [0.217,1.082]	0.81 [0.216,3.041]
Rank	Officer (base)					
	NCM	-1.127 [-2.526,0.272]	2.410* [1.223,4.746]	2.007 [0.555,7.260]	1.845 [0.866,3.927]	2.509 [0.551,11.421]

Deployment length	6+ mos (base)						
	Short (≤5 mos)	0.319 [-0.688,1.325]	1.132 [0.776,1.651]	1.306 [0.631,2.703]	1.041 [0.654,1.656]	1.076 [0.491,2.356]	1.254 [0.589,2.667]
Age post-deployment	24 years or less (base)						
	25 to 34 years	-1.034* [-1.885,-0.182]	0.995 [0.747,1.326]	1.035 [0.564,1.898]	1.167 [0.809,1.682]	1.828 [0.989,3.379]	1.28 [0.676,2.423]
	35 years or more	0.82 [-0.745,2.386]	0.93 [0.520,1.663]	0.487 [0.122,1.950]	1.128 [0.561,2.270]	3.281* [1.075,10.012]	1.079 [0.332,3.507]
Observations		2790		2795	2790	2790	2751
Adjusted R2		0.055		-	-	-	-
AIC		20488.652		2365.054	1557.064	1557.064	594.179
BIC		20666.666		2721.189	1741.012	1741.012	771.771

95% confidence intervals in brackets

* p < 0.05, ** p < 0.01, *** p < 0.001

Table 34: Fully adjusted scale distressing & contextual DRSE & all outcomes

		SF-36 MCS linear (beta coef)	PTSD multinomial logistic (RRR) <i>Likely PTSD</i>	<i>Very Likely PTSD</i>	Depression ordinal logistic (OR) <i>Possible & Probable</i>	Suicidal Ideation logistic (OR)	Anxiety (excl. panic) logistic (OR)
DRSE	Distressing	-0.806*** [-0.986,-0.627]	1.241*** [1.169,1.318]	1.722*** [1.511,1.964]	1.274*** [1.184,1.371]	1.330*** [1.181,1.497]	1.274*** [1.123,1.445]
	Context-dependent	0.144 [-0.011,0.299]	1.037 [0.982,1.096]	0.863* [0.765,0.975]	0.965 [0.901,1.034]	0.911 [0.812,1.021]	0.967 [0.858,1.089]
Language	English (base)						
	French	1.264*** [0.520,2.007]	0.501*** [0.373,0.672]	0.211*** [0.099,0.452]	0.511*** [0.354,0.737]	0.646 [0.356,1.171]	0.323** [0.160,0.653]
Sex	Male (base)						
	Female	-3.439*** [-4.737,-2.142]	2.323*** [1.431,3.769]	4.799** [1.873,12.299]	3.492*** [2.087,5.844]	1.284 [0.448,3.680]	1.248 [0.468,3.331]
Mother's Education	No high school (base)						
	High school complete	1.017* [0.098,1.936]	0.832 [0.598,1.158]	0.517* [0.267,1.000]	0.578** [0.392,0.850]	1.471 [0.701,3.085]	0.556 [0.279,1.110]
	Post-secondary complete	0.079 [-0.918,1.075]	1.008 [0.708,1.435]	0.537 [0.259,1.113]	0.688 [0.454,1.044]	1.552 [0.702,3.435]	1.135 [0.575,2.238]
Smoking status	Never smoked (base)						
	Ex-smoker	-0.579 [-1.488,0.330]	1.108 [0.798,1.538]	1.228 [0.629,2.400]	1.112 [0.746,1.658]	0.74 [0.370,1.480]	0.962 [0.481,1.927]
	Current smoker	-0.307 [-1.196,0.582]	1.429* [1.056,1.932]	1.213 [0.641,2.293]	1.205 [0.828,1.753]	0.797 [0.427,1.487]	1.348 [0.732,2.484]
BMI	Normal/underweight (base)						
	Overweight	-0.049 [-0.817,0.719]	1.282 [0.976,1.685]	0.722 [0.392,1.331]	0.932 [0.659,1.317]	0.945 [0.527,1.694]	0.948 [0.541,1.660]
	Obese	-1.762* [-3.152,-0.372]	2.005** [1.284,3.132]	1.199 [0.428,3.360]	1.51 [0.877,2.597]	2.077 [0.943,4.572]	0.555 [0.161,1.912]
Physical activity	Active (base)						
	Moderately active	-0.539 [-1.450,0.371]	0.988 [0.714,1.369]	0.538 [0.226,1.278]	1.071 [0.714,1.605]	1.409 [0.739,2.688]	1.269 [0.652,2.471]
	Inactive	-0.303 [-1.255,0.649]	0.752 [0.517,1.093]	1.461 [0.745,2.866]	1.063 [0.692,1.632]	1.362 [0.693,2.674]	1.236 [0.606,2.524]
Sleep problems	Normal sleep (base)						
	Disturbed sleep	-1.547*** [-2.256,-0.838]	1.359* [1.054,1.754]	2.941*** [1.635,5.292]	1.770*** [1.284,2.440]	2.053** [1.189,3.544]	1.919* [1.117,3.297]
Social support	High (base)						
	Medium	-0.474 [-1.339,0.390]	1.021 [0.747,1.396]	1.55 [0.813,2.954]	1.006 [0.689,1.469]	1.201 [0.609,2.368]	0.942 [0.522,1.698]
	Low	-1.286** [-2.185,-0.387]	1.106 [0.806,1.518]	1.148 [0.561,2.348]	0.968 [0.650,1.441]	1.521 [0.779,2.969]	0.525 [0.257,1.070]
Education	No high school (base)						
	High school complete	0.285 [-0.675,1.244]	1.068 [0.763,1.494]	0.67 [0.351,1.280]	0.8 [0.539,1.189]	0.901 [0.467,1.739]	0.853 [0.436,1.670]
	Post-secondary complete	1.144 [-0.133,2.422]	0.673 [0.417,1.087]	0.464 [0.183,1.178]	0.631 [0.362,1.099]	0.513 [0.191,1.374]	0.69 [0.273,1.742]
Parental Status	Not a parent (base)						
	Parent	-1.289* [-2.317,-0.261]	1.331 [0.927,1.910]	1.27 [0.618,2.612]	0.982 [0.632,1.528]	1.044 [0.488,2.235]	1.184 [0.594,2.362]
Marital status	Single (base)						
	Married	-0.172 [-1.079,0.735]	1.108 [0.796,1.542]	1.423 [0.703,2.880]	1.199 [0.803,1.791]	0.994 [0.498,1.983]	1.275 [0.641,2.535]
	Widow/divorce/separated	-3.050*** [-4.861,-1.239]	1.305 [0.701,2.427]	3.215* [1.148,9.001]	1.231 [0.597,2.541]	1.454 [0.459,4.605]	2.155 [0.771,6.022]
Years in the military	less than 2.5 years (base)						
	2.5 - 5 years	-0.584 [-2.000,0.832]	1.174 [0.686,2.008]	0.696 [0.266,1.823]	0.73 [0.405,1.317]	0.545 [0.229,1.297]	0.786 [0.265,2.331]
	Over 5 years	-0.782 [-2.375,0.810]	1.371 [0.750,2.506]	1.647 [0.555,4.884]	0.994 [0.511,1.934]	0.635 [0.229,1.758]	2.049 [0.637,6.591]
Branch	Army (base)						
	Navy	-0.681 [-2.831,1.469]	0.713 [0.246,2.066]	1.001 [0.122,8.218]	0.87 [0.299,2.529]	1 [1.000,1.000]	1.582 [0.344,7.287]
	Air Force	0.612 [-0.768,1.993]	1.015 [0.572,1.803]	0.528 [0.113,2.470]	0.493 [0.222,1.092]	0.753 [0.207,2.739]	0.697 [0.194,2.508]
Rank	Officer (base)						
	NCM	-1.083 [-2.463,0.297]	2.271* [1.149,4.490]	2.182 [0.572,8.324]	1.881 [0.878,4.030]	2.463 [0.540,11.234]	2.014 [0.635,6.393]
Deployment length	6+ mos (base)						
	Short (≤5 mos)	0.353 [-0.633,1.340]	1.085 [0.744,1.584]	1.31 [0.621,2.764]	1.009 [0.635,1.604]	0.978 [0.448,2.132]	1.198 [0.567,2.533]

Age post-deployment	24 years or less (base)						
	25 to 34 years	-1.097* [-1.938,-0.257]	1.036 [0.775,1.386]	1.076 [0.579,2.000]	1.206 [0.836,1.739]	1.879* [1.018,3.465]	1.321 [0.701,2.491]
	35 years or more	0.632 [-0.915,2.179]	1.025 [0.570,1.842]	0.51 [0.122,2.138]	1.2 [0.593,2.428]	3.328* [1.090,10.163]	1.094 [0.335,3.575]
Observations		2790		2795	2790	2704	2751
Adjusted R2		0.079		-	-	-	-
AIC		20415.477		2278.526	1520.582	592.378	579.485
BIC		20587.557		2622.79	1698.595	757.648	751.157

95% confidence intervals in brackets

* p < 0.05, ** p < 0.01, *** p < 0.001

Table 35: Fully adjusted categorical distressing/contextual DRSE models & all outcomes

		SF-36 MCS linear (beta coef)	PTSD multinomial logistic (RRR) <i>Likely PTSD</i>	<i>Very Likely PTSD</i>	Depression ordinal logistic (OR) <i>Possible & Probable</i>	Suicidal Ideation logistic (OR)	Anxiety (excl. panic) logistic (OR)
Distressing DRSE	None (base)						
	Low (1-3 DRSE)	-1.241* [-2.372,-0.109]	1.561 [0.907,2.686]	2.008 [0.536,7.528]	1.47 [0.793,2.723]	3.233* [1.001,10.442]	3.082 [0.981,9.684]
	Medium (4-7 DRSE)	-3.000*** [-4.383,-1.617]	3.460*** [1.892,6.325]	6.559* [1.556,27.641]	2.924** [1.454,5.881]	6.055** [1.654,22.160]	3.864* [1.058,14.117]
	High (8+ DRSE)	-7.244*** [-8.919,-5.570]	7.305*** [3.794,14.066]	62.360*** [13.821,281.362]	8.153*** [3.797,17.508]	27.555*** [6.872,110.496]	9.794** [2.465,38.908]
Contextual DRSE	None (base)						
	Low (1-3 DRSE)	-1.917** [-3.282,-0.551]	3.487** [1.416,8.590]	1.636 [0.306,8.747]	1.371 [0.632,2.975]	1.662 [0.347,7.966]	1.23 [0.300,5.040]
	Medium (4-7 DRSE)	-1.283 [-2.904,0.339]	3.528* [1.332,9.346]	1.343 [0.209,8.637]	1.421 [0.588,3.437]	0.946 [0.177,5.060]	1.117 [0.231,5.406]
	High (8+ DRSE)	-0.853 [-2.613,0.906]	4.079** [1.510,11.017]	0.903 [0.133,6.118]	1.056 [0.417,2.673]	0.535 [0.093,3.095]	1.266 [0.248,6.467]
Language	English (base)						
	French	1.281*** [0.537,2.026]	0.494*** [0.368,0.663]	0.229*** [0.108,0.488]	0.509*** [0.353,0.735]	0.654 [0.360,1.188]	0.320** [0.158,0.648]
Sex	Male (base)						
	Female	-3.532*** [-4.833,-2.232]	2.414*** [1.482,3.931]	4.850*** [1.895,12.408]	3.507*** [2.095,5.870]	1.226 [0.421,3.565]	1.253 [0.466,3.370]
Mother's Education	No high school (base)						
	High school complete	1.022* [0.104,1.941]	0.839 [0.603,1.167]	0.613 [0.319,1.177]	0.599** [0.408,0.881]	1.505 [0.716,3.164]	0.586 [0.295,1.165]
	Post-secondary complete	0.092 [-0.904,1.087]	1.021 [0.718,1.452]	0.6 [0.291,1.236]	0.708 [0.468,1.073]	1.583 [0.714,3.509]	1.209 [0.613,2.384]
Smoking status	Never smoked (base)						
	Ex-smoker	-0.569 [-1.478,0.339]	1.103 [0.794,1.531]	1.195 [0.612,2.332]	1.098 [0.737,1.637]	0.747 [0.373,1.494]	0.967 [0.482,1.939]
	Current smoker	-0.3 [-1.189,0.589]	1.418* [1.049,1.916]	1.191 [0.630,2.251]	1.193 [0.819,1.737]	0.796 [0.424,1.491]	1.369 [0.741,2.531]
BMI	Normal/underweight (base)						
	Overweight	0.008 [-0.760,0.777]	1.268 [0.966,1.665]	0.709 [0.384,1.307]	0.919 [0.650,1.299]	0.938 [0.522,1.686]	0.931 [0.530,1.635]
	Obese	-1.611* [-3.002,-0.220]	1.939** [1.242,3.027]	1.239 [0.450,3.411]	1.519 [0.885,2.608]	2.041 [0.927,4.493]	0.558 [0.163,1.906]
Physical activity	Active (base)						
	Moderately active	-0.484 [-1.395,0.427]	0.984 [0.711,1.361]	0.525 [0.221,1.245]	1.076 [0.718,1.612]	1.448 [0.756,2.771]	1.268 [0.652,2.465]
	Inactive	-0.363 [-1.316,0.589]	0.751 [0.517,1.093]	1.551 [0.788,3.052]	1.05 [0.683,1.614]	1.407 [0.714,2.773]	1.262 [0.618,2.577]
Sleep problems	Normal sleep (base)						
	Disturbed sleep	-1.598*** [-2.307,-0.889]	1.352* [1.049,1.742]	3.095*** [1.720,5.571]	1.783*** [1.294,2.458]	2.140** [1.237,3.701]	1.958* [1.138,3.368]
Social support	High (base)						
	Medium	-0.365 [-1.229,0.500]	0.97 [0.710,1.324]	1.479 [0.777,2.815]	0.952 [0.652,1.390]	1.135 [0.575,2.244]	0.916 [0.508,1.651]
	Low	-1.152* [-2.050,-0.254]	1.053 [0.769,1.443]	0.963 [0.470,1.975]	0.91 [0.611,1.354]	1.398 [0.714,2.738]	0.484* [0.237,0.989]
Education	No high school (base)						
	High school complete	0.142 [-0.817,1.100]	1.093 [0.782,1.529]	0.762 [0.399,1.458]	0.832 [0.560,1.235]	0.99 [0.511,1.916]	0.891 [0.455,1.747]
	Post-secondary complete	1.083 [-0.194,2.359]	0.693 [0.430,1.118]	0.55 [0.218,1.387]	0.66 [0.379,1.149]	0.541 [0.201,1.460]	0.74 [0.293,1.869]
Parental Status	Not a parent (base)						
	Parent	-1.359** [-2.388,-0.331]	1.317 [0.918,1.890]	1.333 [0.650,2.734]	0.983 [0.633,1.527]	1.054 [0.492,2.257]	1.216 [0.609,2.431]
Marital status	Single (base)						
	Married	-0.068 [-0.976,0.840]	1.103 [0.793,1.534]	1.278 [0.635,2.574]	1.172 [0.785,1.750]	0.935 [0.468,1.870]	1.207 [0.606,2.404]
	Widow/divorce/separated	-2.898** [-4.710,-1.086]	1.282 [0.688,2.390]	2.922* [1.048,8.146]	1.203 [0.583,2.483]	1.358 [0.428,4.305]	2.086 [0.744,5.849]
Years in the military	less than 2.5 years (base)						
	2.5 - 5 years	-0.582 [-1.997,0.832]	1.189 [0.696,2.030]	0.732 [0.278,1.926]	0.748 [0.415,1.350]	0.551 [0.231,1.314]	0.797 [0.268,2.365]
	Over 5 years	-0.698 [-2.293,0.896]	1.367 [0.749,2.498]	1.597 [0.540,4.725]	0.998 [0.512,1.945]	0.602 [0.216,1.679]	2.054 [0.639,6.598]
Branch	Army (base)						

	Navy	-1.416 [-3.631,0.798]	1.046 [0.349,3.136]	1.248 [0.144,10.799]	0.977 [0.328,2.917]	1 [1.000,1.000]	1.937 [0.389,9.641]
	Air Force	0.58 [-0.806,1.965]	1.047 [0.586,1.870]	0.503 [0.104,2.421]	0.491 [0.221,1.092]	0.763 [0.208,2.802]	0.706 [0.194,2.561]
Rank	Officer (base)						
	NCM	-1.128 [-2.513,0.257]	2.381* [1.204,4.710]	2.076 [0.542,7.949]	1.9 [0.884,4.083]	2.56 [0.558,11.748]	2.113 [0.661,6.752]
Deployment length	6+ mos (base)						
	Short (≤5 mos)	0.358 [-0.637,1.353]	1.121 [0.765,1.643]	1.2 [0.561,2.565]	0.997 [0.626,1.589]	1 [0.455,2.196]	1.193 [0.560,2.539]
Age post-deployment	24 years or less (base)						
	25 to 34 years	-1.076* [-1.916,-0.236]	1.038 [0.777,1.387]	1.033 [0.558,1.913]	1.199 [0.831,1.730]	1.892* [1.021,3.506]	1.293 [0.685,2.441]
	35 years or more	0.664 [-0.883,2.212]	1.048 [0.581,1.891]	0.519 [0.122,2.203]	1.198 [0.590,2.432]	3.454* [1.101,10.841]	1.074 [0.326,3.543]
	Observations	2790		2795	2790	2704	2751
	Adjusted R2	0.07		-	-	-	-
	AIC	20447.321		2341.365	1538.569	604.629	589.789
	BIC	20643.136		2733.114	1740.318	793.509	785.14

95% confidence intervals in brackets

* p < 0.05, ** p < 0.01, *** p < 0.001

APPENDIX L: Adjusted estimates of association for individual ACE models

Table 36: Modelling one type of ACE at a time with SF-36 MCS

Model	ACE	Language	Sex	Mother Ed. HS	Mother Ed. PS
Raised by	-4.205** [-6.903,-1.507]	1.627*** [0.897,2.357]	-1.884** [-3.071,-0.698]	0.872 [-0.044,1.787]	0.181 [-0.797,1.158]
Adopted	-0.93 [-3.611,1.751]	1.647*** [0.915,2.380]	-1.898** [-3.084,-0.711]	0.866 [-0.052,1.784]	0.142 [-0.839,1.123]
Moved frequently	-0.701 [-1.645,0.242]	1.554*** [0.803,2.305]	-1.709** [-2.913,-0.504]	0.864 [-0.073,1.801]	0.029 [-0.972,1.031]
Physical neglect	-1.851* [-3.420,-0.282]	1.721*** [0.970,2.472]	-1.846** [-3.053,-0.639]	0.848 [-0.096,1.793]	0.096 [-0.914,1.106]
Emotional neglect	-2.126** [-3.683,-0.569]	1.586*** [0.832,2.339]	-1.857** [-3.062,-0.651]	0.947 [-0.001,1.896]	0.129 [-0.883,1.142]
Emotional abuse	-2.201*** [-2.980,-1.421]	1.295*** [0.531,2.059]	-1.820** [-3.028,-0.611]	0.667 [-0.282,1.615]	-0.185 [-1.201,0.832]
Physical abuse	-2.332*** [-3.324,-1.339]	1.396*** [0.636,2.156]	-1.798** [-3.004,-0.593]	0.87 [-0.076,1.815]	0.067 [-0.944,1.078]
IPV	-2.285*** [-3.596,-0.974]	1.505*** [0.749,2.262]	-1.719** [-2.928,-0.510]	0.845 [-0.101,1.790]	0.033 [-0.980,1.045]
Sexual abuse	-0.413 [-2.655,1.829]	1.660*** [0.906,2.414]	-1.852** [-3.084,-0.621]	0.889 [-0.062,1.840]	0.145 [-0.871,1.161]
Household mental illness	-1.914*** [-3.006,-0.821]	1.670*** [0.893,2.446]	-1.809** [-3.051,-0.568]	0.603 [-0.375,1.580]	0.055 [-0.987,1.097]
Household alcohol problem	-1.987*** [-2.977,-0.997]	1.582*** [0.826,2.337]	-1.821** [-3.031,-0.611]	0.686 [-0.265,1.638]	-0.063 [-1.080,0.955]

Beta coefficient 95% confidence intervals in brackets

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 37: SF-36 MCS models 1-4 with each type of ACE represented as individual variables

	Model 1	Model 2	Model 3	Model 4
Raised by	-3.287* [-6.138,-0.436]	-2.912 [-5.886,0.063]	-2.687 [-5.757,0.382]	-2.787 [-5.845,0.271]
Adopted	-0.028 [-0.995,0.939]	-0.081 [-1.101,0.938]	-0.046 [-1.086,0.994]	0.001 [-1.039,1.041]
Moved frequently	0.075 [-2.787,2.936]	0.407 [-2.584,3.398]	1.385 [-1.663,4.433]	1.254 [-1.787,4.295]
Physical neglect	-0.157 [-1.879,1.565]	-0.703 [-2.545,1.138]	-0.433 [-2.309,1.444]	-0.519 [-2.386,1.348]
Emotional neglect	-1.321 [-3.047,0.405]	-0.868 [-2.710,0.975]	-0.41 [-2.318,1.499]	-0.372 [-2.273,1.529]
Emotional abuse	-1.272** [-2.155,-0.390]	-1.573** [-2.510,-0.636]	-1.475** [-2.439,-0.511]	-1.424** [-2.386,-0.462]
Physical abuse	-0.768 [-1.959,0.424]	-0.575 [-1.840,0.691]	-0.359 [-1.648,0.931]	-0.325 [-1.610,0.960]
IPV	-1.418 [-2.922,0.087]	-1.245 [-2.835,0.345]	-1.348 [-2.974,0.278]	-1.456 [-3.075,0.164]
Sexual abuse	0.509 [-1.810,2.828]	0.792 [-1.693,3.276]	0.884 [-1.632,3.400]	0.954 [-1.552,3.461]
Household mental illness	-1.158* [-2.254,-0.062]	-1.263* [-2.415,-0.112]	-1.146 [-2.326,0.033]	-1.154 [-2.330,0.022]
Household alcohol problem	-1.437** [-2.490,-0.383]	-1.103 [-2.213,0.007]	-1.147* [-2.277,-0.017]	-1.079 [-2.210,0.052]
Language				
French		1.111** [0.296,1.926]	1.156** [0.314,1.998]	1.312** [0.465,2.158]
Sex				
Female		-1.871** [-3.153,-0.590]	-2.232** [-3.581,-0.883]	-2.855*** [-4.270,-1.440]
Mother's Education				
High school complete		0.423 [-0.585,1.431]	0.495 [-0.537,1.528]	0.421 [-0.617,1.458]
Post-secondary complete		-0.326 [-1.405,0.752]	-0.322 [-1.424,0.781]	-0.455 [-1.575,0.665]
Smoking status				
Ex-smoker			-0.647 [-1.632,0.337]	-0.442 [-1.438,0.554]
Current smoker			-0.652 [-1.631,0.326]	-0.376 [-1.366,0.615]
BMI				
Overweight			-0.299 [-1.142,0.544]	-0.199 [-1.052,0.653]
Obese			-1.540* [-3.076,-0.005]	-1.393 [-2.937,0.150]
Physical activity				
Moderately active			-0.163 [-1.164,0.838]	-0.253 [-1.253,0.747]
Inactive			-0.017 [-1.080,1.045]	-0.076 [-1.136,0.984]
Sleep problems				
Disturbed sleep			-1.285** [-2.071,-0.498]	-1.319** [-2.104,-0.534]
Social support				
Medium			-0.242 [-1.185,0.701]	-0.174 [-1.117,0.770]
Low			-0.456 [-1.464,0.553]	-0.481 [-1.500,0.538]
Education				
High school complete			0.378 [-0.698,1.455]	0.304 [-0.772,1.380]
Post-secondary complete			1.521* [0.217,2.824]	1.049 [-0.365,2.464]
Parental Status				

Parent				-1.019 [-2.148,0.110]
Marital status				
Married				0.136 [-0.857,1.130]
Widow/divorce/separated				-2.721** [-4.683,-0.758]
Years in the military				
2.5 - 5 years				-0.988 [-2.543,0.567]
Over 5 years				-1.1 [-2.849,0.650]
Branch				
Navy				0.696 [-1.660,3.051]
Air Force				2.312** [0.842,3.782]
Rank				
NCM				-1.081 [-2.569,0.407]
Deployment length				
Short (≤ 5 mos)				0.976 [-0.083,2.034]
Age post-deployment				
25 to 34 years				-0.85 [-1.778,0.078]
35 years or more				1.266 [-0.448,2.980]
Observations	2783	2497	2429	2421
AIC	20529.963	18398.071	17916.605	17836.457
BIC	20601.138	18491.236	18073.076	18056.55

Beta coefficient with 95% confidence intervals in brackets

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

In Table 37, each individual ACE was treated as a separate variable and all included within the same model (so that all ACEs were accounted for in the same model). In the fully adjusted model (Model 2), only emotional abuse (β coefficient: -1.573 (95% CI: -2.510, -0.636; $p=0.001$)) and household mental illness (β coefficient: -1.263 (95% CI: -2.415, -0.112; $p=0.032$)) significantly were associated with SF-36 MCS. Most ACEs had little to no association with mental health, likely because when all other ACEs are controlled for within the model, the model isolates the impact of an individual ACE, which occurs infrequently (see Figure 10).

APPENDIX M: Covariate estimates in ACE models for each mental health outcome

Table 38: Type of ACE (q77) scale and all outcomes

Model 2		SF-36 MCS	PTSD		Depression	Suicidal Ideation	Anxiety (excl. panic)
		linear (beta coef)	multinomial logistic (RRR)		ordinal logistic (OR)	logistic (OR)	logistic (OR)
			Likely PTSD	Very Likely PTSD	Possible & Probable		
Types of q77 ACE	Scale	-0.960*** [-1.235,-0.686]	1.200*** [1.107,1.301]	1.420*** [1.235,1.634]	1.355*** [1.235,1.486]	1.304*** [1.118,1.520]	1.294*** [1.113,1.505]
Language	English (base)						
	French	1.239** [0.482,1.997]	0.503*** [0.380,0.666]	0.248*** [0.117,0.528]	0.565** [0.393,0.812]	0.649 [0.357,1.181]	0.325** [0.158,0.669]
Sex	Male (base)						
	Female	-1.742** [-2.945,-0.538]	0.981 [0.654,1.470]	1.255 [0.586,2.689]	1.694* [1.101,2.606]	0.62 [0.222,1.727]	0.794 [0.314,2.009]
Mother's Education	No high school (base)						
	High school complete	0.662 [-0.280,1.604]	0.935 [0.681,1.284]	0.694 [0.380,1.265]	0.739 [0.504,1.083]	1.795 [0.847,3.804]	0.631 [0.320,1.246]
	Post-secondary complete	-0.181 [-1.189,0.827]	1.066 [0.763,1.487]	0.653 [0.334,1.276]	0.828 [0.550,1.246]	1.605 [0.718,3.589]	1.172 [0.606,2.266]
Observations		2758		2760	2757	2752	2717
Adjusted R2		0.027		-	-	-	-
AIC		20307.617		2482.956	1525.758	587.562	572.482
BIC		20343.151		2554.032	1567.211	623.082	607.925

95% confidence intervals in brackets

* p < 0.05, ** p < 0.01, *** p < 0.001

Table 39: Types of ACE (q77) categories and all outcomes

Model 2		SF-36 MCS linear (beta coef)	PTSD multinomial logistic (RRR) <i>Likely PTSD</i>	<i>Very Likely PTSD</i>	Depression ordinal logistic (OR) <i>Possible & Probable</i>	Suicidal Ideation logistic (OR)	Anxiety (excl. panic) logistic (OR)
Types of q77 ACE	None (base)						
	Low (1 ACE)	-0.84 [-1.741,0.061]	1.441* [1.059,1.960]	1.578 [0.758,3.283]	1.736** [1.144,2.635]	1.173 [0.558,2.467]	2.029* [1.005,4.097]
	Medium (2-3 ACE)	-2.775*** [-3.725,-1.825]	2.070*** [1.539,2.785]	3.263*** [1.727,6.165]	2.695*** [1.823,3.984]	2.787** [1.507,5.151]	3.311*** [1.734,6.321]
	High (4-8 ACE)	-3.873*** [-5.411,-2.336]	1.794* [1.124,2.865]	4.707*** [2.170,10.209]	4.214*** [2.557,6.943]	3.218** [1.374,7.539]	2.506 [0.953,6.587]
Language	English (base)						
	French	1.235** [0.477,1.993]	0.504*** [0.380,0.667]	0.249*** [0.117,0.529]	0.568** [0.395,0.817]	0.668 [0.367,1.215]	0.324** [0.158,0.667]
Sex	Male (base)						
	Female	-1.727** [-2.931,-0.522]	0.975 [0.650,1.462]	1.241 [0.579,2.658]	1.700* [1.105,2.615]	0.61 [0.219,1.701]	0.781 [0.308,1.981]
Mother's Education	No high school (base)						
	High school complete	0.689 [-0.253,1.631]	0.93 [0.678,1.277]	0.679 [0.373,1.236]	0.738 [0.504,1.081]	1.759 [0.831,3.723]	0.612 [0.311,1.205]
	Post-secondary complete	-0.158 [-1.166,0.851]	1.052 [0.754,1.468]	0.639 [0.328,1.246]	0.825 [0.548,1.240]	1.579 [0.707,3.523]	1.122 [0.583,2.161]
Observations		2758		2760	2757	2752	2717
Adjusted R2		0.026		-	-	-	-
AIC		20310.63		2484.599	1526.755	587.212	572.283
BIC		20358.008		2579.366	1580.052	634.573	619.541

95% confidence intervals in brackets
 * p < 0.05, ** p < 0.01, *** p < 0.001

Table 40: All types of ACE scale and all outcomes

Model 2		SF-36 MCS linear (beta coef)	PTSD multinomial logistic (RRR) <i>Likely PTSD</i>	<i>Very Likely PTSD</i>	Depression ordinal logistic (OR) <i>Possible & Probable</i>	Suicidal Ideation logistic (OR)	Anxiety (excl. panic) logistic (OR)
All types of ACE	Scale	-0.873*** [-1.122,-0.623]	1.189*** [1.105,1.279]	1.368*** [1.205,1.552]	1.309*** [1.204,1.424]	1.268*** [1.103,1.457]	1.273*** [1.111,1.459]
Language	English (base)						
	French	1.215** [0.454,1.976]	0.511*** [0.385,0.677]	0.249*** [0.117,0.529]	0.566** [0.394,0.814]	0.652 [0.358,1.186]	0.329** [0.160,0.678]
Sex	Male (base)						
	Female	-1.706** [-2.911,-0.502]	0.974 [0.650,1.460]	1.235 [0.576,2.646]	1.676* [1.089,2.579]	0.611 [0.219,1.704]	0.779 [0.307,1.973]
Mother's Education	No high school (base)						
	High school complete	0.629 [-0.315,1.573]	0.945 [0.688,1.298]	0.702 [0.385,1.281]	0.747 [0.510,1.095]	1.809 [0.853,3.838]	0.642 [0.325,1.270]
	Post-secondary complete	-0.205 [-1.216,0.805]	1.066 [0.763,1.489]	0.654 [0.335,1.279]	0.833 [0.553,1.254]	1.615 [0.722,3.613]	1.187 [0.614,2.297]
Observations		2751		2753	2750	2745	2711
Adjusted R2		0.027		-	-	-	-
AIC		20258.93		2476.731	1526.633	587.541	571.577
BIC		20294.449		2547.776	1568.069	623.046	607.008

95% confidence intervals in brackets
 * p < 0.05, ** p < 0.01, *** p < 0.001

Table 41: All types of ACE categories and all outcomes

Model 2		SF-36 MCS	PTSD multinomial logistic (RRR)		Depression	Suicidal Ideation	Anxiety (excl. panic)
		linear (beta coef)			ordinal logistic (OR)	logistic (OR)	logistic (OR)
			Likely PTSD	Very Likely PTSD	Possible & Probable		
Types of ACE	None (base)						
	Low (1 ACE)	-0.581 [-1.472,0.311]	1.266 [0.920,1.741]	1.916 [0.922,3.984]	1.683* [1.101,2.572]	0.724 [0.325,1.612]	1.366 [0.654,2.856]
	Medium (2-3 ACE)	-2.282*** [-3.228,-1.335]	2.005*** [1.479,2.719]	2.703** [1.334,5.477]	2.171*** [1.430,3.297]	2.189* [1.173,4.085]	2.593** [1.340,5.017]
	High (4-9 ACE)	-3.759*** [-5.136,-2.381]	2.110*** [1.396,3.189]	4.912*** [2.268,10.638]	4.158*** [2.588,6.680]	2.909** [1.343,6.300]	2.469* [1.051,5.800]
Language	English (base)						
	French	1.242** [0.480,2.004]	0.516*** [0.390,0.684]	0.248*** [0.116,0.527]	0.567** [0.394,0.815]	0.661 [0.363,1.204]	0.325** [0.158,0.669]
Sex	Male (base)						
	Female	-1.711** [-2.918,-0.505]	0.967 [0.645,1.450]	1.236 [0.578,2.645]	1.677* [1.091,2.579]	0.611 [0.219,1.704]	0.784 [0.310,1.983]
Mother's Education	No high school (base)						
	High school complete	0.655 [-0.289,1.600]	0.944 [0.687,1.295]	0.691 [0.380,1.257]	0.743 [0.508,1.088]	1.802 [0.851,3.815]	0.618 [0.314,1.217]
	Post-secondary complete	-0.171 [-1.182,0.840]	1.062 [0.760,1.483]	0.636 [0.327,1.239]	0.824 [0.548,1.238]	1.604 [0.719,3.578]	1.135 [0.590,2.186]
Observations		2751		2753	2750	2745	2711
Adjusted R2		0.024		-	-	-	-
AIC		20267.577		2481.523	1531.391	586.286	576.305
BIC		20314.935		2576.25	1584.665	633.626	623.546

95% confidence intervals in brackets

* p < 0.05, ** p < 0.01, *** p < 0.001

Table 42: q77 ACE intensity scale and all outcomes

Model 2		SF-36 MCS	PTSD multinomial logistic (RRR)		Depression	Suicidal Ideation	Anxiety (excl. panic)
		linear (beta coef)			ordinal logistic (OR)	logistic (OR)	logistic (OR)
			Likely PTSD	Very Likely PTSD	Possible & Probable		
q77 ACE intensity	Scale	-0.277*** [-0.349,-0.204]	1.061*** [1.038,1.084]	1.090*** [1.048,1.134]	1.089*** [1.061,1.117]	1.074*** [1.030,1.121]	1.074*** [1.030,1.120]
Language	English (base)						
	French	1.122** [0.362,1.882]	0.521*** [0.393,0.691]	0.246*** [0.116,0.523]	0.580** [0.403,0.835]	0.659 [0.362,1.200]	0.332** [0.161,0.684]
Sex	Male (base)						
	Female	-1.793** [-2.994,-0.591]	0.986 [0.657,1.479]	1.275 [0.596,2.728]	1.727* [1.122,2.659]	0.624 [0.224,1.741]	0.797 [0.315,2.019]
Mother's Education	No high school (base)						
	High school complete	0.636 [-0.304,1.577]	0.947 [0.690,1.301]	0.682 [0.375,1.241]	0.74 [0.505,1.084]	1.788 [0.844,3.787]	0.632 [0.320,1.247]
	Post-secondary complete	-0.201 [-1.207,0.806]	1.08 [0.773,1.508]	0.63 [0.323,1.228]	0.823 [0.547,1.238]	1.588 [0.711,3.546]	1.164 [0.603,2.247]
Observations		2758		2760	2757	2752	2717
Adjusted R2		0.03		-	-	-	-
AIC		20298.5		2478.987	1523.687	587.643	572.173
BIC		20334.033		2550.063	1565.14	623.163	607.617

95% confidence intervals in brackets

* p < 0.05, ** p < 0.01, *** p < 0.001

Table 43: q77 ACE intensity categories and all outcomes

Model 2		SF-36 MCS linear (beta coef)	PTSD multinomial logistic (RRR) <i>Likely PTSD</i> <i>Very Likely PTSD</i>	Depression ordinal logistic (OR) <i>Possible & Probable</i>	Suicidal Ideation logistic (OR)	Anxiety (excl. panic) logistic (OR)
q77 ACE intensity	None (base)					
	Low (1 ACE)	-1.352** [-2.316,-0.387]	1.322 [0.900,1.943]	1.182 [0.482,2.900]	1.469 [0.845,2.554]	1.396 [0.579,3.370]
	Medium (2-3 ACE)	-2.570*** [-3.610,-1.531]	2.206*** [1.504,3.236]	2.289 [0.968,5.415]	2.666*** [1.555,4.572]	3.409* [1.288,9.022]
	High (4-8 ACE)	-4.785*** [-6.087,-3.483]	2.887*** [1.878,4.438]	4.376** [1.807,10.597]	5.064*** [2.885,8.888]	3.927** [1.577,9.782]
Language	English (base)					
	French	1.126** [0.366,1.886]	0.529*** [0.399,0.701]	0.247*** [0.116,0.525]	0.587** [0.408,0.845]	0.667 [0.367,1.215]
Sex	Male (base)					
	Female	-1.821** [-3.022,-0.619]	0.996 [0.664,1.494]	1.295 [0.605,2.770]	1.755* [1.140,2.701]	0.634 [0.228,1.768]
Mother's Education	No high school (base)					
	High school complete	0.663 [-0.276,1.603]	0.949 [0.691,1.303]	0.681 [0.375,1.238]	0.739 [0.504,1.082]	1.773 [0.839,3.748]
	Post-secondary complete	-0.185 [-1.191,0.821]	1.082 [0.775,1.510]	0.625 [0.321,1.215]	0.817 [0.544,1.228]	1.573 [0.706,3.502]
Observations		2758		2760	2757	2752
Adjusted R2		0.03		-	-	-
AIC		20300.493		2484.599	1519.808	589.65
BIC		20347.871		2579.366	1573.105	637.011

95% confidence intervals in brackets

* p < 0.05, ** p < 0.01, *** p < 0.001

Table 44: All ACE intensity scale and all outcomes

Model 2		SF-36 MCS linear (beta coef)	PTSD multinomial logistic (RRR) <i>Likely PTSD</i> <i>Very Likely PTSD</i>	Depression ordinal logistic (OR) <i>Possible & Probable</i>	Suicidal Ideation logistic (OR)	Anxiety (excl. panic) logistic (OR)
ACE intensity	scale	-0.250*** [-0.316,-0.185]	1.057*** [1.037,1.078]	1.080*** [1.043,1.119]	1.077*** [1.053,1.102]	1.065** [1.026,1.106]
Language	English (base)					
	French	1.117** [0.355,1.879]	0.528*** [0.398,0.700]	0.247*** [0.116,0.524]	0.579** [0.402,0.833]	0.658 [0.361,1.197]
Sex	Male (base)					
	Female	-1.775** [-2.977,-0.573]	0.982 [0.655,1.474]	1.264 [0.590,2.706]	1.717* [1.115,2.644]	0.62 [0.222,1.730]
Mother's Education	No high school (base)					
	High school complete	0.603 [-0.340,1.545]	0.958 [0.697,1.316]	0.69 [0.379,1.256]	0.748 [0.510,1.096]	1.799 [0.849,3.813]
	Post-secondary complete	-0.233 [-1.241,0.776]	1.084 [0.775,1.515]	0.637 [0.327,1.243]	0.832 [0.553,1.252]	1.602 [0.717,3.579]
Observations		2751		2753	2750	2745
Adjusted R2		0.03		-	-	-
AIC		20249.916		2471.565	1525.758	587.562
BIC		20285.434		2542.61	1567.211	623.082

95% confidence intervals in brackets

* p < 0.05, ** p < 0.01, *** p < 0.001

Table 45: All ACE intensity categories and all outcomes

Model 2		SF-36 MCS linear (beta coef)	PTSD multinomial logistic (RRR) <i>Likely PTSD</i> <i>Very Likely PTSD</i>		Depression ordinal logistic (OR) <i>Possible & Probable</i>	Suicidal Ideation logistic (OR)	Anxiety (excl. panic) logistic (OR)
ACE intensity	None (base)						
	Low (1-5)	-1.188* [-2.255,-0.121]	1.01 [0.659,1.548]	1.533 [0.508,4.626]	1.411 [0.753,2.647]	1.129 [0.404,3.158]	2.12 [0.613,7.328]
	Medium (6-11 ACE)	-2.512*** [-3.633,-1.392]	1.962** [1.297,2.967]	2.901 [0.994,8.467]	2.547** [1.381,4.696]	2.627 [0.994,6.947]	3.33 [0.983,11.282]
	High (12-37 ACE)	-4.700*** [-5.990,-3.409]	2.667*** [1.717,4.141]	4.777** [1.616,14.126]	4.541*** [2.436,8.465]	3.517* [1.279,9.671]	6.249** [1.838,21.240]
Language	English (base)						
	French	1.132** [0.372,1.892]	0.535*** [0.403,0.709]	0.245*** [0.116,0.521]	0.581** [0.404,0.836]	0.673 [0.370,1.223]	0.346** [0.168,0.712]
Sex	Male (base)						
	Female	-1.820** [-3.021,-0.618]	0.996 [0.664,1.496]	1.298 [0.607,2.774]	1.759* [1.144,2.706]	0.639 [0.229,1.780]	0.808 [0.319,2.046]
Mother's Education	No high school (base)						
	High school complete	0.638 [-0.303,1.579]	0.959 [0.698,1.318]	0.679 [0.374,1.234]	0.739 [0.505,1.081]	1.786 [0.845,3.776]	0.634 [0.322,1.249]
	Post-secondary complete	-0.224 [-1.232,0.783]	1.094 [0.783,1.529]	0.63 [0.324,1.225]	0.825 [0.549,1.240]	1.596 [0.717,3.554]	1.189 [0.617,2.291]
Observations		2751		2753	2750	2745	2711
Adjusted R2		0.031		-	-	-	-
AIC		20249.2		2466.446	1524.549	587.149	570.097
BIC		20296.558		2561.174	1577.824	634.49	617.338

95% confidence intervals in brackets

* p < 0.05, ** p < 0.01, *** p < 0.001

APPENDIX N: ACE “types” and “intensity” supplemental figures

Error! Reference source not found. visualizes three types of comparisons between ACE variables in their association with SF-36 MCS:

1. “Question 77 ACE” versus “All ACE” variables
2. “Types of ACE” versus “ACE intensity” variables
3. Scale and categorical ACE variables

Figure 30: “ACE types” versus “ACE intensity” variables and SF-36 MCS

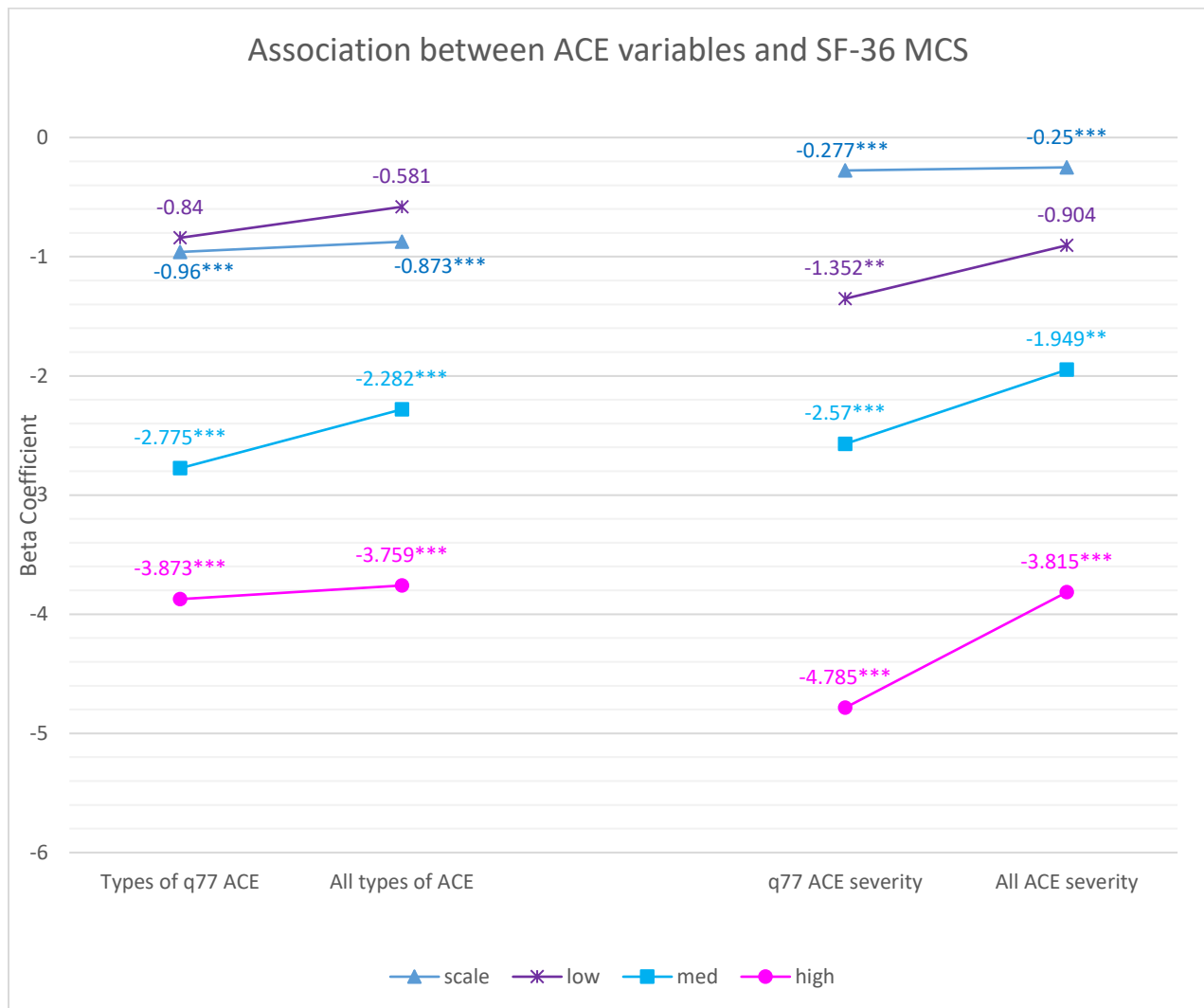
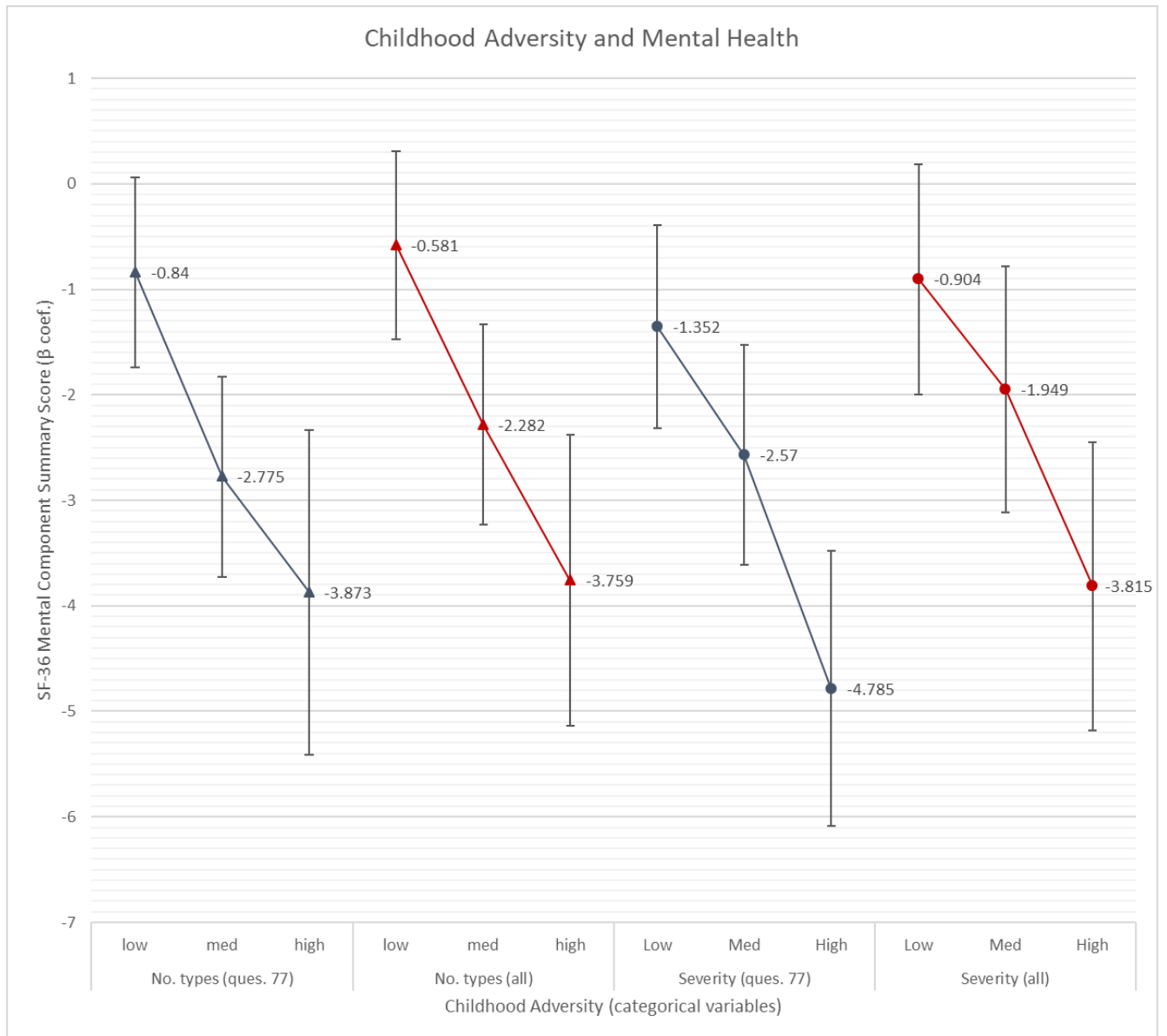


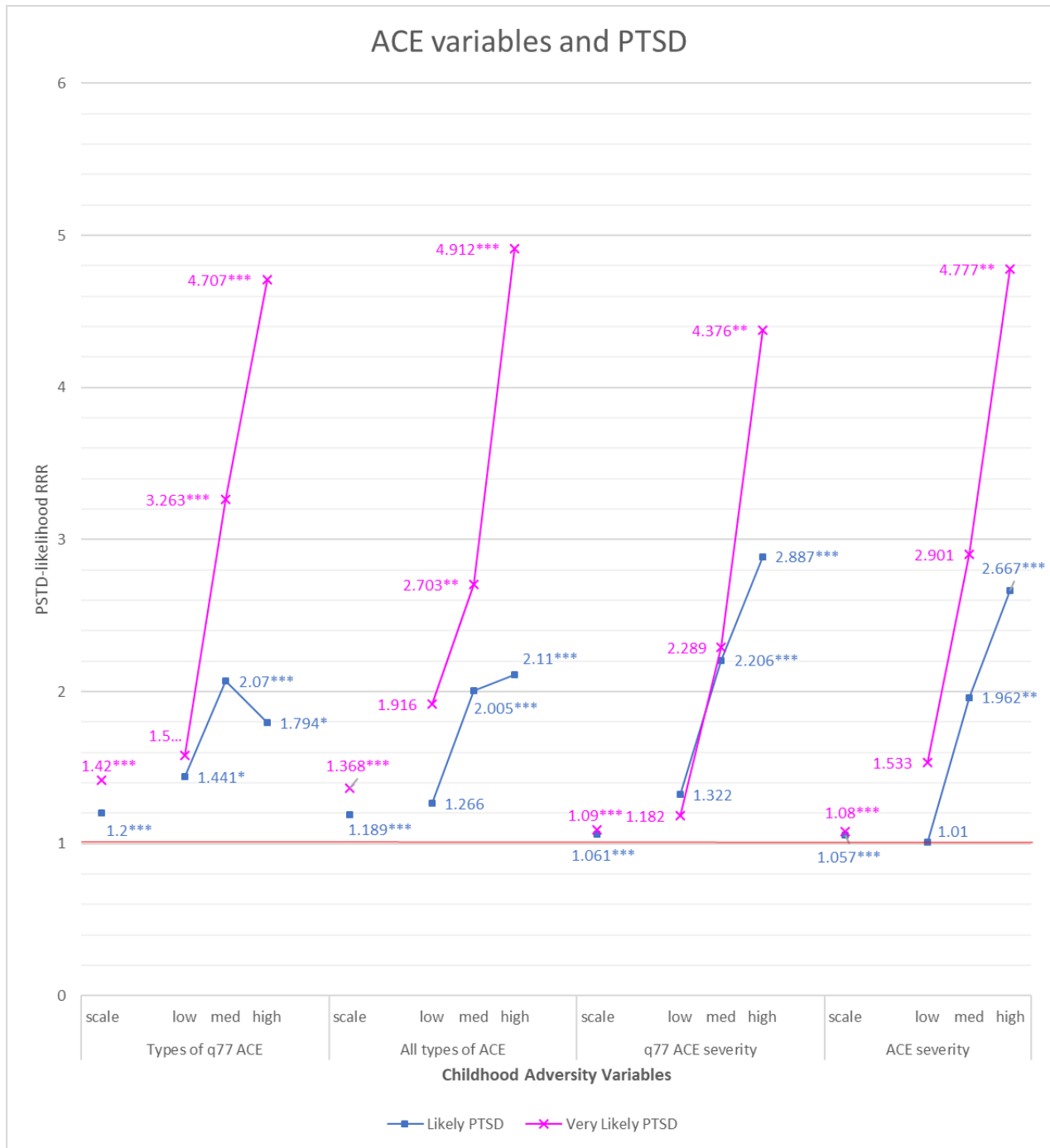
Figure 31 depicts comparisons of categorical variable versions of cumulative types of ACE (“ACE types”) and “ACE intensity.”

Figure 31: “ACE types” versus “ACE intensity” categorical variables and SF-36 MCS



Cumulative types of childhood adversities experienced (“ACE types” variable) and “ACE intensity” variables in their association with PTSD-likelihood are depicted below.

Figure 32: “ACE types” versus “ACE intensity” scale variables and PTSD



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