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**COMPARISONS OF MEDICAL PRESENTATION AND
ADMISSION RATES DURING VARIOUS COMBAT OPERATIONS**

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DURING VARIOUS COMBAT OPERATIONS**

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TABLE OF CONTENTS

Executive Summary 2

Introduction 3

Method 5

Results 7

Discussion 10

References 13

Fig 1. Okinawa Combat Troop Casualty Rates 14

Fig 2. Okinawa Combat Troop DNBI Rates 15

Fig 3. Okinawa Support Troop Casualty Rates 16

Fig 4. Okinawa Support Troop DNBI Rates 17

Fig 5. Korea Combat Troop Casualty Rates 18

Fig 6. Korea Combat Troop DNBI Rates 19

Fig 7. Korea Support Troop Casualty Rates 20

Fig 8. Korea Support Troop DNBI Rates 21

Fig 9. Vietnam Combat Troop Casualty Rates 22

Fig 10. Vietnam Combat Troop DNBI Rates 23

Fig 11. Falklands Amphibious Force Casualty Rates 24

Fig 12. Falklands Amphibious Force DNBI Rates 25

Fig 13. Comparisons of Wounded-in-Action Rates 26

Fig 14. Comparisons of DNBI Rates 27

Table 1. Lengths of Treatment 28

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SUMMARY

Problem

Medical resource planning requires projections of the anticipated casualties and disease/non-battle injury (DNBI) incidence likely to be sustained during an operation. Further, severity of the anticipated illnesses and injuries must be factored into the medical requirements.

Objective

The present investigation seeks to determine rates of casualty and DNBI incidence among combat and support troops for different types of ground operations.

Approach

Casualty and disease rates per 1000 strength per day were computed for ground troops deployed to Okinawa, Korea, Vietnam, and the Falklands. Daily rates were calculated for medical "presentations", which were those cases requiring less than three days of treatment, and "admissions", those cases which were retained at treatment facilities for three days or more.

Results

Daily rates of wounded-in-action (WIA) admissions for combat troops ranged from 1.61 to 5.54 per 1000 strength depending on the operation. Support troop WIA admission rates ranged from 0.05 to 0.43. Rates of DNBI admissions ranged from 0.99 to 4.03 for combat troops, while support troops evidenced rates between 0.71 and 0.93.

Conclusions

Accurate medical logistics planning requires factoring of the specific troop type percentages to account for the differences in casualty and DNBI incidence between combat and support troops. Likewise, battle intensity is a factor that affects DNBI incidence and must be planned for accordingly.

COMPARISONS OF MEDICAL PRESENTATION AND ADMISSION RATES
DURING VARIOUS COMBAT OPERATIONS

Medical and manpower resource planning for military operations require that logisticians project the numbers of casualties likely to be sustained. Medical and manpower losses include wounded-in-action (WIA), killed-in-action (KIA), and disease and non-battle injuries (DNBI). There are differing degrees of severity among WIA and DNBI occurrences, which in turn, require distinct levels of medical care.

Logistics planning necessitates differentiating between "presentations,"¹ which include all illnesses and injuries needing some form of treatment, and "admissions," which denotes those conditions that warrant retention at a medical treatment facility. In addition to forecasting incidence rates of presentations and admissions, average lengths of stay among WIA and DNBI admissions also need to be projected. Determination of in-theater bed requirements, for example, is based upon assessments of the expected numbers of personnel who will present with medical conditions, the percentage of those presenting who will require admission to a treatment facility, and the average time span between admission and return to duty or evacuation.

In combat, medical services are provided at a series of treatment facilities representing different echelons of clinical care. Echelon I facilities offer basic first aid at highly mobile units located near the combat area. Echelon II care is characterized by the Fleet Marine Force Manual (FMFM) 4-50, *Health Service Support*² as that provided by "a collecting and clearing company, surgical support company, or casualty and receiving ship." Similarly, FMFM 4-50 describes Echelon III as that "level of care normally provided at combat zone fleet hospitals or hospital ships."

Because Echelon I performs the dual functions of administering health care on an outpatient basis as well as acting as a gateway to higher echelon treatment facilities, it may receive the largest numbers of patient visits. However, it is the second and third

echelon facilities, which admit patients on an inpatient basis, that are much more resource-intensive and involve more extensive medical resource planning.

Medical planning models generally require projections of Echelon III hospital admissions. While projections of Echelon III admissions are intended to reflect the clinical capability demands for this level of care, other factors may influence whether an individual is treated at a second or a third echelon facility. Other variables which may determine treatment site include the locations of the facilities, tempo of military operations, ease of intra-theater evacuations, evacuation transport availability, overall theater evacuation policy, presence of air superiority, incidence rate of medical casualties, and status of nations (allied/enemy/neutral) in the surrounding region. As the Gulf War demonstrated, with air superiority, low rates of casualties, and allies in the surrounding region, admissions to second echelon facilities could be transported in a timely fashion to the third echelon fleet hospitals.

In contrast, the U.S. Marine Corps experiences in Korea and in Western Pacific operations of World War II underscore the difficulty of providing medical support to casualties in extremely hostile environments. These ground operations were of longer duration than that anticipated for the Gulf War and consequently the maximum number of days a patient could be retained at a combat zone treatment facility (evacuation delay) was set at a higher level. A short evacuation delay implies not only that patients will be retained for a minimal period of time, thus requiring fewer medical assets at this level, but also that it becomes much more difficult logistically for individuals to later rejoin their units as they are transported rearward. Also, the casualty rates in Korea and in the Western Pacific were relatively high, and medical battalions (Echelon II) could not be used simply as "flow-through" facilities on the way to Echelon III. In fact, many patients were admitted, treated, and returned to duty from the second echelon facilities. This practice is congruent with medical doctrine that states that "no patient shall be evacuated further to the rear than his medical condition requires or the military situation demands."²

Because a future scenario may likewise require medical battalions to treat, retain, and return personnel to duty, it is proposed that medical resource planners adopt an operational (vice medical-administrative) definition of patient presentations and admissions. Given that the aforementioned factors can affect when, and even whether, Echelon II patients are evacuated to the rear, planning models should be based on empirical data from operations in which both second and third echelon treatment facilities functioned as the final treatment center before the personnel were returned to duty.

The present investigation examines casualty and DNBI incidence across four military operations to determine the overall rates of occurrence. This study distinguishes between presentation and admission rates, and defines them in terms of lengths of stay at medical facilities independent of the echelon at which the care was administered.

METHOD

Casualty and DNBI incidence data were extracted for combat and support troops from administrative and medical records of military operations spanning four decades. Information was collected on the numbers of WIA, KIA, and DNBI sustained as well as the unit strengths, the lengths of treatment, and the types of facilities in which the casualties were treated. Casualty and DNBI rates were computed per 1000 strength per day. "Presentation" rates represent the incidence of all injuries and illnesses requiring treatment, while "admission" rates, a subset of presentations, were defined as the incidence of cases requiring treatment lasting three days or more.

Okinawa Data

The assault on Okinawa was a three-month operation lasting from April through June of 1945. U.S. Marines involved in the assault included the 1ST Division, the 6TH Division, and, in the closing stage, the Eighth Marines from the 2ND Division. Although muster rolls were not available for every month for every unit, data from all regiments in the 1ST and 6TH were extracted from 36 company

muster rolls and 38 battalion muster rolls. These combat troop data represented 471,936 mandays in April, 408,224 mandays in May, and 343,990 mandays in June.

Additionally, data were extracted for a number of other units that participated as combat support elements. Supporting units included two medical battalions, two engineering battalions, two pioneer battalions, two motor transport battalions, two amphibian truck companies, two service battalions, two assault signal companies, and a headquarters battalion. Support troop data represented 146,418 mandays in April, 274,912 mandays in May, and 229,568 mandays in June.

Korea Data

Data were extracted from Unit Diaries of U.S. Marine combat and support units deployed to Korea during 1951. The tempo of operations during the Korean War was generally more moderate than the overall intensity level seen in WWII. A five-month period of data (February to June 1951) was extracted for randomly selected companies from infantry battalions of the 1ST Marine Division, which saw a range of combat intensities. These data represented five Headquarters & Service Companies (H&S), four Weapons Companies, and 11 Rifle Companies that were elements of the 1ST and 5TH regiments. The total mandays represented of these 20 companies was 625,209.

Additionally, data were extracted from Unit Diaries for 35 companies providing support to the infantry troops during the same time period. These 35 companies represented troops from a medical battalion, engineer battalion, ordnance battalion, signal battalion, shore party battalion, motor transport battalion, service battalion, headquarters battalion, and the Marine Air Wing service squadron. The total mandays represented by the support troops over the five-month period were 1,134,036.

Vietnam Data

Data were extracted from Unit Diaries of eight randomly selected companies from infantry battalions of the 1ST Marine Division. A four-month period from May through August, 1968 was chosen for analysis because its June mid-point was the peak of U.S.

Marine involvement in Vietnam. The companies analyzed were six rifle companies and two Headquarters & Service companies from the 1st and 5th infantry regiments; the total mandays of these eight companies was 205,186.

Falklands Data

Data detailing casualties among the United Kingdom Amphibious Force (UKAF) were extracted from OPERATION CORPORATE medical logs/records maintained during the 1982 Falklands Conflict. These data included the numbers of WIA, KIA, and DNBI sustained as well as the treatment facilities and unit strengths during the 25 day ground operation occurring from May 21 through June 14, 1982. The total number of mandays represented by the UK ground forces during OPERATION CORPORATE was 168,609. The UKAF was composed of approximately 90 percent combat troops and 10 percent logistics troops.

RESULTS

Okinawa combat troop rates

Figure 1 is a display of the daily WIA presentation and KIA rates per 1000 strength among infantry troops during the Okinawa operation. Wounded-in-action rates ranged from 0.0 to 31.8, while KIA rates ranged from 0.0 to 6.4. The total casualty (WIA and KIA combined) and DNBI presentation rates are shown in Figure 2. Daily DNBI rates fluctuated between 1.3 and 14.5. The WIA and DNBI presentation rates across the operation were, respectively, 6.57 and 4.56 per 1000 troops per day, while the KIA rate was 1.35.

Twelve percent of DNBI presentations and 16 percent of WIA presentations were treated and released in two days or less. Defining admissions as those presentations requiring treatment for three days or more, yielded a DNBI admission rate of 4.03 and a WIA admission rate of 5.54.

Okinawa support troop rates

Figure 3 depicts the WIA presentation and KIA rates among

combat support troops during the Okinawa operation. The daily WIA presentation rate ranged from 0.0 to 2.7, while the KIA rate varied between 0.0 and 0.8. Figure 4 plots the overall casualty rate and the DNBI presentation rates across the 91 days of the operation. The daily DNBI presentation rate fluctuated between 0.1 and 2.9. The overall presentation rates per 1000 strength per day across the operation were: WIA, 0.43; KIA, 0.09; and DNBI, 0.93.

Fifteen percent of the DNBI presentations and 32 percent of the WIA presentations were treated and returned to duty in two days or less. The admission rates among combat support troops for WIA and DNBI, then, were 0.29 and 0.79 per 1000 strength per day respectively.

Korea combat troop rates

Figure 5 shows the daily fluctuations in WIA presentation and KIA rates for infantry battalions during a period of the Korean War. The daily WIA rates varied between 0.0 and 74.2 per 1000 per day, while the KIA rate ranged from 0.0 to 7.1. The total casualty and DNBI presentation rates are graphed in Figure 6. Daily DNBI presentation rates showed a low of 0.0 and a high of 13.4. The overall WIA and DNBI presentation rates were 2.75 and 3.31 per 1000 strength per day, respectively, while the KIA rate was 0.20.

Twenty-one percent of DNBI presentations and 38 percent of WIA presentations were treated and released in two days or less. The admission rates among combat troops in Korea, therefore, were 1.7 for WIA and 2.6 for DNBI per 1000 strength per day.

Korea support troop rates

Figure 7 displays the daily WIA presentation and KIA rates among combat support troops during the Korean War. The daily WIA presentation rate fluctuated between 0.0 and 1.35 per 1000 strength, while the KIA rate varied between 0.0 and 0.52. The overall casualty and DNBI presentation rates are shown in Figure 8. Daily DNBI presentation rates ranged from 0.13 to 2.59 per 1000 strength. The overall WIA and DNBI presentation rates for the combat support troops were 0.10 and 0.76, while the KIA rate was 0.01 per 1000 strength per day.

Seven percent of DNBI presentations and 44 percent of WIA presentations were treated and released in two days or less. The admission rates for combat support troops, then, were 0.71 daily DNBI incidence per 1000 strength and 0.05 WIA daily per 1000 strength.

Vietnam combat troop rates

Figure 9 depicts the WIA presentation rate and KIA incidence among infantry battalions in Vietnam. The WIA presentation rate ranged from 0.0 to 13.9 per 1000 per day, while the KIA rate varied between 0.0 and 6.4. The total casualty rate and DNBI presentation incidence are shown in Figure 10. Daily DNBI presentation rates fluctuated between 0.0 and 19.0 per 1000 strength. The overall WIA and DNBI presentation rates were, respectively, 2.50 and 1.78 while the KIA rate was 0.31 per 1000 strength per day.

Twelve percent of DNBI presentations and 36 percent of WIA presentations required treatment lasting two days or less. The admission rates for the infantry battalions, then, were 1.57 DNBI and 1.61 WIA per 1000 strength per day.

Falklands rates

Figure 11 shows the daily WIA presentation rates and KIA rates among U.K. ground troops participating in OPERATION CORPORATE. The WIA presentation rate was 1.86 and varied between 0.0 and 14.7 per 1000 per day, while the KIA rate was 0.71 and ranged between 0.0 and 5.7. Figure 12 displays the casualty rates and DNBI presentation rates across the Falklands ground operation. The DNBI presentation rate across the operation was 1.27 per 1000 strength per day and varied from a low of 0.1 to a high of 3.3.

Twenty-two percent of the DNBI presentations and one percent of the WIA presentations were treated and released in two days or less. The admission rates for DNBI and WIA respectively, then, were 0.99 and 1.84 per 1000 strength per day.

Comparisons of rates across operations

Figure 13 contrasts the WIA presentation and admission rates across four military operations. The WIA presentation rates ranged

from a low of 1.86 during OPERATION CORPORATE to a high of 6.57 during the Okinawa operation. Admission rates for WIA ranged from 1.61 during Vietnam to 5.54 in Okinawa. Figure 14 compares the DNBI presentation and admission rates across the military operations. The DNBI presentation rates varied from a low of 1.27 during OPERATION CORPORATE to a high of 4.56 during Okinawa. Admission rates per 1000 strength per day for DNBI ranged from 0.99 during the Falklands operation to 4.03 during the Okinawa assault.

Lengths of treatment among DNBI and WIA

Detailed information on duration of treatment existed for troops deployed to Korea and Vietnam. Table 1 shows the various lengths of treatment of DNBI and WIA presentations for combat troops in Vietnam, and for both combat and support troops deployed to Korea. These lengths of treatment represent a summation of the days that a patient was treated at one or more facilities. The data indicate that among all three groups, large proportions of WIAs were treated and returned to duty on the same day that they were wounded. These data also show that, among combat troops, 26 to 38 percent of presentations were of a nature that precluded returns to their unit due to transfer while sick or wounded, and that 13 percent of the support troops had medical conditions that did not allow for their return.

Among infantry troops in Vietnam, the mean number of sick days before return to duty for DNBI presentations was 9.5, while the average for WIA presentations who returned to duty was 5.1 days. Among combat troops in Korea, DNBI treatment duration averaged 9.6 days and WIA treatment averaged 4.3 days. For support troops in Korea, there was an average 8.8 days before return to duty among DNBI presentations and 2.9 days among WIA presentations.

DISCUSSION

Medical and manpower logistics planning requires projections of the casualty and DNBI incidence likely to be incurred over the course of an operation. Estimates of WIA, KIA, and DNBI rates for future military scenarios should be based on empirical data

obtained from previous operations. The current investigation examined the rates of DNBI and WIA incidence requiring medical attention (presentation rates) and the rates of DNBI and WIA incidence requiring more than two days of treatment (admission rates). This "operational" definition approach to casualty projections was used because numerous and sometimes uncontrollable factors may determine whether a medical casualty is evacuated rearward or retained, treated, and returned to duty from an Echelon II facility. Consequently, to adequately estimate medical resource requirements, planning models should focus on combined medical requirements at second and third echelons of medical care. Several medical logistics models are based on projections of the numbers of patients requiring treatment at Echelon III facilities; the rates provided as "admissions" in the present investigation reflect the DNBI and WIA incidence that would require a bed and treatment at a third echelon facility when Echelon II operated under a three-day evacuation delay. The presentation rates, likewise, are important for planning purposes as they represent personnel who will require some treatment, and who may be lost to their unit for a short period of time.

The graphs of the daily WIA and KIA rates underscore the dynamic nature of military operations. Estimates of casualties based on point estimates do not accurately reflect the flow of casualties³. In contrast to casualty rates, the incidence of DNBI over a military operation is typically much more stable. While DNBI incidence is related to battle intensity⁴, it can be seen on the daily rate graphs for Korea, Vietnam, and the Falklands that DNBI rates are relatively constant. During heightened battle tempos there will be more battle fatigue cases, non-battle injuries, and opportunistic diseases related to stress-induced immunosuppression, all of which will contribute to fluctuations in DNBI incidence.

Among the Okinawa, Korea, and Vietnam operations there was substantial variation between the presentation rates and the admissions rates. This variation reflects the significant numbers of personnel who require minimal treatment for their injuries and illnesses. The Falklands data exhibited less variation between WIA

presentation and admission rates than the other three operations. This was, in part, due to the Falklands data being extracted from medical logs rather than Unit Diaries, with the result that some minor wounds treated in the field may not have been recorded. Also, during OPERATION CORPORATE some wounded personnel who, in a lengthier conflict might have been treated and returned to their combat unit, were instead held in reserve or, in some cases, redeployed as logistic troops.

Because casualty and DNBI rates differ between combat and support troops, medical needs projections will require specifying the proportions of combat and support troops. The current study presented combat and support troop data separately for Okinawa and Korea, combat troop data for Vietnam, and the entire U.K. amphibious force for the Falklands. Comparisons between the combat troops of the first three operations and the U.K. ground forces are valid because only 10 percent of the amphibious force were logistic troops. Also, because of the lack of air superiority, particularly in the early stages of OPERATION CORPORATE, the logistics troops were at equal risk as the combat troops.

The operations and time periods in the present analyses were selected because it is believed that they may represent scenarios similar to operations in which the U.S. Marines may be involved in the future. While caution should be applied in generalizing from rates witnessed in the Kuwaiti Theater of Operations (KTO), limited data on casualty and DNBI incidence from the KTO have also been reported^{5,6}. Desert Shield DNBI rates, however, are perhaps most representative of the DNBI incidence of troops stationed in that geographical region rather than typifying incidence during combat. Further, given the short duration of the ground war, the low casualty rates are probably unique to that particular operation.

Past operational rates, rate distribution characteristics, and parameters defining an anticipated conflict can be used to develop simulations of battlefield medical casualties. Rates of casualty and disease incidence from battlefield simulations may then be used as input to models that project the medical resource and manpower requirements of an operation, as well as in the determination of resource allocation among treatment echelons.

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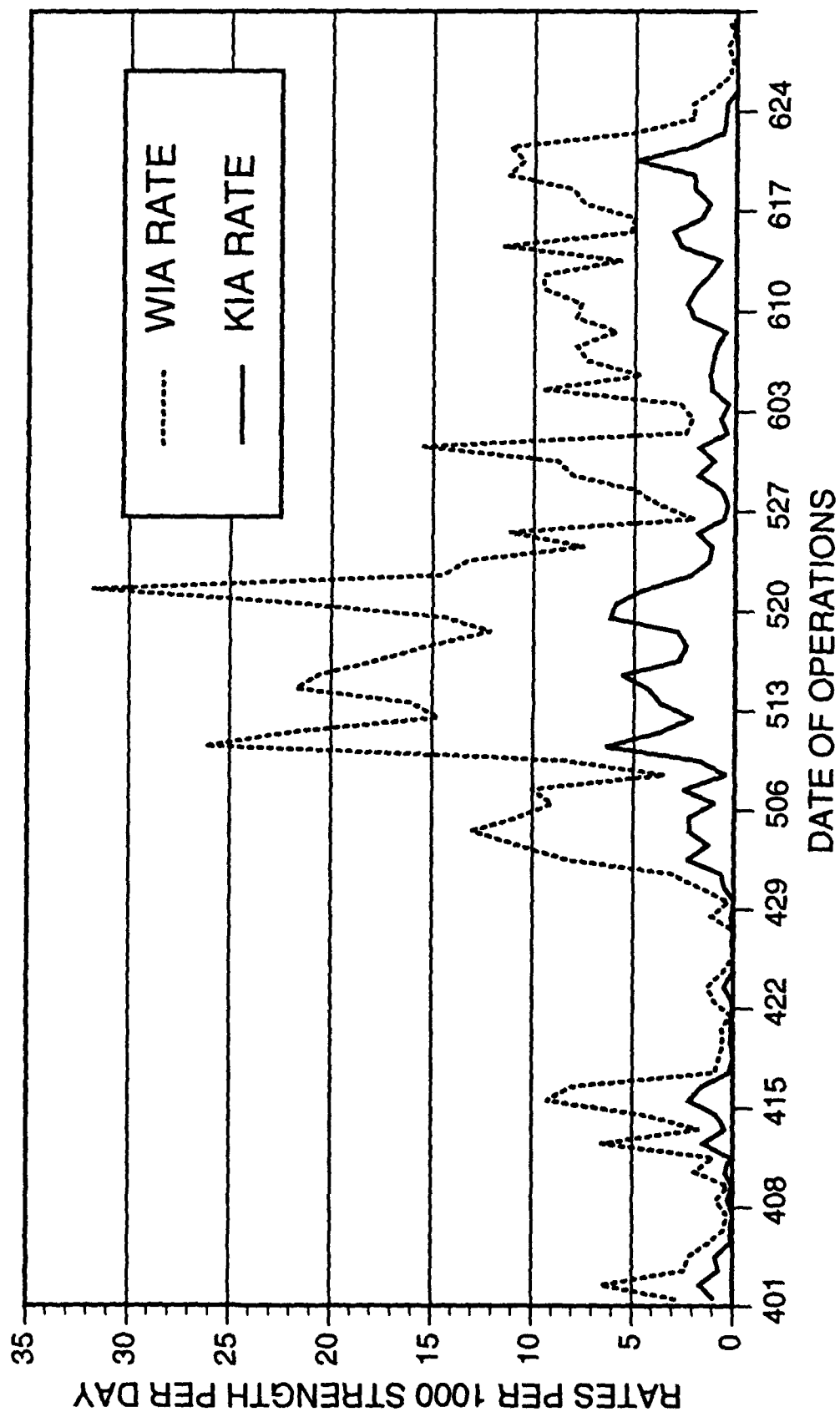


Figure 1. Presentation rates of wounded in action (WIA) and killed in action (KIA) among infantry battalions during the Okinawa Operation (1945)

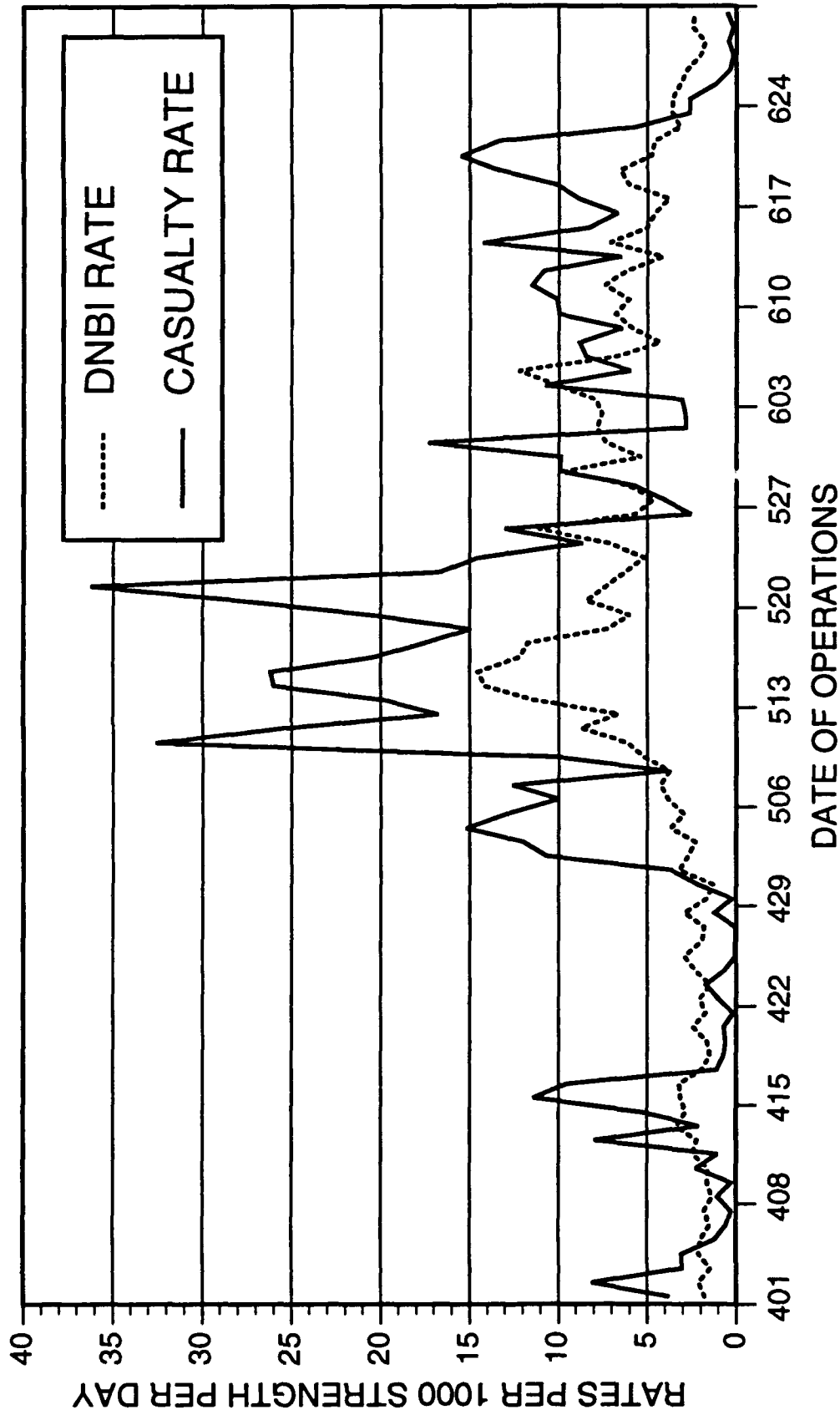


Figure 2. Presentation rates of disease and non-battle injury (DNBI) and casualties among infantry battalions during the Okinawa Operation (1945)

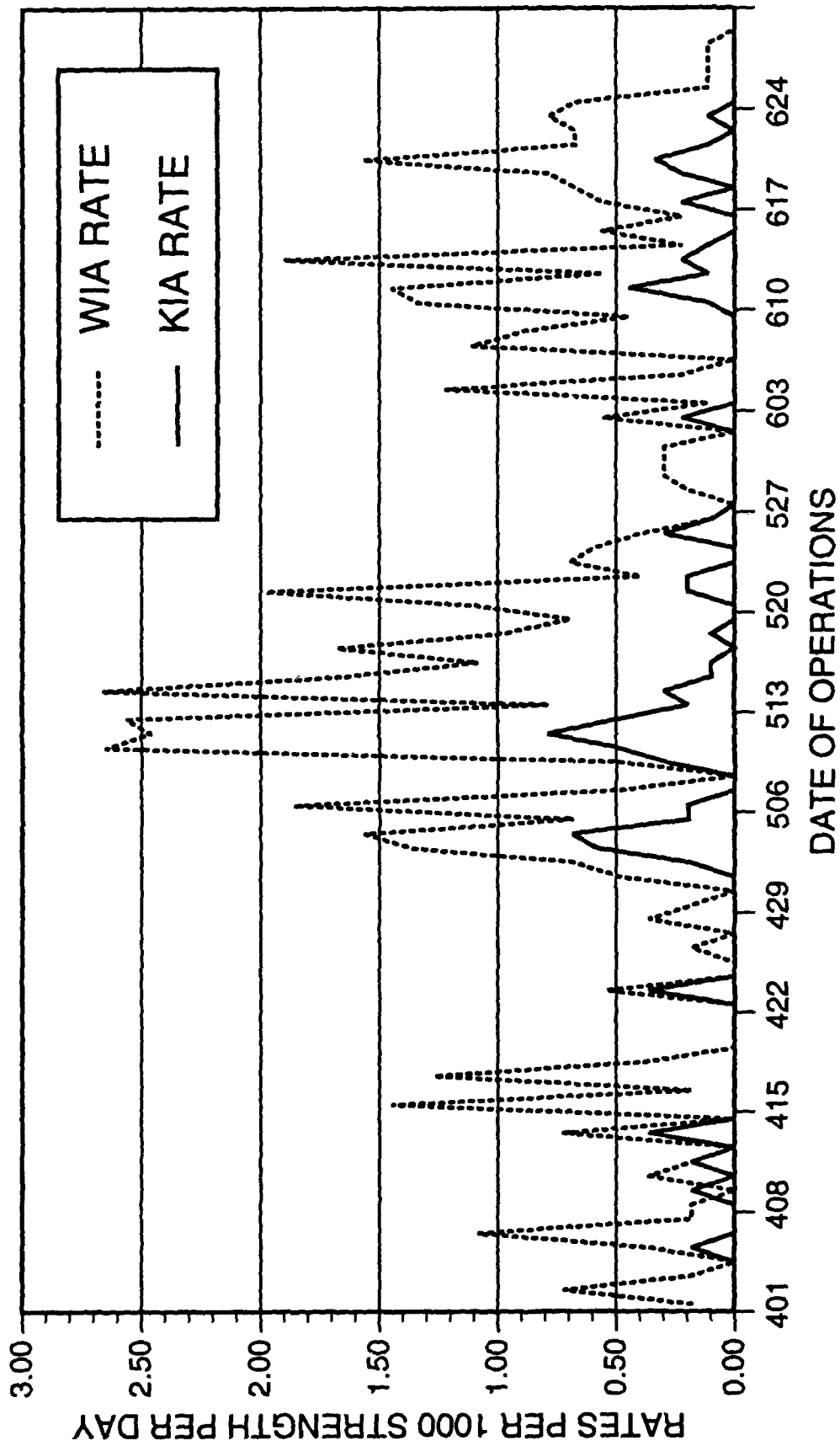


Figure 3. Presentation rates of wounded in action (WIA) and killed in action (KIA) among combat support troops during the Okinawa Operation (1945)

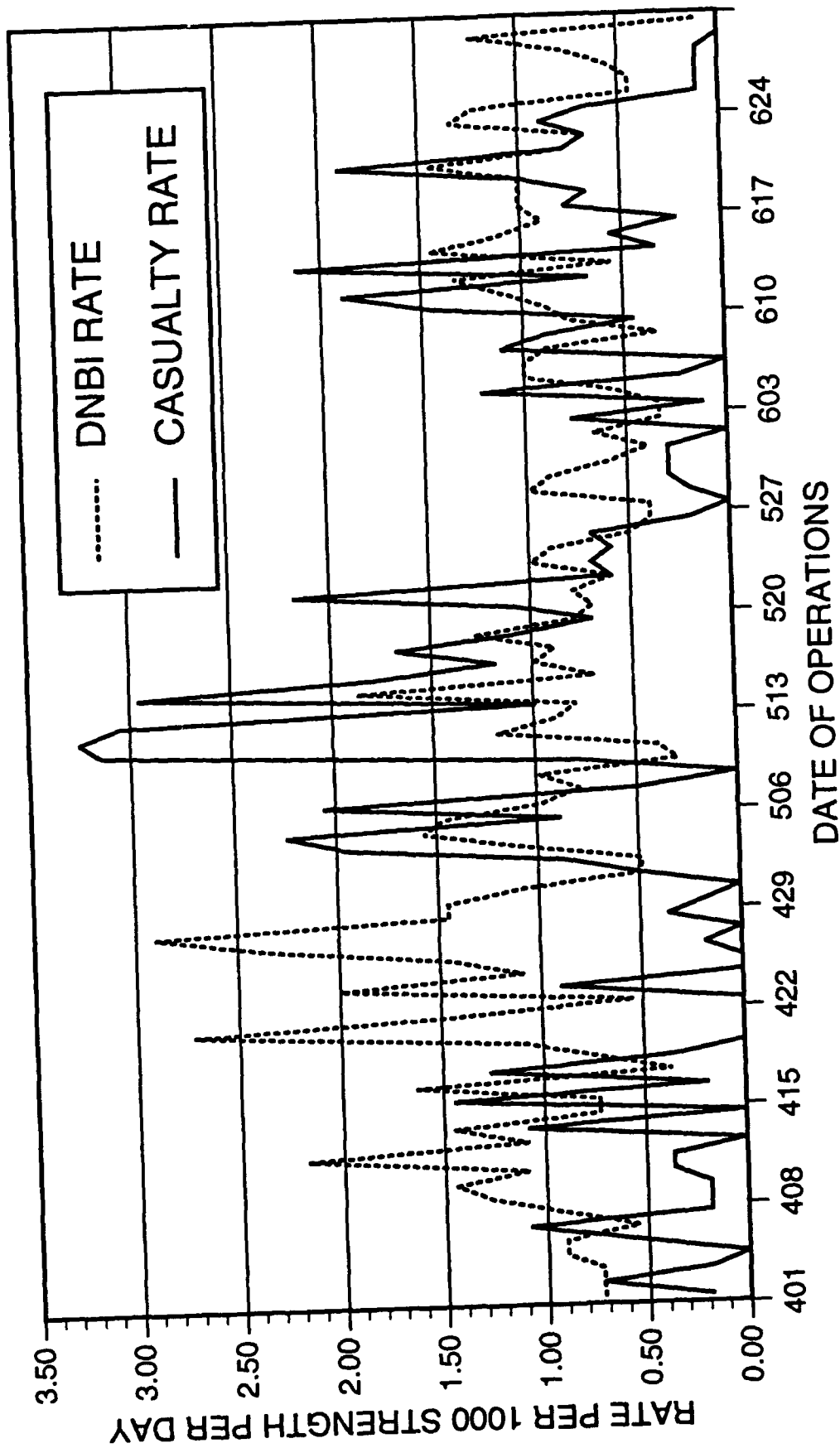


Figure 4. Presentation rates of disease and non-battle injury (DNBI) and casualties among combat support troops during the Okinawa Operation (1945)

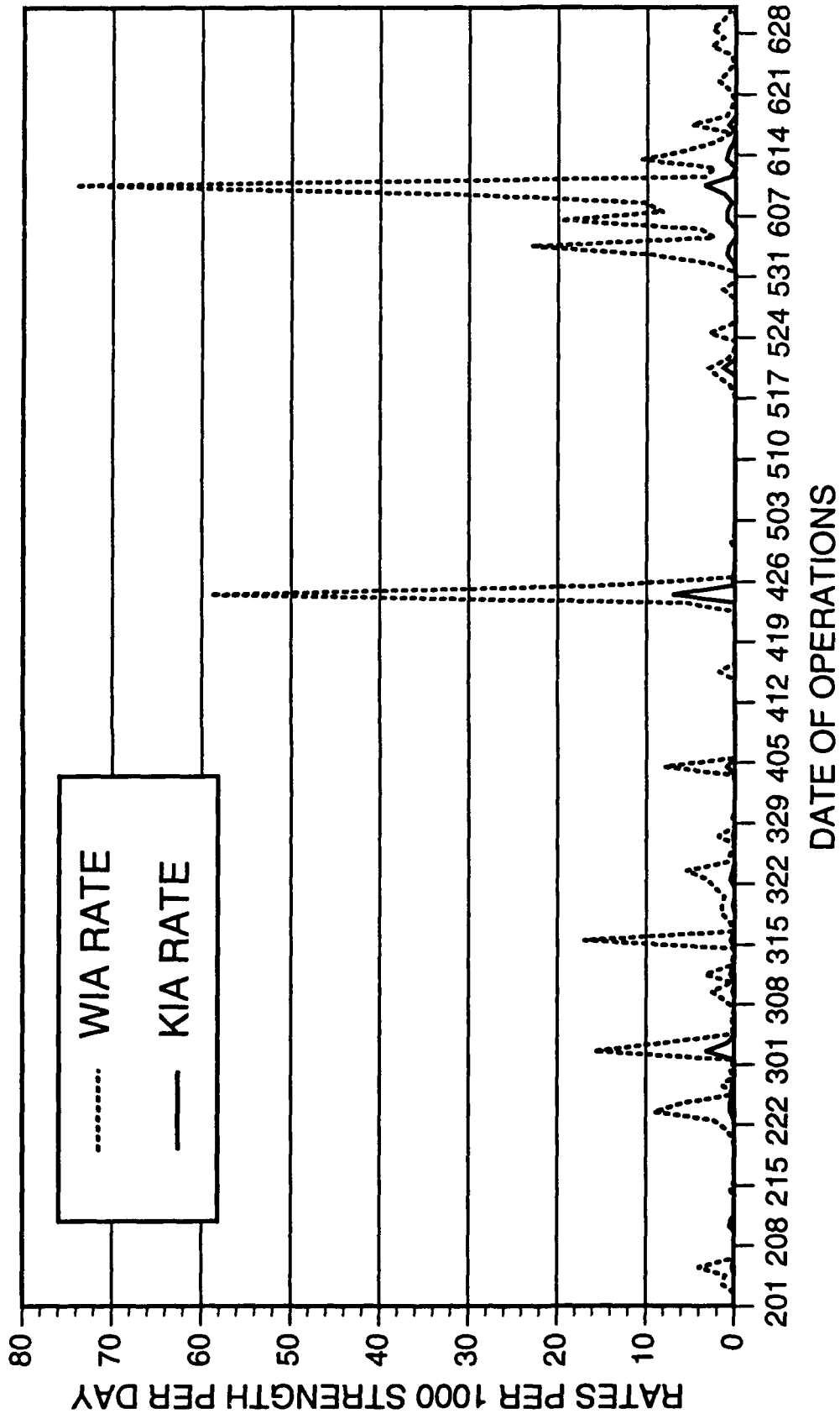


Figure 5. Presentation rates of wounded in action (WIA) and killed in action (KIA) among infantry battalions during a five month period of the Korean Conflict (1951)

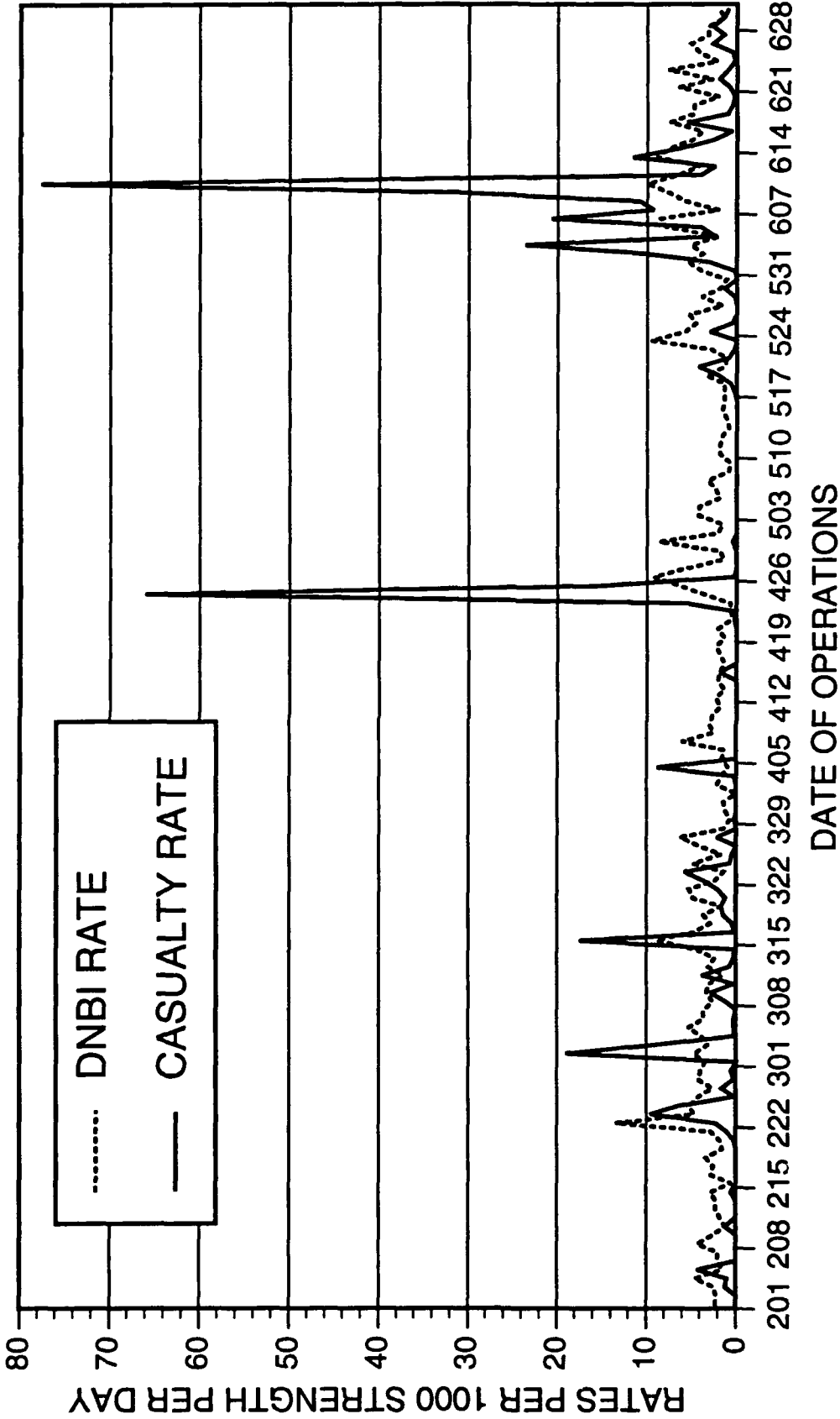


Figure 6. Presentation rates of disease and non-battle injury (DNBI) and casualties among infantry battalions during a five month period of the Korean Conflict (1951)

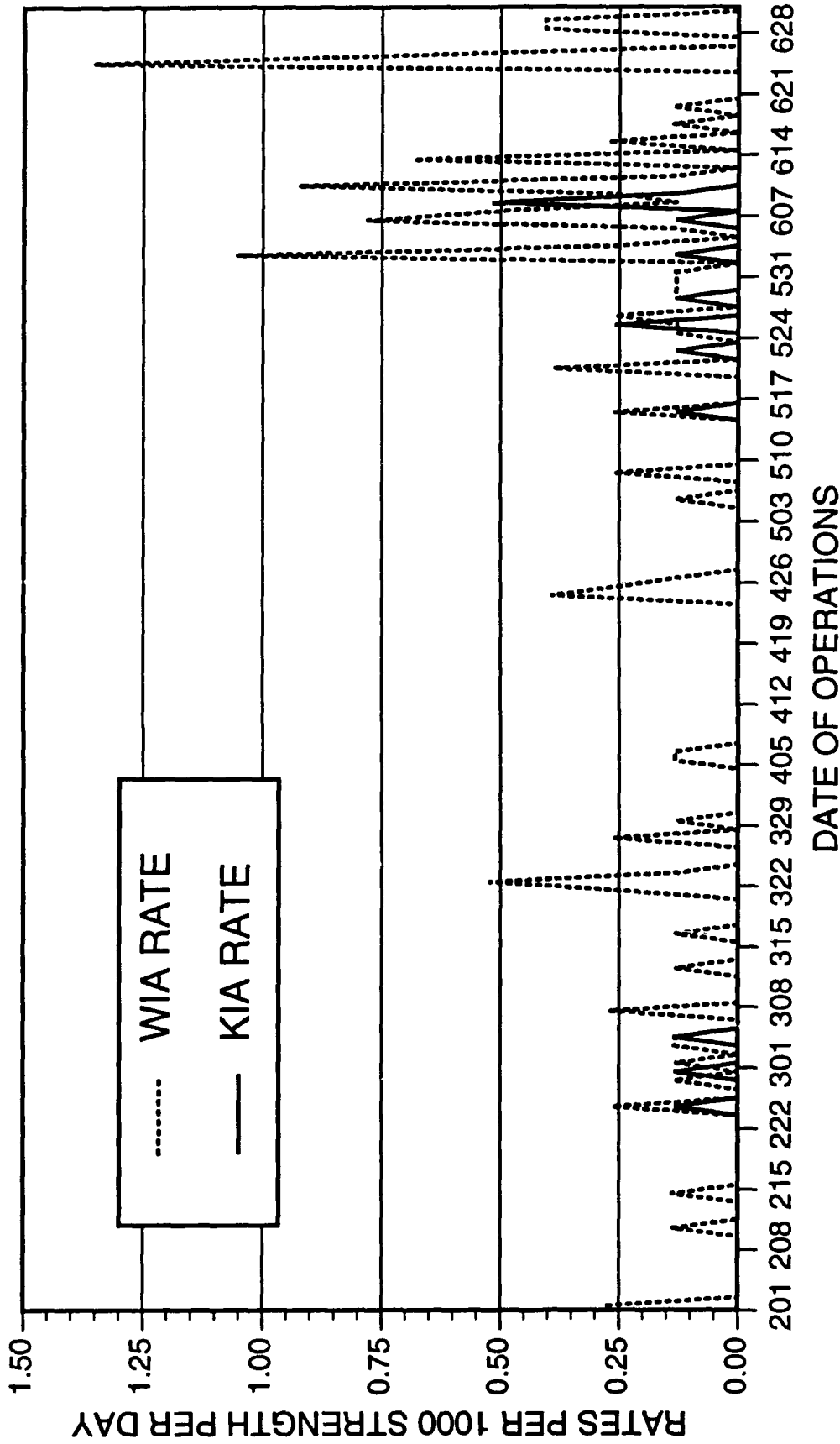


Figure 7. Presentation rates of wounded in action (WIA) and killed in action (KIA) among combat support troops during a five month period of the Korean Conflict (1951)

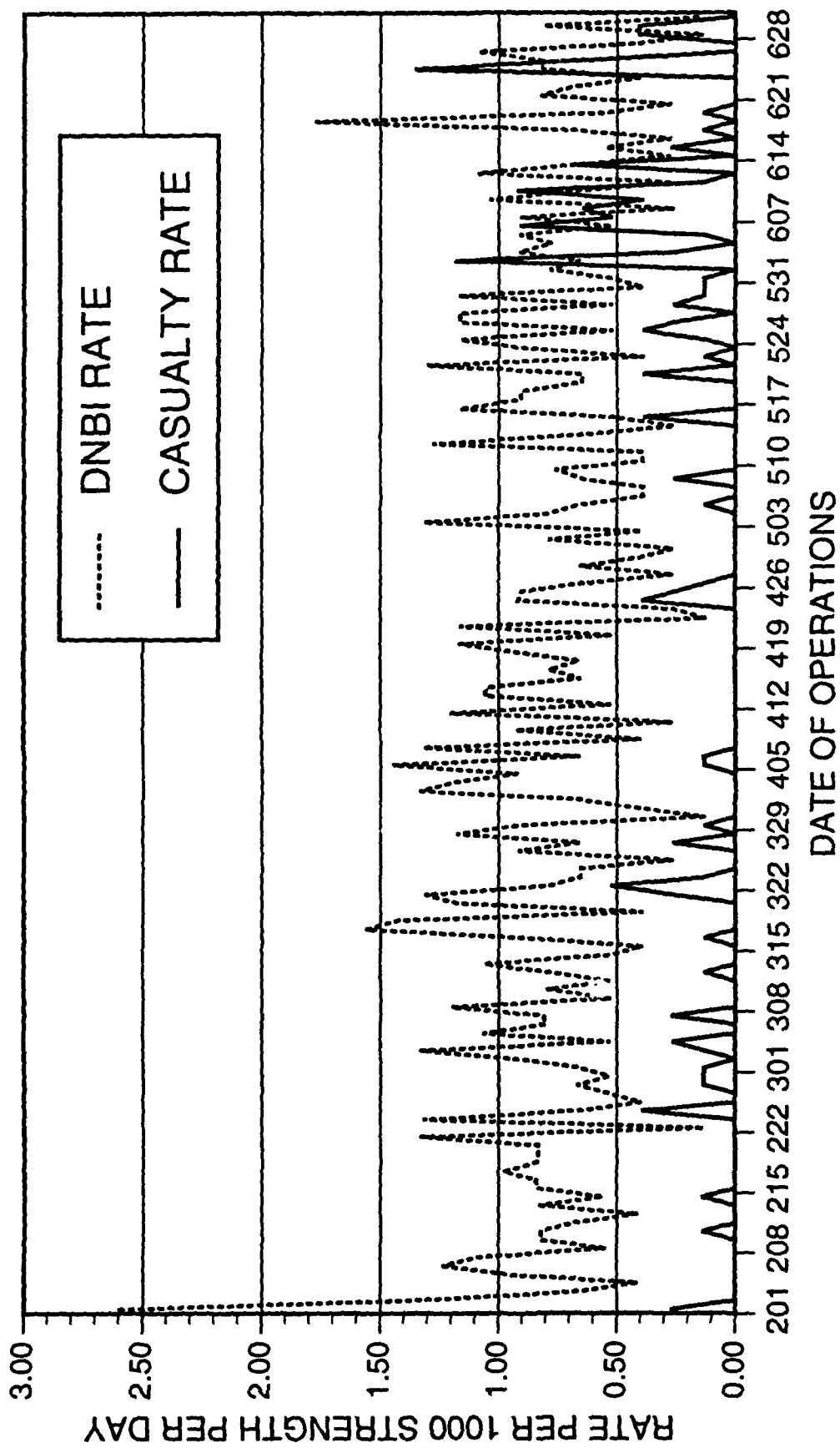


Figure 8. Presentation rates of disease and non-battle injury (DNBI) and casualties among combat support troops during a five month period of the Korean Conflict (1951)

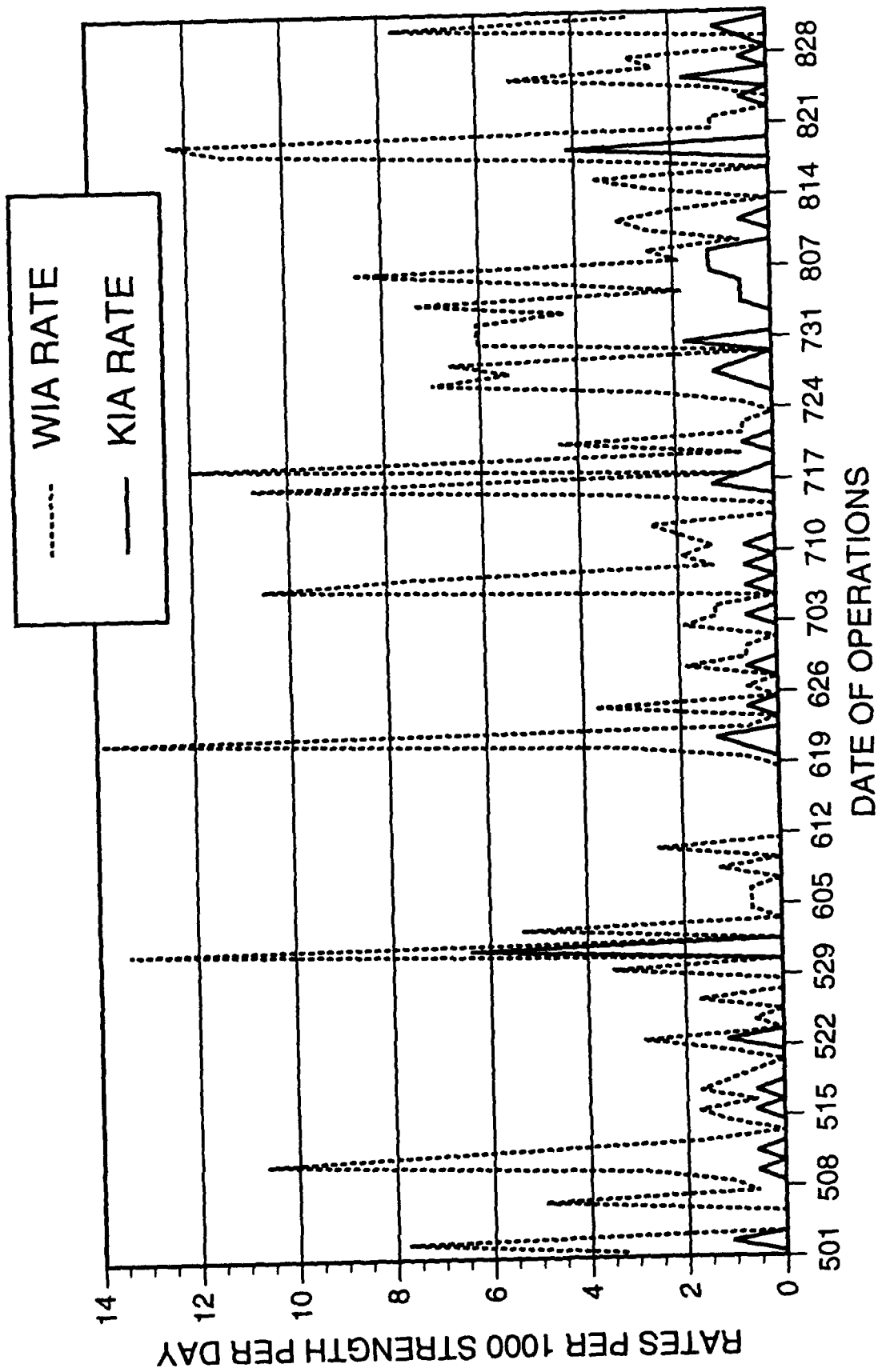


Figure 9. Presentation rates of wounded in action (WIA) and killed in action (KIA) among infantry battalions during a four month period of the Vietnam War (1968)

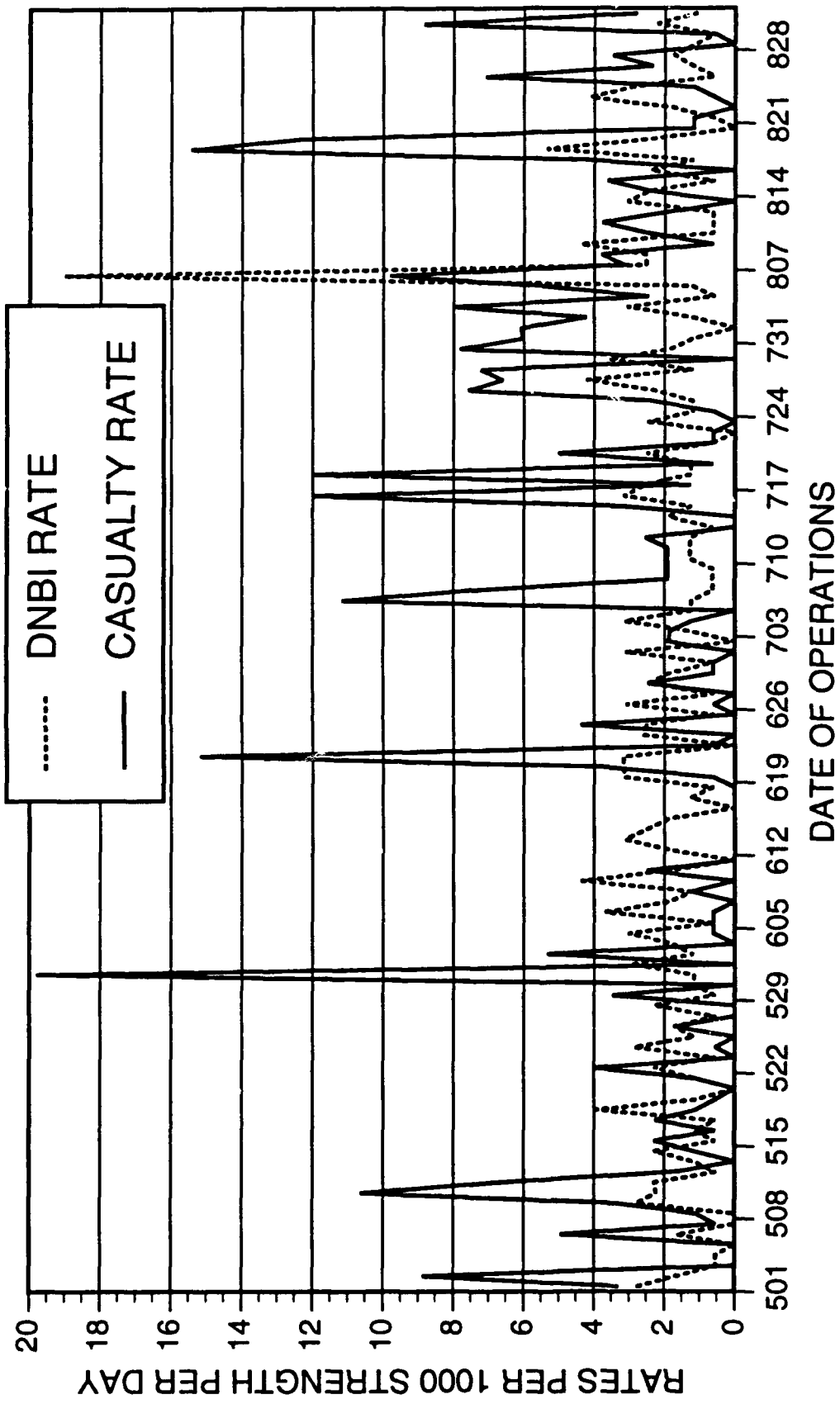


Figure 10. Presentation rates of disease and non-battle injury (DNBI) and casualties among infantry battalions during a four month period of the Vietnam War (1968)

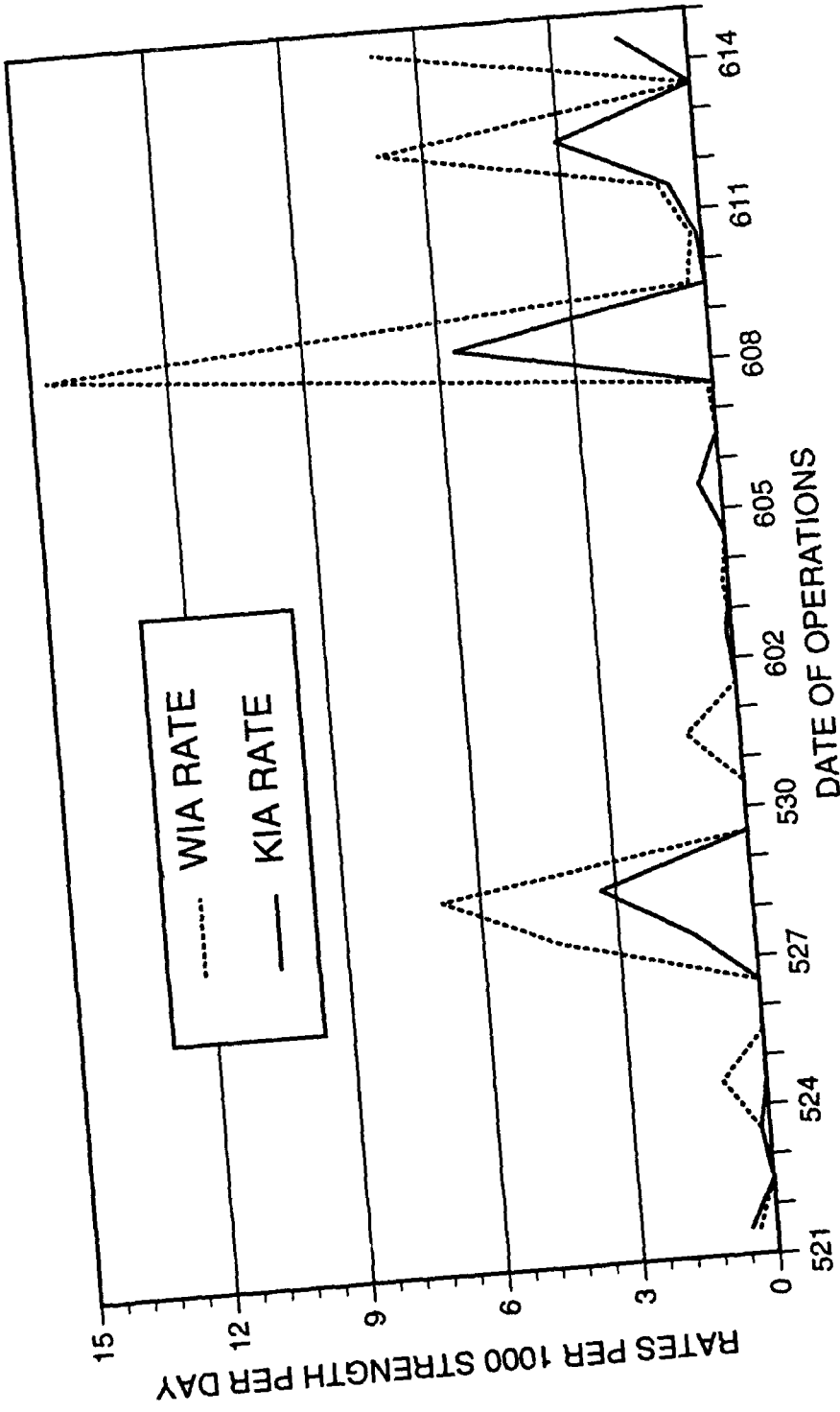


Figure 11. Presentation rates of wounded in action (WIA) and killed in action (KIA) during the Falklands War (1982)

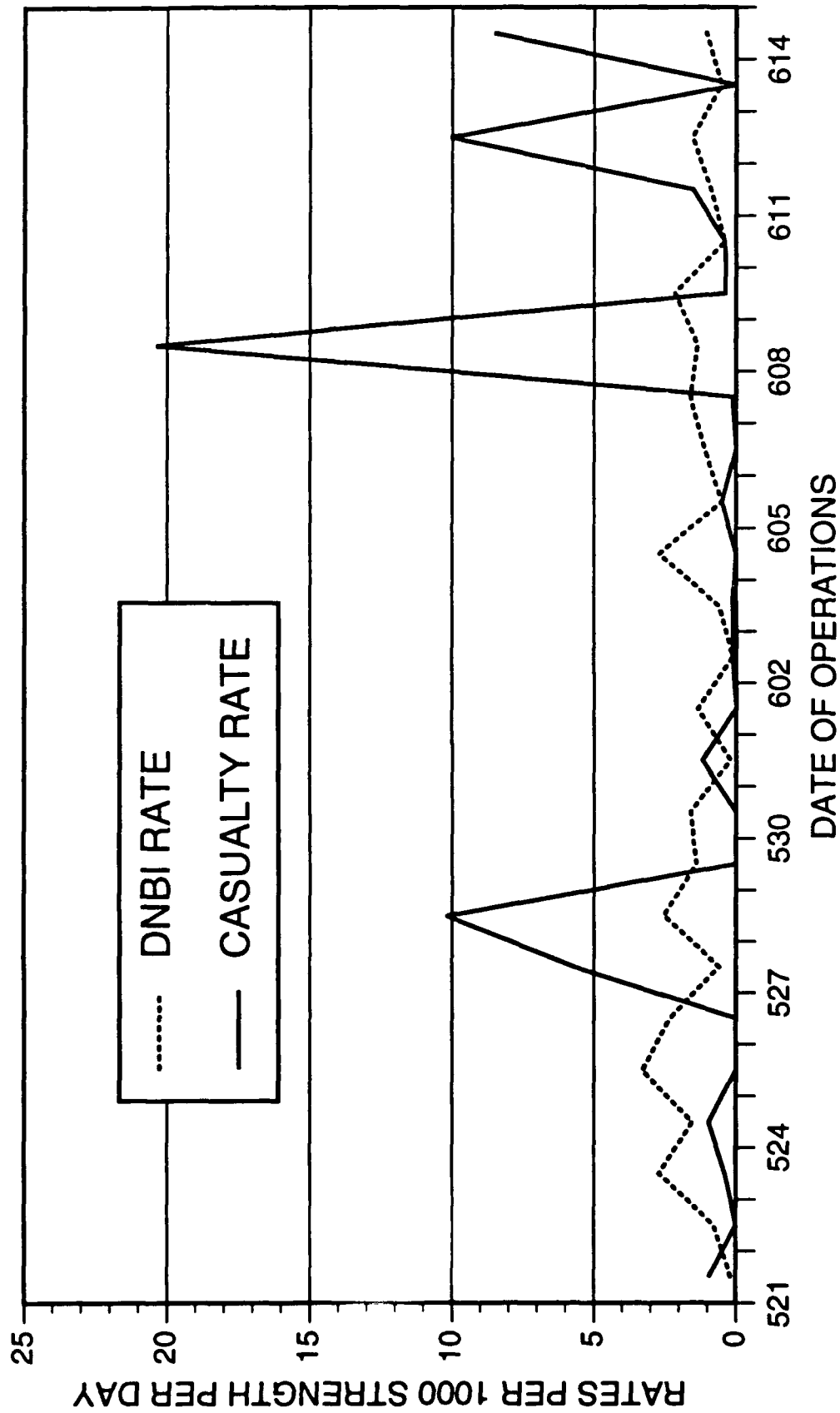


Figure 12. Presentation rates of disease and non-battle injury (DNBI) and casualties during the Falklands War (1982)

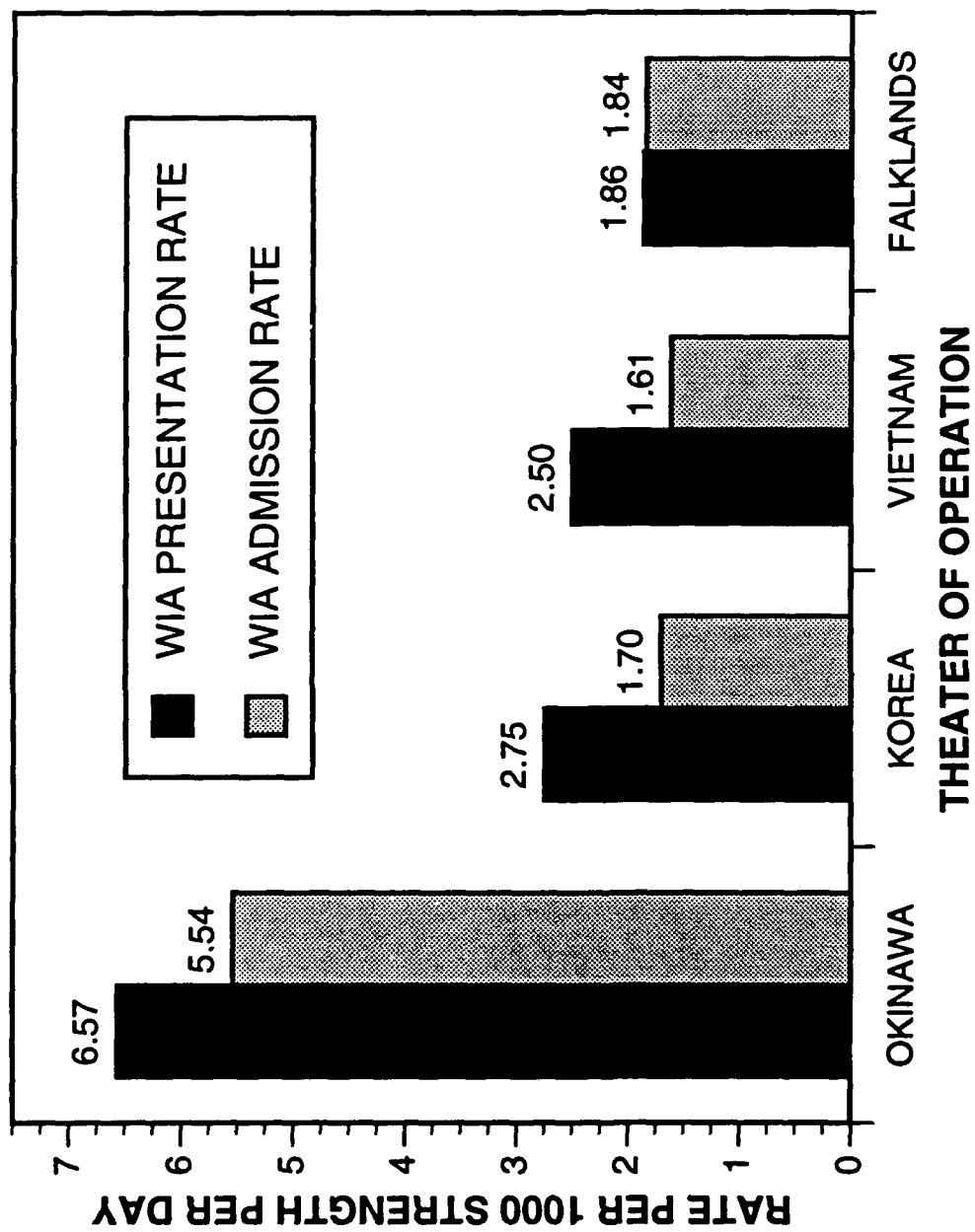


Figure 13. Rates of wounded in action (WIA) among combat troops during various military operations

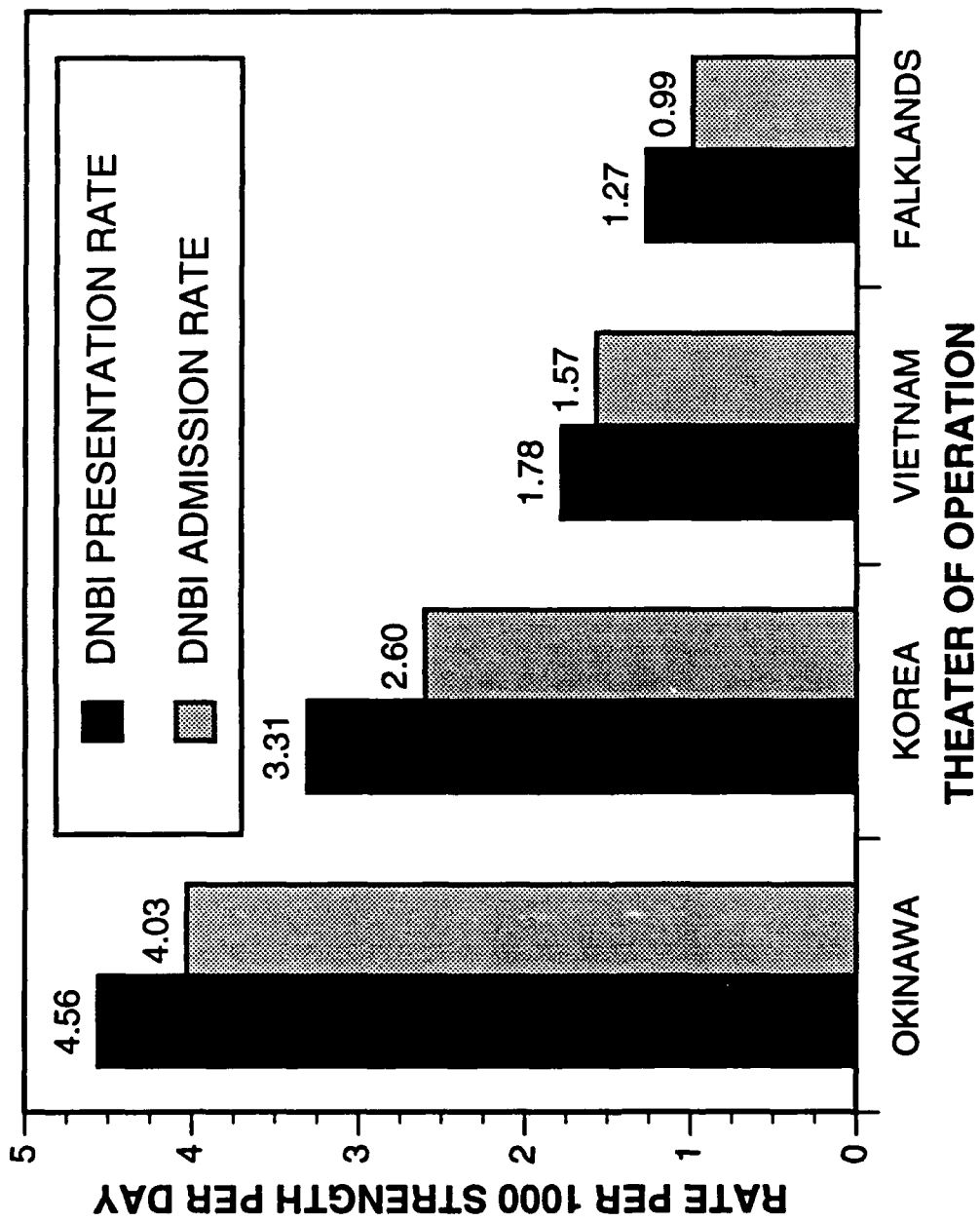


Figure 14. Rates of disease and non-battle injury (DNBI) among combat troops during various military operations

Table 1. PERCENTAGE OF DISEASE AND NON-BATTLE INJURY (DNBI) AND WOUNDED IN ACTION (WIA) PRESENTATIONS BY LENGTH OF TREATMENT BEFORE RETURN TO UNIT

Length of Treatment (Days)	Vietnam Combat Troops		Korea Combat Troops		Korea Support Troops	
	DNBI%	WIA %	DNBI%	WIA %	DNBI%	WIA %
0	0.3	30.4	5.0	40.2	1.2	53.4
1	6.2	2.6	2.7	0.7	6.1	3.8
2	4.9	2.2	4.0	0.9	6.9	3.8
3	7.4	2.4	4.3	1.5	10.7	3.1
4	5.8	2.2	7.1	1.2	6.5	3.1
5	4.0	2.0	6.2	1.9	7.3	3.8
6	3.7	1.5	5.5	1.5	6.8	2.3
7	1.8	2.9	5.5	1.1	6.0	0.8
8	3.4	3.7	4.1	1.1	4.7	2.3
9	1.5	0.9	3.3	1.5	2.3	0.0
10	1.5	0.4	2.8	1.0	3.5	1.5
11	2.2	1.3	2.7	0.6	3.3	1.5
12	0.9	0.9	2.5	0.7	2.1	1.5
13	2.8	1.1	1.5	0.6	2.0	1.5
14	0.6	1.3	2.5	0.6	2.1	0.0
15	1.2	0.9	1.5	0.7	0.8	0.8
16	2.2	0.4	1.1	0.6	1.6	0.0
17	0.9	0.2	1.1	0.8	1.7	0.0
18	0.6	0.7	1.3	0.9	1.4	0.0
19	2.8	1.5	0.9	0.6	1.0	0.0
20	0.3	0.4	0.9	0.6	0.7	0.8
21-30	4.2	1.6	4.8	2.1	5.8	3.1
31-60	2.1	0.8	3.7	1.3	1.9	0.0
No Return To Unit	38.5	37.2	26.2	37.6	13.8	13.0
	100%	100%	100%	100%	100%	100%

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13. ABSTRACT (Maximum 200 words) Daily rates of casualty and illness incidence were analyzed and compared for four ground operations: Okinawa, Korea, Vietnam, and the Falklands. Daily admission rates of wounded-in-action (WIA) for combat troops ranged from 1.61 to 5.54 per 1000 strength. The killed-in-action (KIA) rates of combat troops ranged from 0.2 to 1.35. Disease and non-battle injury (DNBI) admission rates among combat troops ranged from 0.99 to 4.03 per 1000 strength per day. Casualty and disease rates were lower among support troops than combat units. The mean number of sick days of combat troop WIA cases before return to duty were 4.3 and 5.1 days for two different operations, while DNBI treatment duration averaged 9.5 and 9.6 days.				
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