

The Duration of Deployment and Sensitization to Stress

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This article addresses conceptual and theoretical issues concerning how the duration of deployment to a combat theater of operations may impact the mental health of deployed troops. A core principle of occupational medicine, critical to this aim, is to identify hazardous exposures in the workplace and define levels of acceptable exposure to those hazards. The known relationship between combat exposure and combat stress reactions, and the long-term risk of posttraumatic stress disorder (PTSD), is well established.¹ However, the critical issue of the duration of exposure and its impact on the delayed emergence of symptoms has not been analyzed. To date, the literature has not considered the underlying mechanisms that might mediate the adverse effects of duration of deployment in relation to PTSD.

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BACKGROUND ISSUES

In the first half of the 20th century, the intensity of combat was slow to be accepted as a cause of military casualties. A review of the morbidity and the rate of loss of combat-ready servicemen during World War I led the British War Office Commission of Enquiry into Shellshock² to conclude that “shellshock” was a consequence of the failings of individual character and that some individuals were more resilient than others. In so doing, an emerging body of literature about the relationship between casualty rates and the intensity of combat was not seen to be compelling. As a consequence, considerable emphasis was put on screening and recruitment strategies during World War II to weed out individuals who would appear to not cope in combat. However, this intense effort failed to change the rates of combat stress casualties.³

The British threat of combat troop mortality and morbidity and the rate of acute experience from World War II⁴ established a constant relationship between acute psychiatric casualties. Major variables were perceived to be the quality of the troops and the nature of the fighting. Based on similar observations, Bomber Command initially limited a tour of duty to 30 missions, because of the increasing evidence of the unendurable strain that was being placed on British-based bomber crews with mission assignments over occupied Europe and Germany.⁵ Observations from the beginnings of the American military’s 1943 Italian campaign demonstrated that even the most hardened combat troops had an increasing rate of psychiatric casualty and combat-related exposure that extended more than 60 days. The unheard message was that even the most robust individuals had a breaking point.⁶

By the time of the Vietnam War, the accepted link or relationship between combat psychological and physical casualties led to the implementation of the practice of not requiring troops to serve the entirety of a campaign. The time of the tour of duty was

limited to 1 year in theater. Each person sent to Vietnam was given a date eligible for return from overseas (DEROS). As a consequence of the accumulated weight of evidence, the provision of forward psychiatric services based on the proximity, immediacy, expectancy, simplicity (PIES)



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medical and psychological principle became the psychiatric community’s accepted approach to dealing with the psychological problems associated with combat stress. Intensity of combat was a predictor of combat psychiatric casualties; however, the ability of combat to produce long-term adverse effects is not well reflected in the literature. For example, Glass⁷ noted that the effective application of forward psychiatry in the Vietnam War allegedly prevented long-term adverse outcomes. As the recent re-examination of the National Vietnam Veterans Readjustment Study (NV-VRS)⁸ again demonstrated, this was not the case. The acceptance of PTSD in the *Diagnostic and Statistical Manual of Mental Disorders*, third edition (DSM-III), was driven in part by an acceptance that there is a definitive relationship between combat and long-lasting psychiatric morbidity.

Today there remains little consensus about the effect of the duration of deployment in a combat environment on troop mental health. This paper reviews the literature addressing this association, using the Bradford Hill Criteria, a method for determining the significance and nature of epidemiological associations, which may change one’s understanding of possible adverse effects of deployment.⁹

DEPLOYMENT-RELATED VARIABLES

The increasing rates of divorce and the instability of families in the civilian western world is a background issue that further increases the potential adverse effects of a military deployment. The greater involvement of women in Defence Force roles raises issues, including separation from children and how that affects child rearing practices. These have not had to be addressed in previous deployments. Therefore, it is not simply the fact of deployment, but the separation from family that can be an important factor in determining long-term mental health outcomes. The increased prevalence of dual career roles in the civilian and military community to maintain living standards means that families are placed under greater strain if one partner or both partners are removed for a prolonged period of time.

A number of deployment-related factors are important: brief psychoeducation appears to have some protective effect against the evolution of posttraumatic symptoms, as does pre-deployment training dealing with the impending risk of combat-related injuries and death.¹⁰ Post-deployment decompression strategies provide a chance for troops to ventilate and express their feelings and concerns. Vogt¹¹ highlighted gender differences in the U.S. National Guard and Reserve. Active-duty women were more at risk for emotional difficulties. The longer a parent is absent, especially when it is the mother, the greater the risk of psychological dysfunction interfering with post-deployment family life.

In a recent study examining combat veterans' use of mental health services, Milliken et al¹² highlighted the higher rates of psychiatric morbidity among U.S. reserve officers. Similar findings were identified by Browne et al,¹³ demonstrating that reservists in the U.K. forces had different experiences on deployment, both determined because of their rank and their higher exposures to traumatic experiences. They also faced different challenges on returning home.

BRADFORD HILL CRITERIA

Sir Austin Bradford Hill suggested nine criteria to be considered in determining a cause-and-effect relationship between one event and another.¹ He states: "None of my nine viewpoints bring indisputable evidence for or against the cause-and-effect hypothesis," but "if specificity exists we may be able to draw conclusions without hesitations; if it is not apparent, we are not thereby necessarily left sitting irresolutely on the fence." Thus, the more objective and quantifiable the data, the greater the probability that there may be a cause-and-effect relationship. This conceptual model is used to examine the relationship between deployment-related issues and the evolution of the psychiatric condition usually referred to as PTSD. It is important to recognize and appreciate that the cause and management of combat stress reactions are not synonymous with the etiology and treatment of PTSD.

1. Strength of Association

A U.K. study of 5,547 regular troops identified that individuals who had deployed for 13 months or more in the previous 3 years had a significantly greater risk (odds ratio of 1.5) of PTSD.¹⁴ Similar trends were found for general psychiatric distress and multiple physical symptomatology. Furthermore, they found a significant relationship between severe alcohol problems and the duration of deployment. The total duration of deployment, not the number of deployments,

was the critical risk factor. These findings are consistent with the association between duration of deployment and increased levels of psychological distress. This association has only been examined after single deployments.¹⁵⁻²⁰

2. Consistency

Hill emphasized the importance that an observation can be found repeatedly by different persons in different places, circumstances, and times. He noted that across the countries involved in warfare, there is a consistent finding that the duration of the deployment,¹⁴ particularly when combat exposure occurs, is associated with adverse outcomes.²¹ It is reported that combat stress reactions are not synonymous with the etiology and treatment of PTSD.

The literature has only begun to clarify the conceptual importance of distinguishing the effects from intense combat exposure as a cause of combat stress reactions compared with the duration of deployment in a combat zone as a risk factor for PTSD. Senior war strategists before and during World War I and World War II had significant concerns about the maintenance of their fighting forces in active service roles for the duration of the conflict. Managing and preventing combat stress reactions are a means of increasing force strength and effectiveness. More recently, the literature has focused on the rate of PTSD and other psychiatric disorders observed in the aftermath of deployment.²² This separation of acute events from the lasting effects of combat is a critical issue, because the underlying etiological mechanisms and individual symptomatic presentations are different. Although individuals with acute stress disorders represent part of a particular group who have a higher risk of long-term adverse psychological outcomes, the majority of individuals who develop PTSD do so in the absence of acute stress disorders.²³ Furthermore, the delayed emergence of PTSD morbidity (observed in 23% of this longitudinal cohort of Israeli veterans) has provoked considerable skepticism.

A recent review about delayed-onset PTSD emphasized how much of the confusion has arisen from different definitions of delayed-onset PTSD.²⁴ For example, different interpretations of the concept include an individual who has had sub-syndromal symptoms that have crossed a threshold of clinical severity, in contrast to the alternative formulation, where an individual has been asymptomatic and then, at some later point, developed the disorder. The potential for an exposure to have a long tail of effect is a critical issue in determining whether the duration of repeated deployments in defined time periods carries a greater risk. The recent U.K. study¹⁴ provides the first reliable data addressing this question and suggests that the risk of PTSD is greater in those units that have had longer durations of deployment with less time to recuperate between deployments. This latter group highlights the importance of considering the underlying psychopathological mechanisms, such as kindling and sensitization, which are discussed below. Failure to understand the different causal mechanisms in this group of PTSD patients has been one of the greatest sources of confusion in the debate about the psychological costs of war.

3. Specificity

Specificity is established when a single putative cause produces a specific effect. However, Bradford Hill argued that the importance of this characteristic should not be overemphasized. He highlighted how specific toxins, for example, could cause cancer at multiple sites or how milk, as a carrier of infection, could transmit a variety of infectious agents. The duration of deployment does not have a specific effect; rather, there is an apparent increased risk of various psychiatric disorders such as acute stress disorders, PTSD, depression, and alcohol and substance abuse.²⁴ Furthermore, in considering this variable of duration of deployment, it is important to emphasize that most diseases, particularly of psychological nature, are

a consequence of the interaction of multiple factors.²⁵ Therefore, deployment may represent a proxy marker for a number of intermediate variables.

4. Temporality Relationship

The essence of the temporal relationship argument is that the duration of deployment is a variable which precedes the onset of the adverse mental health outcomes. Thus, deployment must precede the occurrence of psychiatric morbidity. The challenge in any military is that a proportion of troops who do deploy are already experiencing significant psychological symptoms.²¹ Therefore, those studies that have had pre-deployment screens²⁶⁻²⁸ demonstrated that the intensity of combat exposure is critical to the demonstration of the temporal relationships, independent of pre-existing disorders.

5. Dose-response Relationship

The essence of the literature dealing with a dose-response relationship is that a total time deployed of more than 13 months, throughout a 3-year period, is associated with a significant increased risk of the development of dysfunctional psychopathology. Armed services, by their nature, require an expeditionary function for deployment into warlike zones. There is a second dose-response relationship. The adverse outcomes of deployment are noted in those with high combat exposure.^{21,28} This was also confirmed in studies of the performance of American soldiers in the Vietnam War.²⁹ A confounding factor is that there are multiple traumatic experiences that occur in civilian communities, such as motor vehicle accidents, domestic violence,³⁰ and childhood abuse.^{10,31} This background morbidity is subsumed in the recruit population and may predispose a selected portion of combat troops to dysfunctional psychiatric morbidity. Thus, the fact that duration of deployment is a proxy for repeated combat exposure cannot be overemphasized.

6. Biological Plausibility

This criterion requires that the underlying mechanism of action that explains the association between deployment (cause) and psychiatric morbidity (effect) is consistent with known biological processes. The central mechanism is the process of sensitization to the subtle reminders of traumatic memories of combat as well



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as exposure to prior and future traumatic events. This process of reactivity to minor cues, which very frequently go unrecognized by the individual, serves to progressively increase and exacerbate the reactivity of the dysfunctional individual.³² This leads to an interaction between the individual's distress, psychophysiological reactivity, and the neurohormonal response at the time of the traumatic event. In discussing this question, it is important to recognize that being in combat is not the equivalent of a single traumatic event, such as being in a motor vehicle accident. Being in a combat zone and being in a prolonged combat engagement involves repeated activations of the fear and stress

systems, which are then prone to present and future dysregulation over time.

Individuals who develop PTSD have been found to have a progressive³³ evolution of dysfunction. Progressively, individuals react to the presence of potential threat with greater amplitude or intensity. Ultimately, they develop an overgeneralized reaction to a range of stimuli in their civilian and military environments that remind them of the traumatic event. This cycle of increasing reactivity to a range of cues in their environment serves to further reinforce the distress response. Elzinga and Bremner³⁴ have further characterized the role of the noradrenergic system in the enhanced encoding of the emotional memories and fear-conditioning in individuals who develop PTSD. The failure of the normal neurotransmitter inhibitory mechanisms that quell the stress response appears to be important in the progression of the individual's distress into a full-blown post-event or PTSD. Miller³⁵ characterizes this process as an explanation of how childhood trauma increases the risk of adult psychopathology because of the same process of sensitization.³⁶ Shalev³⁷ has highlighted how this process is also intimately integrated into the person's social and cultural setting. Shalev states that traumatic events are followed by "a critical period of increased brain plasticity, during which irreversible neuronal changes may occur in those who develop PTSD." He also emphasizes the importance of group cohesion, marital discord, and leadership skills as mediating factors.

Fear conditioning, kindling, and sensitization contribute to the manner in which repeated activation of the fear memories in PTSD³⁸ contribute to the emergence of subsequent apparent spontaneous intrusive memories. There is emerging medical scientific literature indicating that pharmacological agents may be able to modify these responses.³⁹ The measurement of the startle response can objectively characterize the sensitization that occurs in the fear and alarm response in PTSD. Increased

heart rate in response to sudden loud tones suggests a more recently acquired PTSD rather than a pre-existing emotional abnormality.⁴⁰ This abnormality emerges following traumatic exposure and suggests the role of fear conditioning and increased reactivity.⁴¹ The acquisition of an increased startle response was not related to the severity of the event or the initial intensity of the symptoms. This is consistent with the model of progressive neuronal sensitization and increasing heart rate reactivity over the subsequent 6 months. This pattern of increased reactivity is also observed in relationship to innocuous and aversive stimuli in a conditioning experiment where increased autonomic reactivity was demonstrated to both types of stimuli.⁴² Once conditioned, those with PTSD had reduced extinction to conditioned responses.

PTSD is only one of the outcomes that have been associated with military deployment. The emergence of multiple physical symptoms also has been attributed to various combat-related exposures. However, the consensus opinion is that these syndromes are indicative of a general reflection of distress. The underlying mechanisms of these disorders have been related to similar mechanisms of sensitization noted in those with PTSD.⁴³ In parallel, in civilian populations, multiple traumas have an accumulative effect on physical health, which appears to be independent of the development of PTSD.⁴⁴

7. Coherence

In essence, “the cause and effect interpretation of our data should not seriously conflict with the generally known facts of the natural history and biology of the disease.”⁹ The acceptance of the role of deployment in the development of acute combat stress disorders and those cases of PTSD beginning during the deployment is an issue of little contention. However, in cases of PTSD where there has been a latency period between the combat exposure and emergence of symptoms, skepticism occurs.⁴⁵ Classic psychopathological theo-

ries have not provided plausible explanations for this delayed impact of exposure. As a consequence, there is much literature where the war veteran who had coped in the heat of battle, and only broke down on return to his home years later, was viewed with considerable skepticism. His or her emotions and behaviors were seen as indicative of personality pathology as articulated in psychoanalytic models.⁷ However, the belief that forward psychiatry could resolve the psychological morbidity of war failed to address the possibility that there are some individuals in whom a psychopathological process that began in combat does not produce threshold clinical symptoms until much later.

Longitudinal studies have documented the progressive recruitment of symptoms with time.^{22,46-48} It is only with the passage of time that the level of symptoms crosses a threshold sufficient to warrant a clinical

diagnosis. Additional adversity, conflict, or stress plays a role in the later emergence of dysfunctional psychopathology.^{49,50} Further support for the delayed emergence of symptoms in military populations is the finding from the U.S. military that symptoms increase in the first 6 months following deployment.^{12,51} Thus, there appears to be a general escalation of symptoms following deployments.

PTSD is a condition that does not always develop at the time of the traumatic event. PTSD may develop in those who do not have an acute stress or adjustment disorder. PTSD is part of a complex psychobiological process that leads to the emergence of the disorder in the weeks, months, or years after the event.

8. Experimental Evidence

Experimental or semi-experimental evidence can be found from the results of

preventative interventions. The question is whether the intervention had some preventative or protective effect. The comparison of different lengths of deployment across specific armed service units¹⁵ demonstrated that the duration of deployment does have an important impact on the severity of psychological distress that results. This observation has not been confirmed by any experimental design.

Given the costs of military training and the challenges of recruitment, there is the increasing need to conduct such observational studies. This is particularly important following the findings of detrimental loss of verbal and visual working memory capacity in deployed troops, independent of reported stress symptoms, head injury, and other exposures.²⁷ The emergence of large psychophysiological databases permits military units to be monitored to determine the optimal periods of deployment using changes in physiological parameters from baseline or pre-deployment to the combat-related events and then in the post-deployment environment.⁵² The documented impact of prolonged stress exposure means that there is an environmental risk where the thresholds for prolonged adverse effects need to be systematically recorded.

9. Analogy

Sir Bradford Hill has argued that in some circumstances, "It would be fair to judge by analogy." He saw this as a reason for considering slighter but similar evidence and how it might be pertinent in defining a causal relationship. The essence of occupational medicine is identifying exposure gradients and then calculating health risk. Different potential forces or toxins, such as heat and cold, lead or radiation, are known to be associated with particular health risks. Through epidemiological observation and assessments, safe limits and protective mechanisms have been developed. The substantial literature on combat stress reactions and their relationship to the intensity and duration of combat exposure argues for the application of these

quantitative principles. This implies that with regard to deployment, the concept of a threshold of duration, when risk begins to accumulate above and beyond tolerable morbidity, requires further study.



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Police officers serve in a similar capacity to combat soldiers. They have to deal with repeated situations of danger with differing degrees of associated threat. Emsley⁵³ found that in a group of police officers retired on psychiatric grounds, the duration of exposure of a mean of 17 years preceded the onset of significant symptoms. It appeared that many of these individuals had delayed-onset PTSD with a significant latent period occurring between the trauma that led to their dysfunctional symptoms and their final disability. Prolonged exposure, in both instances, carries an accumulated risk of psychiatric morbidity.

CONCLUSION

The construct of exposure gradients to toxic risk factors is central to occupational health. The increasing evidence that prolonged deployments, particularly of more than 13 months in a 3-year period (Table, see page 87), highlights the need to con-

sider this threshold as an important variable in determining personnel management in military services. Opportunities exist to characterize the psychophysiological costs of combat exposure and their reversibility across time. The Bradford Hill Criteria provides a valuable template for considering the possible associations.

Given the critical issue of force maintenance and replacement, particularly in social environments that pose challenges for recruitment into the armed services, the impact of deployments on the physical and mental health of the troops must be recognized and addressed. A recent policy document from NATO allies,⁵⁴ reviewing the commitments of its forces to the Middle East Area of Operations, recommended that the duration of external operations deployments "should not normally exceed 4 months, or 6 months, with a period of home leave." It further indicated that there should be a minimum period of 18 months between the first and second mission. From an administrative perspective, this is an intervention that can readily be implemented. Rational scheduling of deployments may be a cost-effective, non-intrusive means of limiting psychiatric morbidity and maintaining troop morale.

This article has focused on specific military personnel issues. Military medicine has provided valuable insights into the management of civilian and military environmental risks and the basis for preventative strategies. The impact of prolonged exposure to stressful circumstances is a matter of considerable importance in terms of maintaining the health and retention of military personnel and their civilian counterparts.

The challenge in reviewing the effect of the duration of deployment is that it is not a unitary variable. Other factors such as the number of repeated exposures to traumatic events before enlistment in military service, and the intensity and duration of exposure to stressful events in service, affect the psychological and physical responses during and after combat experiences.

TABLE 1

Prevalence and Association Between Duration and Number of Deployments since 2000, for About a 3-year Period, and Psychological Symptoms, Posttraumatic Stress Disorder, Physical Symptoms, and Severe Alcohol Problems (N = 5,547)

Variables	Posttraumatic Stress Disorder		Psychological Distress Case		Multiple Physical Symptoms		Severe Alcohol Problems	
	No (%)	Odds ratio (95% CI)*	No (%)	Odds ratio (95% CI)*	No (%)	Odds ratio (95% CI)*	No (%)	Odds ratio (95% CI)*
Duration of deployment								
<5 months	26 (3.0)	1.00 (0.61 - 1.64)	169 (19.1)	1.12 (0.90 - 1.38)	88 (9.8)	0.93 (0.71 - 1.22)	96 (10.9)	0.70 (0.54 - 0.91)
5-8 months	55 (3.1)	1.00	308 (17.3)	1.00	192 (10.6)	1.00	298 (16.7)	1.00
9-12 months	60 (3.8)	1.10 (0.75 - 1.61)	308 (19.2)	1.10 (0.92 - 1.31)	173 (10.6)	0.97 (0.78 - 1.21)	305 (19.0)	1.02 (0.85 - 1.23)
≥13 months	62 (5.2)	1.58 (1.07 - 2.32)	257 (21.8)	1.35 (1.10 - 1.63)	175 (14.5)	1.49 (1.19 - 1.87)	285 (23.9)	1.35 (1.11 - 1.64)

* Adjusted for age, sex, serving status, rank, marital status, and service.

The Millennium Cohort Study, the U.K. Post-Deployment cohort studies, and the Deployed Health Surveillance Program in Australia will provide more data on the natural history of combat-related resilience and psychiatric dysfunction. A priority should be to examine the interaction between the duration of deployments, the exposure to combat, the impact on relationships at home, and the effects on re-integration into civilian life and non-combat home-based life. Further information is required about the effect of inter-deployment intervals as the evidence about sensitization suggests that an undefined period of time is required to allow the reversal of deployment-related hyperarousal and dysfunctional psychopathology. Interventions that can assist service personnel to re-establish their normal homeostasis, their normal psychophysiological level of arousal, and self regulation need to be identified, and their effectiveness should be studied in an experimental design.

Prospective and retrospective epidemiological studies have demonstrated that it is insufficient to merely identify, treat, and follow individuals who have become fully dysfunctional during or immediately post-deployment. The critical issue is to be able to identify those who have not yet become dysfunctional, but

may do so. Individuals with subclinical symptoms are at risk for having their symptoms aggravated to a dysfunctional level when exposed to additional trauma in either the civilian or military sectors. Pre-existing emotional factors, such as depression and abuse, have been noted to be risk factors for subsequent military-related dysfunctional behaviors.

Currently, the length of deployments to combat areas is driven by operational requirements and the logistical and cost factors of rotating troops for a deployment. The obligation to care and protect the troops may require greater operational flexibility and increased front-end logistic costs. These front-end costs may very well be offset by lower future costs from having to support and treat fewer psychiatric casualties. There is an ongoing balancing act that needs to be scientifically assessed. It is argued that the cohesion and integrity of fighting units cannot be constantly disrupted by frequent troop rotations. The ability of military leaders and personnel management strategists to reach a consensus to mitigate the effects of prolonged deployment requires the type of analytic approach or methodology presented above. Scientific evidence-based data are required to achieve a balance between optimal deployment times and intervals,

troop physical and psychiatric morbidity, and the needs of the military.

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