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PERSONNEL ATTRITION RATES IN HISTORICAL LAND COMBAT OPERATIONS: SUSCEPTIBILITY AND VULNERABILITY OF MAJOR ANATOMICAL REGIONS

AUGUST 1993

PREPARED BY
SPECIAL ASSISTANT FOR MODEL VALIDATION

US ARMY CONCEPTS ANALYSIS AGENCY
8120 WOODMONT AVENUE
BETHESDA, MARYLAND 20814-2797

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Director
US Army Concepts Analysis Agency
ATTN: CSCA-MV
8120 Woodmont Avenue
Bethesda, MD 20814-2797

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Robert L. Helmbold

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This paper uses published personnel attrition data to estimate the susceptibility and vulnerability of major anatomical regions to threats similar to bullets and shell fragments. Its findings will be useful to those engaged in weapons systems analysis and development, war gaming and simulation, and the assessment of personal protective devices.

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PERSONNEL ATTRITION RATES IN HISTORICAL LAND COMBAT OPERATIONS: SUSCEPTIBILITY AND VULNERABILITY OF MAJOR ANATOMICAL REGIONS

August 1993

Prepared by

Dr. Robert L. Helmbold
OFFICE, SPECIAL ASSISTANT FOR MODEL VALIDATION
US Army Concepts Analysis Agency
8120 Woodmont Avenue
Bethesda, Maryland 20814-2797

PREFACE

The Personnel Attrition Rates (PAR) Study as a whole is limited to studying personnel strengths and battle casualties in historical land combat operations. Other types of attrition (nonbattle losses, losses to equipment, casualties to other services, and so forth) are outside PAR's scope, as are personnel losses in models, simulations, wargames, field experiments, or training exercises (like those of the National Training Center).

Phase 1, or PAR-P1, was devoted to assembling the available data and past studies on personnel strengths and attrition rates in land combat operations, preparing a comprehensive bibliography of it, and planning the approach to subsequent phases. Its specific objectives were to:

- Collect as many as possible of the available tabulated data and data-based studies of attrition rates in historical land combat operations,
- Prepare a comprehensive bibliography of such data and studies, and
- Outline an approach to accomplishing the subsequent phases of the PAR Study as a whole.

The bibliography of works collected during Phase 1 was published as *Personnel Attrition Rates in Land Combat Operations: An Annotated Bibliography*, US Army Concepts Analysis Agency Research Paper, CAA-RP-93-2, June 1993. The collection of data and data-based studies consists of the files of pertinent documents maintained at the US Army Concepts Analysis Agency.

Phases 2 and 3 of the PAR Study will convert some of the most important data to electronic form in order to facilitate its analysis, and will perform selected analyses of the attrition data to derive information useful in US Army wargames, studies, and analyses.

This paper, written as part of Phase 2, illustrates one such analysis. It uses historical data on personnel attrition to derive estimates of the susceptibility (*i.e.*, probability that a particular anatomical region is hit, given a hit somewhere on the whole body) and vulnerability (*i.e.*, the conditional probability of being killed or wounded in action, given a hit on a particular anatomical region) of selected major anatomical regions (such as the head, thorax, abdomen, arms, and legs). These estimates will be useful to all who need to consider such factors to evaluate weapons effectiveness, estimate personnel attrition, perform studies and analyses, or assess protective equipment for personnel.

DEPARTMENT OF THE ARMY
US ARMY CONCEPTS ANALYSIS AGENCY
8120 WOODMONT AVENUE
BETHESDA, MARYLAND 20814-2797

REPLY TO
ATTENTION OF:

CSCA-MVM

28 SEP 1993

MEMORANDUM FOR DEPUTY UNDER SECRETARY OF THE ARMY (OR),
HEADQUARTERS, DEPARTMENT OF ARMY,
WASHINGTON, DC 20310

SUBJECT: Personnel Attrition Rates in Historical Land Combat Operations: Susceptibility and Vulnerability of Major Anatomical Regions

1. The U.S. Army Concepts Analysis Agency (CAA) is pleased to publish this Research Paper by Dr. Robert L. Helmbold. Its use of available personnel attrition data to estimate the susceptibility and vulnerability of major anatomical regions yields results that should be useful to those engaged in weapons systems analysis and development, war gaming and simulation, and the assessment of personal protective devices. Wide dissemination will make this work available to others for further use in their work.

2. Questions or inquiries should be directed to the Office of Special Assistant for Model Validation, U.S. Army Concepts Analysis Agency (CSCA-MV), 8120 Woodmont Avenue, Bethesda, MD 20814-2797, (301) 295-1611 or DSN 295-1611.

E. B. VANDIVER III
Director

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CAA	PERSONNEL ATTRITION RATES IN HISTORICAL LAND COMBAT OPERATIONS: SUSCEPTIBILITY AND VULNERABILITY OF MAJOR ANATOMICAL REGIONS	SUMMARY CAA-RP-93-3

THE REASON FOR PREPARING THIS PAPER is that the data collected on personnel attrition rates can be used to estimate the susceptibility and vulnerability of major anatomical regions, and that such estimates will be useful to those engaged in weapons systems analysis and development, wargaming and simulation, and the assessment of personal protective devices.

THE SPONSOR is the Director, US Army Concepts Analysis Agency.

THE OBJECTIVE is to provide the Army with estimates of the susceptibility and vulnerability of major anatomical regions, derived on an empirical basis.

THE SCOPE OF THE STUDY is limited to the susceptibility (probability of hitting one of the major anatomical regions) and vulnerability (conditional probability of being wounded or killed in action given a hit in one of the major anatomical regions) of personnel to bullets, shell fragments, and similar threats.

THE MAIN ASSUMPTION of this paper is that the bulk of the pertinent works have been collected and are on file at CAA.

THE BASIC APPROACH is to use published data on personnel attrition to estimate the susceptibility and vulnerability of major anatomical regions (such as the head, thorax, abdomen, arms, and legs).

THE PRINCIPAL FINDINGS of this work are that published personnel attrition data can be used to estimate the susceptibility and vulnerability of major anatomical regions. The susceptibility estimates based on various sources are generally similar, which suggests that they are influenced only slightly by variations in the tactical situation. The vulnerability estimates appear to be somewhat more sensitive to the tactical situation, but clearly indicate that a hit in one of the central regions (head, thorax, and abdomen) is far more likely to result in a killed in action than a hit on the extremities (arms and legs).

THE STUDY EFFORT was directed by Dr. Robert L. Helmbold, Scenarios and Model Validation Division.

COMMENTS AND SUGGESTIONS may be sent to the Director, US Army Concepts Analysis Agency, ATTN: CSCA-MV, 8120 Woodmont Avenue, Bethesda, Maryland, 20814-2797.

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CONTENTS

FIGURES

TABLES

CHAPTER 1

EXECUTIVE SUMMARY

1-1. BACKGROUND. In April 1992, the US Army Concepts Analysis Agency (CAA) started a three-phased study of Personnel Attrition Rates (PAR). The present document covers only the portion of this work having to do with selected aspects of the anatomical distribution of hits and casualties.

1-2. OBJECTIVE. The main reason for performing this study was to put on record the work done on the anatomical distribution of hits and casualties using the extensive data collected during Phase I of PAR. The issue addressed is, "What do the data tell us about the susceptibility and vulnerability of various parts of the body?" Here susceptibility is defined to be the probability that a certain anatomical region will be hit, given a hit somewhere on the whole body. Vulnerability is defined to be the (conditional) probability that one or another type of casualty will result, given that a certain anatomical region is hit.

1-3. SCOPE. PAR is limited to studying personnel strengths and battle casualties of land combat forces. Other types of attrition (nonbattle losses, losses to equipment, casualties to other services, and so forth) are outside PAR's scope. PAR is concerned only with historical data on actual combat operations: it will *not* deal with personnel losses in models, simulations, wargames, field experiments, or training exercises (like those of the National Training Center). PAR focuses mainly on either original or translated works in English, although some important work in other languages may be included. Studies of personnel attrition are also included, provided they contain cogent analyses of a publicly available, nonproprietary body of tabulated data on attrition in actual combat operations. Since trends in attrition over long periods of time are of interest, data on ancient as well as recent battles are solicited. However, as no contract support is anticipated and in-house resources are limited, no systematic effort is made to extract data from the archives or primary source materials, and no original historical research is envisioned. Thus, PAR relies almost exclusively on secondary works that contain data in readily usable tabulated form. All works received prior to the cutoff date of 31 May 1993 are included in the final report on Phase I (see CAA-1993, in the References listed in Appendix A).

The scope of the present paper is limited to wounds inflicted on personnel by projectile impact, where "projectiles" include bullets, shell fragments, flechettes, shrapnel, grapeshot, and similar items. It is (at least in principle) possible to locate the anatomical site of the injuries caused by such projectiles. Bodily injury inflicted by weapons or weapons effects that are difficult to localize are excluded from the

scope of this paper Some examples of the types of weapons or weapon effects excluded are chemical weapons (encompassing war gases and other toxic substances, flame weapons, and biological agents), nuclear weapons effects (blast, ionizing radiation, and thermal effects), and directed energy weapons. Injuries to personnel in armored vehicles are not included, primarily because sufficient data to perform a proper analysis of that case was not in hand.

1-4. ASSUMPTIONS. The main assumption of this paper is that the bulk of the pertinent works have been collected and are on file at CAA.

1-5. APPROACH. The basic approach is to use published data on personnel attrition to estimate the susceptibility and vulnerability of major anatomical regions.

1-6. FINDINGS AND OBSERVATIONS. It is feasible to use published data on personnel attrition to estimate the susceptibility and vulnerability of selected major anatomical regions. Based on our results, we suggest the nominal values in Table 1-1 as applicable to US Army combat operations under contemporary conditions (see the Glossary for the abbreviations KIA, WIA, *etc.*). These values are consistent with the results obtained in Appendix B, but are otherwise more or less arbitrary.

Table 1-1. Suggested Nominal Values of Personnel Susceptibility and Vulnerability

Anatomical Region	Nominal P(Hit)	Nominal P(KIA|Hit)	Nominal P(WIA|Hit)	Nominal P(DOW|Hit)	Nominal P(NFW|Hit)
Head&Neck	0.23	0.45	0.55	0.03	0.52
Thorax	0.15	0.45	0.55	0.04	0.51
Abdomen	0.10	0.35	0.65	0.10	0.55
Arms	0.20	0.03	0.97	0.01	0.96
Legs	0.32	0.05	0.95	0.02	0.93
Total	1.00	----	----	----	----

The implied nominal unconditional probability of KIA, obtained from the formula,

$$P(\text{KIA}) = \sum P(\text{KIA}|\text{Hit}) \times P(\text{Hit}),$$

where the sum is taken over all of the major anatomical regions, is P(KIA) = 0.228. This value is close to the traditional rule of thumb that about 1/4 to 1/5 of those hit are KIA.

We observe that these nominal hit probabilities are not the same as those implied by the hypothesis that hits are uniformly distributed over the body when the relative areas of the major anatomical regions are taken to be those given in the Joint Munitions Effects Manual (JMEM), in particular in Ref JMEM-1991). In addition, the JMEM casualty criteria (such as being able to conduct a defense for some specified minimum period of time) have no known relation to the conventional casualty categories used in the published data on personnel attrition (such as KIA, WIA, and so forth).

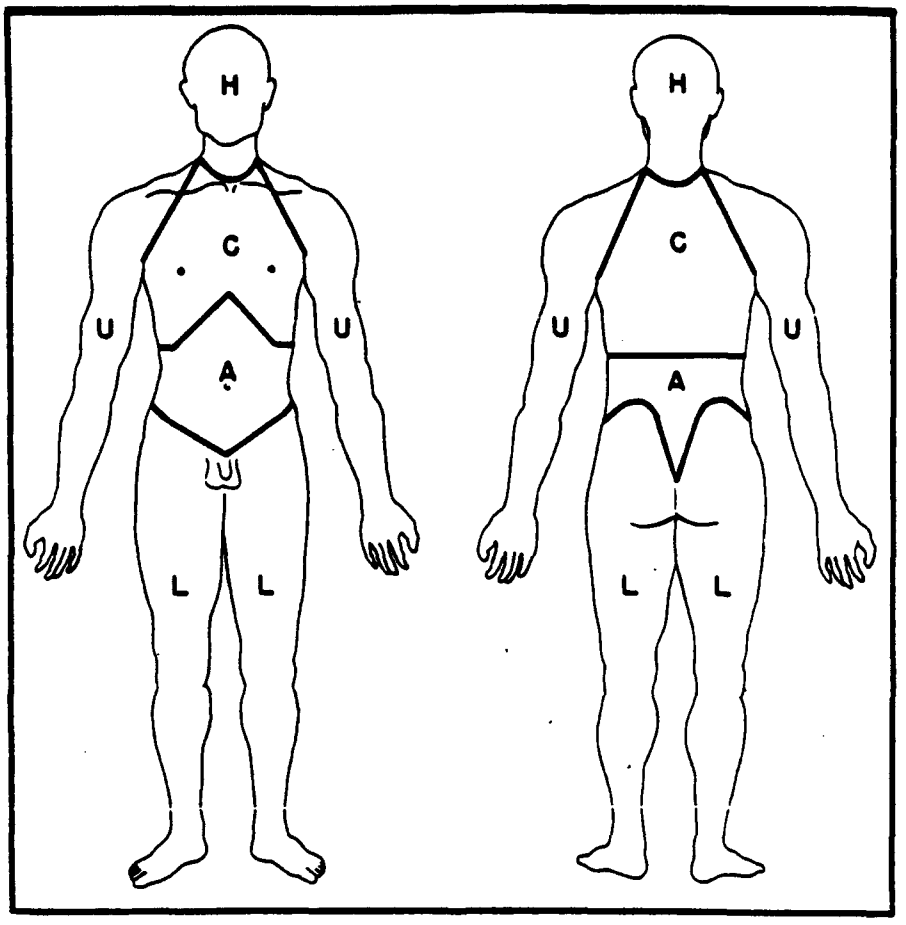
CHAPTER 2

DISCUSSION OF VARIOUS CONSIDERATIONS BEARING ON THE MAIN ISSUE

2-1. INTRODUCTION. As stated in Chapter 1, the issue to be addressed is "What do the data tell us about the susceptibility and vulnerability of various parts of the body?" Here susceptibility is interpreted as the probability that a certain anatomical region will be hit. Vulnerability is interpreted as the (conditional) probability that one or another type of casualty will result, given that a certain anatomical region is hit. This chapter describes and discusses various considerations bearing on the estimation and interpretation of the susceptibility and vulnerability probabilities. As such, it covers both background and approach.

2-2. DEFINITION OF ANATOMICAL REGIONS. The major anatomical regions in common use are the following: head and neck, thorax, abdomen, pelvis, arms, and legs. However, many authors omit the pelvis as a separate region and include it under one or more of the other regions. In addition, many refinements of these basic regions are possible. For example, the head and neck may be subdivided into the following four regions: head (less face and neck), face (less eyes), eyes, and neck. Others subdivide the arms into shoulder, upper arms, elbow, lower arm, wrist, hand, and fingers. The legs may be similarly subdivided. Many include a "Multiple Wounds" and/or an "Other (or Unknown)" category to account for records that do not fit easily into any of the above categories or are missing. Because various authors use somewhat different boundaries for the anatomical regions, we are often forced to use various descriptors, or to estimate how to convert a set of values based on one anatomical categorization to a different categorization (*e.g.*, from values based on a categorization by head, neck, thorax, abdomen, spine, shoulder, arms, hips and buttocks, and legs to another categorization according to head and neck, thorax, abdomen, pelvis, arms, and legs).

Figure 2-1 shows the definition of anatomical regions used in most routine US Army casualty reports from the field during World War II and Korea. However, there is no assurance that this definition of anatomical regions is used by all of the sources considered here. In fact, Beyer-1962, pp 762-763, presents a somewhat different demarcation of anatomical regions that was used for some of the battle casualty surveys done during the Korean War. Beyer-1962, p 558, notes that "The lack of a standardized method of demarcation of the regions of the body makes it impossible to compare accurately the distribution of wounds in any two or more collections of casualty data."



THE REGIONS OF THE BODY AS DEMARCATED ACCORDING TO THE DESCRIPTION IN THE TEXT

SYMBOL	REGION	PER CENT OF TOTAL BODY SURFACE AREA
H	HEAD AND NECK	12
C	CHEST	16
A	ABDOMEN	11
U	UPPER EXTREMITIES	22
L	LOWER EXTREMITIES	39

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Figure 2-1. Demarcation of Major Anatomical Regions (from Beyer-1962, p 560).

Moreover, it is often difficult in practice to identify the anatomical region struck unless the individual is stripped and given a detailed, thorough examination. The KIA are seldom subjected to such a procedure, and the data on their anatomical region of wounding should be viewed accordingly.

2-3. PRESENTED AREA OF ANATOMICAL REGIONS. The presented area of the anatomical regions is thought by some sources to influence their susceptibility to being hit. Such a view usually takes the form of hypothesizing that hits are uniformly and randomly distributed over the body. This hypothesis would imply that the susceptibility of each anatomical region is proportional to its average presented area. The hypothesis of uniform distribution of hits is based on the following considerations. If, as is generally believed, missiles are seldom aimed at a particular individual (much less at a particular anatomical region of a particular individual), and even if so aimed the dispersion of their impact points (allowing for aiming and other errors) is large compared to the dimensions of the human body, it then follows that the distribution of hits on the body should have (very nearly) a uniform random distribution. However, this randomness is conditioned by the degree to which various body portions are "exposed," or susceptible to being hit, and such exposure may differ from one situation to another. In particular, posture and cover (including defensive works such as foxholes, bunkers, and revetments; wading through water in an amphibious assault, stream crossing, or swamp; crouching or prone versus standing; the type and "density" of local vegetation as well as other aspects of the local "micro-terrain"; transport in armored or unarmored vehicles versus on foot; body armor and helmets and (to a lesser extent) the heavy clothing worn during cold weather; and a host of other factors) affects the degree to which various body portions are exposed in this sense, and hence affects the reported numbers or statistics on anatomical location of wounds (since a missile impact that does not penetrate the helmet, armor, or clothing and does not produce broken bones, contusions, or other injuries serious enough to qualify as a "wound" will not find their way into the statistical tabulations). Hence the relative susceptibility of the major anatomical regions may not correspond exactly to their average presented areas.

Table 2-1 shows some of the presented area estimates that have appeared in the literature. It is not clear whether the variation apparent in these estimates is due mainly to differences in demarcation of anatomical regions, or to other differences in estimating their relative proportions. Also, it would seem reasonable to expect particular individuals to depart more or less from the average presented areas due to their peculiar size and shape, but we found no satisfactory treatment of such individual variability.

2-4. DEFINITION OF CASUALTY CATEGORIES. The principal battle casualty categories in current use by the United States Army for reporting data obtained in the field are killed in action (KIA), wounded in action (WIA), and died of wounds (DOW). These are defined as follows.

KIA.- Killed in action (DOD, NATO, IADB). A battle casualty who is killed outright or who dies as a result of wounds or other injuries before reaching a medical treatment facility. See also died of wounds received in action.

Table 2-1. Estimated Average Presented Areas of Major Anatomical Regions

Anatomical region	Percentage of total body area[a]				
	BBZ[b]	MG[b]	L[b]	B[b]	JMEM[b]
Head&Neck	12.0%	6.0%	9.0%	42.0%	6.5%
Thorax	16.0%	41.0%	29.0%	(w/HeadNeck)	13.0%
Abdomen	11.0%	(w/Thorax)	(w/Thorax)	(w/HeadNeck)	10.7%
Pelvis	--	--	--	--	11.6%
Upper Limbs	22.0%	20.0%	21.0%	19.0%	20.5%
Lower Limbs	39.0%	33.0%	41.0%	39.0%	37.8%
Total	100.0%	100.0%	100.0%	100.0%	100.0%

Table Notes:

[a] Dashes indicate values not given in the source. The notation (w/···) indicates that the source does not list this anatomical region separately, but includes it under the ··· heading.

[b] BBZ = Black, Burns and Zuckerman, as cited by Beyer-1962 pp 108, 572, 611, and 847; and by Beebe-1952 p 167.
MG = McMillen and Gregg, as cited by Beebe-1952 p 167.
L = Longmore, as cited by Beebe-1952 p 167 and Otis-1883 p 691.
B = Berkow, as cited by Beebe-1952 p 167.
JMEM = Taken from JMEM-1991, Chapter 2.

WIA.- Wounded in action (DOD, NATO, IADB). A battle casualty other than "killed in action" who has incurred an injury due to an external agent or cause. The term encompasses all kinds of wounds and other injuries incurred in action, whether there is a piercing of the body, as in a penetrating or perforated wound, or not, as in the contused wound; all fractures, burns, blast concussions, all effects of biological and chemical warfare agents, the effects of exposure to ionizing radiation, or any other destructive weapon or agent.

DOW.- Died of wounds received in action (DOD, NATO). A battle casualty who dies of wounds or other injuries received in action, after having reached a medical treatment facility. See also killed in action.

The carded for record only (CRO) cases are not generally reported, where CRO is defined as follows:

CRO.- Carded for record only. (Adapted from Beebe-1952.) Basically, admissions to a medical treatment facility include all cases admitted for medical care and not returned to duty on the same calendar day as that on which first seen, but they also include certain other cases treated on an outpatient (duty) status and designated as carded for record only (CRO).

Sometimes the WIA are subdivided into seriously (SWIA) and lightly or slightly wounded (LWIA) categories, defined as follows:

LWIA.- Lightly or slightly wounded in action. A casualty that is a sitting or walking case.

SWIA.- Seriously wounded in action. A stretcher case. See also WIA.

In practice, of course, varying definitions of KIA and WIA have obtained at various times within the US Army. For example, during World War II and Korea, the "medical treatment facility" indicated in the above definitions of WIA and KIA was the battalion aid station. However, during and subsequent to the Vietnam War, it was changed to mean hospital. Other US services do not necessarily use the same definitions. For instance, during World War II, the Navy and Marine Corps counted as KIA those who died within 24 hours of being wounded, whether they were under medical care or not. Nowadays, they use the same definitions as does the Army. We remark that the personnel casualty criteria used by the Joint Munitions Effectiveness Manual (JMEM-1991) are quite different from, and have no known relation to, the above casualty categories.

Furthermore, our allies do not necessarily use the same definitions as we do. For example, Thayer-1985, p 101, states that "... every allied force in Vietnam counted its wounded differently so those figures are not comparable among forces," and Love-1932 states that "The British classify as battle casualties ... those who suffered shock to the nervous system caused by bursting shells although producing no visible trauma ... " while the US Army did not and does not. Even when common definitions are officially adopted, they may not exactly fit the situation, or they may not be faithfully and accurately applied. Such errors in reports at the lowest levels will propagate through the reporting system, which may itself introduce additional errors (due to double-counting, mistakes in transcription, lost or mislabeled records, and so forth).

2-5. QUALITY OF THE BASIC DATA. The basic data on anatomical distribution of various casualty categories may be affected by a variety of errors. Some of these have been mentioned above in connection with the definitions of anatomical regions and of casualty categories. A few others are mentioned below. Unfortunately, there usually are no satisfactory objective methods either for estimating their magnitude or for correcting them.

There are errors in the basic casualty records. This basic information is usually derived from the records made by personnel in the field. Records on KIA and other deaths are generally maintained by personnel specialists and forwarded to The Adjutant General, while records of wounded and their treatment in medical facilities are normally maintained by medical specialists and forwarded to The Surgeon General. However, there is often some overlap in reporting between these two systems, and in most cases the duplication reveals discrepancies between the two systems. For example, Reister-1975 (p 4) reports the discrepancies described in Table 2-2 with regard to World War II statistics. Beyer-1962 (p 451) reports the discrepancies described in Table 2-3 with regard to the actual location of wounds and those reported on the Emergency Medical Tags (EMTs) used to record medical data on casualties. Datel-1979 notes major discrepancies between The Surgeon General and The Adjutant General with regard to the counts of suicides in the US Army, even during peacetime.

Table 2-2. Comparison of Wounded and Battle Deaths, US Army, World War II

Type of casualty	The Adjutant General's report	The Surgeon General's report
Wounded in action	592,170[a]	723,560
Carded for record only	--	123,836
Wounded admissions	--	599,724
Total deaths	216,005	213,030
Killed in action	189,696[b]	192,220
Died of wounds	26,309[a]	20,810
Other battle deaths	18,869[c]	16,793[d]

Table Notes:

[a] Excludes 453 died of wounds while captured.

[b] Excludes 3,102 killed after capture.

[c] Includes 3,102 killed, 453 died of wounds, 6,058 declared dead, and 9,256 died of other causes, nonbattle, while captured or interned.

[d] Based on The Adjutant General's file of declared dead and died in enemy prisons.

Table 2-3. Comparison of Regions Actually Involved and Regions Recorded on EMTs

Body region	Region actually involved	Regional involvement present and noted on EMT	Noted on EMT but not actually present
Head	431	327	49
Neck	178	58	19
Thorax	572	338	42
Abdomen	269	114	47
Pelvis	175	26	14
Extremities:			
Upper	409	113	42
Lower	388	190	34
Genitalia	23	3	3
Total	2,445	1,169	250

In the future, we can expect to be faced with similar or worse discrepancies between counts assembled and provided by various agencies, since (as noted by Schmidt-1963, Smith-1969, and Uhorchak-1992) there is at present no designated organization or explicit requirement either to collect, process, and disseminate during combat operations any data on casualties or attrition, or to resolve the

discrepancies among various reporting agencies. For example, The Surgeon General concentrates on personnel who are admitted to hospitals for treatment, while The Adjutant General also reports on personnel who are KIA, MIA, captured, or otherwise lost from their assigned unit.

2-6. COUNT WOUNDS OR WOUNDED. The sources consulted sometimes provide data on the number of wounds and sometimes on the number of casualties. In general, attempts to convert one of these types of tabulations to the other are inappropriate. For example, one casualty hit three times (*e.g.*, in the leg, arms, and thorax) can hardly be said to be equivalent to three casualties each hit once (one of them in the arm, another in the leg, and another in the thorax). Counting wounds rather than casualties tends to multiply-count the casualties (since each of the wounds suffered by a casualty are counted), yet counting casualties rather than wounds tends to undercount wounds (since each casualty is assigned to only one wound category even though that individual may have suffered multiple wounds).

Regardless of whether they count wounds or casualties, the sources rarely provide any information on the number of casualties who sustained exactly a certain number of wounds (*e.g.*, exactly one, exactly two, ...). For example, a source might indicate that 800 casualties experienced a total of 1,000 wounds: 150 wounds located in the head, 250 in the thorax, 300 in the arms, and 300 in the legs. However, there is no way of telling from this information how often a given anatomical region was associated with a casualty. For example, it is possible that of the 800 casualties, 150 were wounded in the head exactly once, 250 were wounded in the thorax exactly once, 300 were wounded in the arms exactly once, and 100 of them were wounded exactly three times in the legs. On the other hand, it is also possible that 150 were wounded in the head exactly once, 200 were wounded exactly twice (in both the thorax and legs), another 50 exactly once in the thorax, 100 exactly once in the legs, and 300 exactly once in the arms. Obviously, many other allocations of wounds to casualties are also mathematically possible, and there is no objective way of determining which allocation is correct. In view of this ambiguity, in this paper we use data giving counts of the casualties rather than those giving counts of the wounds. This, in effect, makes the same assumption that is often adopted by similar studies—namely, that the sources that count casualties by anatomical site of wound are reporting the anatomical site of the *primary* wound for that casualty.

2-7. ANATOMICAL DISTRIBUTION FOR WIA VERSUS KIA. Some sources attempt to deduce the susceptibility and vulnerability of various anatomical regions by examining data on the distribution of hits for WIA casualties. Some writers have even attempted to assess the relative merit of various body armor configurations on such data. However, this is improper, because it ignores the data on KIA casualties and so commits a fallacy like that in the oft-repeated military operations research story about the official who wanted to armor those parts of an airplane that exhibited the greatest frequency of hits upon their return to base. The heart of this fallacy lies in the fact that the relative vulnerability or

sensitivity of various portions of the body to missile impact affects the anatomical distributions reported in the usual statistics.

To illustrate this phenomenon, suppose that only a certain type of missile is used, which is invariably lethal if it strikes the head, and invariably nonlethal otherwise. Then the distribution of *fatal* hits by anatomical region will show that *all* of them struck the head (and the force using that missile may get a reputation as "sharpshooters"). On the other hand, the distribution of *nonfatal* hits by anatomical region will show that *none* of them struck the head.

In general, the differences in relative vulnerability of the anatomical regions (*i.e.*, in the probability of a KIA *versus* a WIA resulting when that region is struck by a missile) causes the distribution of hits by anatomical region for the KIA casualties to differ from that for WIA casualties. In fact, when distributions of anatomical region are given for KIA and WIA, they should be treated as reflecting the probability of a hit in a given anatomical region *given* that a KIA (or, respectively, a WIA) occurred. Symbolically, they are related to Prob(Hit Region R | KIA) and Prob(Hit Region R | WIA). Some information relevant to these conditional probabilities is presented later in this section.

However, before doing so we remark that these are *not* the probabilities needed for evaluating munitions effectiveness, assessing casualties in wargames and simulations, or estimating the benefits of various protective measures. For such purposes one needs the (unconditional) distribution of hits on the anatomical regions, together with the conditional probability of a KIA (or WIA) *given* a hit in a specified anatomical region. These may be expressed symbolically as Prob(Hit Region R), Prob(KIA | Hit Region R), and Prob(WIA | Hit Region R). A method for estimating those probabilities is described in the next paragraph (2-8). The results obtained thereby are discussed in Chapter 3.

To estimate the Prob(Hit Region R | KIA) and Prob(Hit Region R | WIA) we proceeded as follows. We started with the data in Tables B-1 and B-2 of Appendix B. We then discarded those data for which the sample size was not known. The remaining values were adjusted by distributing the values in the "other/unknown" anatomical region to the other regions, assuming that they were in proportion to the known cases for those regions. Then we sorted the records into two groups according as to whether the data were for KIA or WIA. Each of these groups was further subdivided according as to whether they tallied the number of wounds or the number of wounded. The anatomical distribution data for each of these four groups was then averaged, using a weighted average weighted by the number of cases in the sample size. The resulting estimates of the conditional distribution of hits given KIA or WIA are displayed in Figures 2-2 and 2-3, respectively, where the notations #Wnds and #Cas means that the values shown are based on the number of wounds and the number of wounded (respectively).

What is apparent from these figures is that the distribution of hits given WIA is about the same whether the counts are based on wounds or on wounded. On the other hand, the distribution of hits given KIA when counts are based on wounds is not the same as when counts are based on wounded.

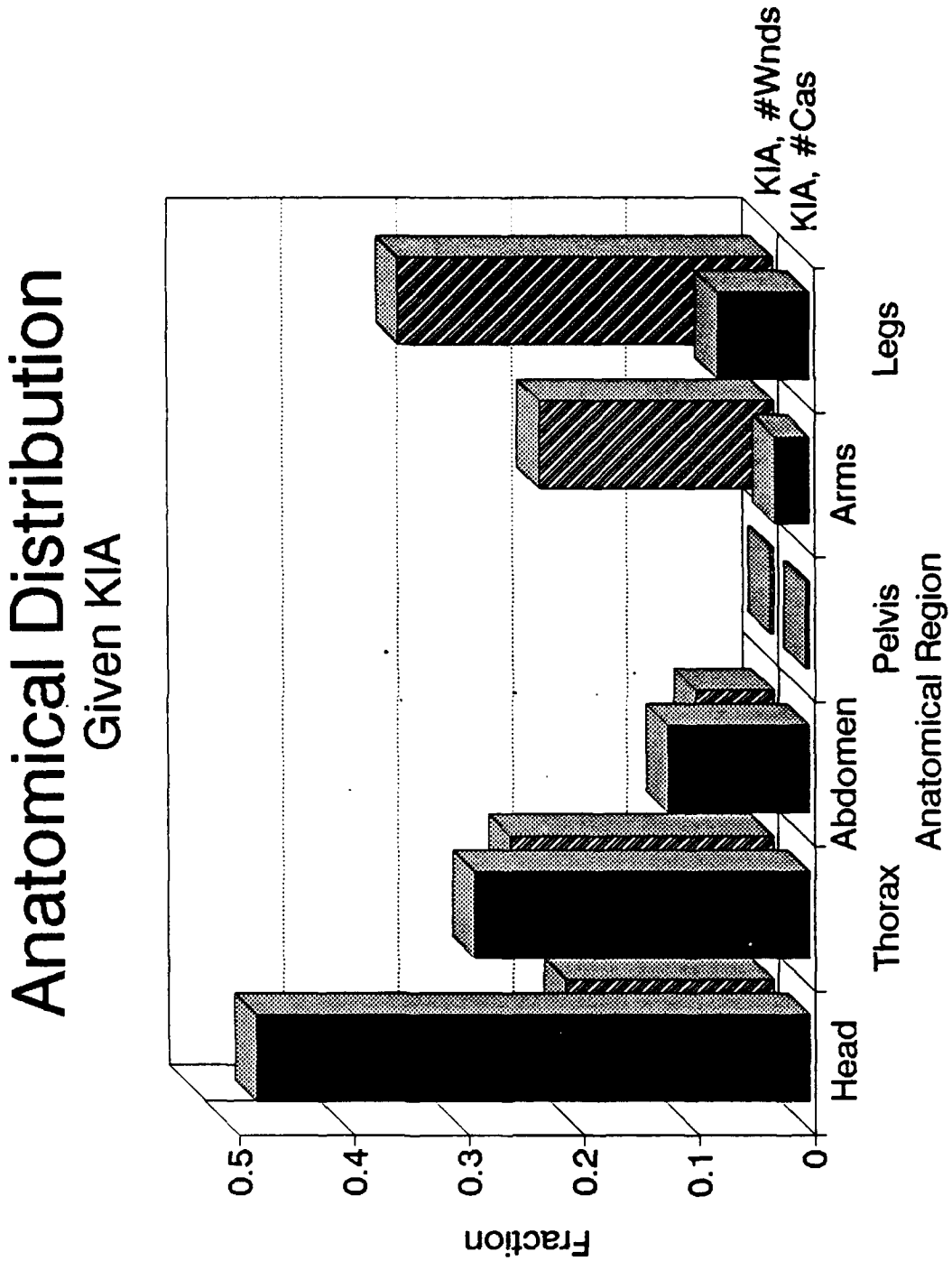

Figure 2-2. Observed Anatomical Distribution of Hits, Given KIA.

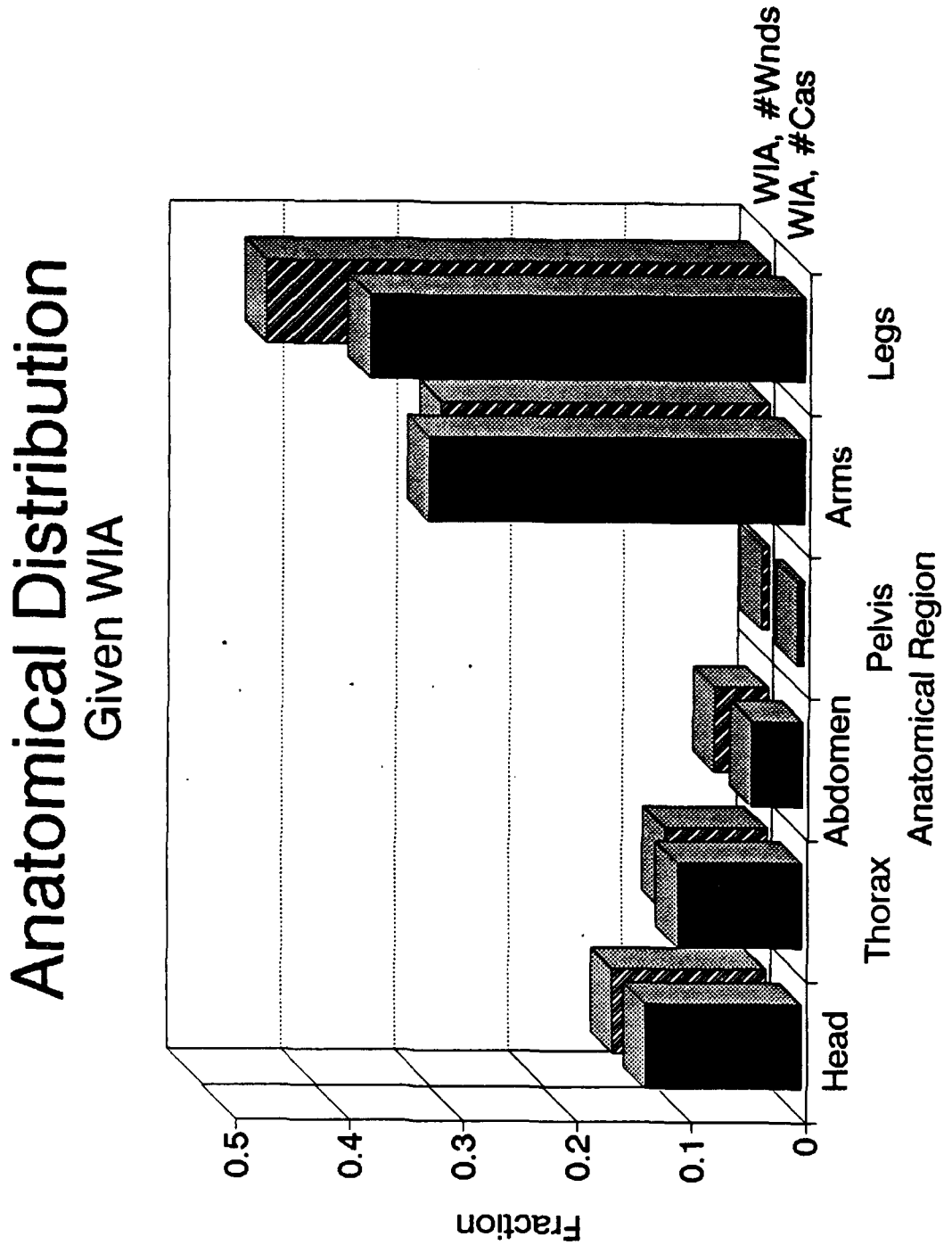

Figure 2-3. Observed Anatomical Distribution of Hits, Given WIA.

Also, when counts are based on wounded, the distribution of hits given WIA tends to be concentrated in the extremities (arms and legs), while the distribution of hits given KIA tends to be concentrated in the central regions (head, thorax, and abdomen). Presumably part of this is due to the fact that WIA are seldom hit in multiple anatomical regions, while KIA are. We do not attempt a deeper interpretation of these figures because, as noted earlier, we are not much interested in the probabilities of the corresponding events.

2-8. ESTIMATING SUSCEPTIBILITY AND VULNERABILITY. The method for estimating the probabilities of more interesting events follows essentially the procedures outlined by Bellamy-1983 and used in the Bougainville and New Georgia-Burma studies reported in Beyer-1962. That is, we prepare a table like that shown in Table 2-4, with rows for the anatomical regions (head, face, eye, neck, thorax, abdomen, pelvis, spine, upper arm, lower arm, hand, hip and buttock, upper leg, lower leg, foot, multiple, and other and unknown) and columns for the casualty categories (KIA, WIA, DOW, and NFW, where NFW is an abbreviation for nonfatal wounds). At the intersection of each row and column we record the number of casualties corresponding to the appropriate anatomical region and casualty category. The data shown in Table 2-4 are from Tables 21 and 23 of Reister-1975, and apply to World War II, US Army, 1942 through 1944, all theaters.

Some sources give the required values directly. Others give them indirectly by providing the total number of casualties in each casualty category together with the percentage of such casualties by each anatomical region. In either situation, the number of cases for each anatomical region is adjusted by adding to it a proportion of the cases tabulated under the other (*i.e.*, unknown) and multiple anatomical region headings (this assumes that such proportions are about the same as for those cases in which the anatomical region is specified). In this paper, the results of adjusting for both the other and the multiple anatomical region headings is called the "fully adjusted" values to distinguish them from the adjusted values using only the other/unknown headings. Table 2-5 shows the results of fully adjusting Table 2-4 values in this fashion. Note that this adjustment does not affect the column totals. Also, note that the adjustment is typically much larger, and hence potentially more subject to error, for the KIA than for the other casualty categories.

The final step is to estimate from these data the probability that a given anatomical region is hit (given, of course, that *some* anatomical region has been hit) and the conditional probabilities that various casualty states will result from a hit in a given anatomical region. The probability of a hit in a given anatomical region is estimated by dividing the adjusted row-totals for that anatomical region by the total number of casualties for the entire table. The results when Table 2-5 is used are shown in Table 2-6. For example, the probability that the head region is hit is estimated by dividing 123,150.7 by 791,944. The (conditional) probabilities that various casualty states will result from a hit in a given anatomical region are estimated by dividing the adjusted row-values for that anatomical region and

casualty category by the adjusted total number of hits on that anatomical region. For instance, the estimate in Table 2-6 of the probability that a hit in the head region will result in a KIA is obtained by dividing 76,255.5 by 123,150.7.

Table 2-4. Initial Data on Hits by Anatomical Region and Casualty Category

Line no	Anatomical region	Casualty category KIA	WIA	DOW	NFW[a]	Total
1	Head	30599	46267	3932	42335	76866
2	Face-Eye[b]	2988	32423	623	31800	35411
3	Eye	278	11774	66	11708	12052
4	Neck	3990	9804	456	9348	13794
5	Thorax	17957	43427	3615	39812	61384
6	Abdomen	12917	41170	5986	35184	54087
7	Pelvis	122	5253	240	5013	5375
8	Spine	278	7715	712	7003	7993
9	UArm[c]	2511	153015	999	152016	155526
10	LArm[d]	--[e]	--	--	--	--
11	Hand	--	--	--	--	--
12	Hip&Buttock	970	19487	381	19106	20457
13	ULeg-Hip[c,f]	4522	221355	3183	218172	225877
14	LLeg[d]	--	--	--	--	--
15	Foot	--	--	--	--	--
16	Multiple	8821	1901	430	1471	10722
17	Other	106267	6133	290	5843	112400
18	Total	192220	599724	20913	578811	791944
19	Proportion	0.2427	0.7573	0.0264	0.7309	1.0000
20	Frac. known	0.4013	0.9866	0.9656	0.9874	0.8445

Table Notes:

[a] NFW stands for "nonfatal wounds."
[b] Face, not including the eye.
[c] U stands for "upper."
[d] L stands for "lower."
[e] Dashes indicate values not given in the source consulted, or not applicable for other reasons.
[f] Upper leg, not including the hip and buttock region.

The number of CRO cases is omitted from these computations, partly because they represent relatively minor injuries and partly because the records on those cases have not found their way into the generally available statistical data. Consequently, the estimated susceptibilities and vulnerabilities obtained by this procedure (such as those in Table 2-6) should be interpreted as conditional on the hit producing a battle casualty (*i.e.*, either a KIA or WIA).

Table 2-5. Adjusted Data on Hits by Anatomical Region and Casualty Category

Line no	Anatomical region[a]	Casualty category KIA	WIA	DOW	NFW	Total
1	Head	76255.5	46895.2	4018.4	42876.8	123150.7
2	Face-Eye	7446.4	32863.2	656.3	32207.0	40309.6
3	Eye	692.8	11933.9	76.0	11857.8	12626.7
4	Neck	9943.4	9937.1	469.5	9467.6	19880.6
5	Thorax	44750.5	44016.7	3695.1	40321.5	88767.1
6	Abdomen	32190.3	41729.0	6094.7	35634.3	73919.4
7	Pelvis	304.0	5324.3	247.2	5077.2	5628.4
8	Spine	692.8	7819.8	727.1	7092.6	8512.6
9	UArm	6257.6	155092.6	1131.2	153961.5	161350.3
10	LArm	--	--	--	--	--
11	Hand	--	--	--	--	--
12	Hip&Buttock	2417.3	19751.6	401.1	19350.5	22168.9
13	ULeg-Hip	11269.2	224360.6	3396.4	220964.2	235629.8
14	LLeg	--	--	--	--	--
15	Foot	--	--	--	--	--
16	Multiple	--	--	--	--	--
17	Other	--	--	--	--	--
18	Total	192220	599724	20913	578811	791944.0
19	Proportion	0.2427	0.7573	0.0264	0.7309	1.0000

Table Notes:

[a] See Table 2-4 for abbreviations used.

We also remark that, to the extent that wearing body armor prevents such casualties, hits on the armored portions of the anatomy will not be recorded as either KIA or WIA. Accordingly, the effect of wearing body armor would be noticeable in such estimates as those of Table 2-6 by either (i) a relatively lesser chance of being "hit" in the region covered by the body armor, or (ii) a relatively less severe casualty state resulting from such a hit, or both. In case (i), it might appear at first sight that the use of body armor merely had the effect of shifting the distribution of hits by anatomical region, even though it is actually preventing certain "hits" from appearing in the casualty statistics and thus reducing the total number of KIA plus WIA. In case (ii), the body armor has already failed to prevent a casualty, but may have reduced its severity.

Table 2-6. Estimated Susceptibility and Vulnerability Values

Line no	Anatomical region[a]	Event[b] P(Hit R)	P(KIA|R)	P(WIA|R)	P(DOW|R)	P(NFW|R)
1	Head	0.1555	0.6192	0.3808	0.0326	0.3482
2	Face-Eye	0.0509	0.1847	0.8153	0.0163	0.7990
3	Eye	0.0159	0.0549	0.9451	0.0060	0.9391
4	Neck	0.0251	0.5002	0.4998	0.0236	0.4762
5	Thorax	0.1121	0.5041	0.4959	0.0416	0.4542
6	Abdomen	0.0933	0.4355	0.5645	0.0825	0.4821
7	Pelvis	0.0071	0.0540	0.9460	0.0439	0.9021
8	Spine	0.0107	0.0814	0.9186	0.0854	0.8332
9	UArm	0.2037	0.0388	0.9612	0.0070	0.9542
10	LArm	--	--	--	--	--
11	Hand	--	--	--	--	--
12	Hip&Buttock	0.0280	0.1090	0.8910	0.0181	0.8729
13	ULeg-Hip	0.2975	0.0478	0.9522	0.0144	0.9378
14	LLeg	--	--	--	--	--
15	Foot	--	--	--	--	--
16	Multiple	--	--	--	--	--
18	Total	1.0000	--	--	--	--

Table Notes:

[a] See Table 2-4 for abbreviations used.

[b] R stands for "Anatomical Region," i.e., P(Hit R) is the estimated probability of a hit in anatomical region R.

2-9. OTHER CONSIDERATIONS. In view of the above, it would be of interest to determine the anatomical distribution of hits under at least the following variations in basic conditions, in order to determine how sensitive the recorded data are to such variations. However, a systematic analysis of such factors is not attempted in this paper.

a. Terrain.

b. Weather.

c. Type of tactical operation (at least attack and defense, with pursuit and delay or withdrawal operations if possible).

d. Mix of weapons used (or, as a surrogate, at least the epoch in which the data were gathered).

e. Conventions on defining anatomical regions and classifying hits as KIA, WIA, CRO, and "not wounded."

CHAPTER 3

RESULTS AND DISCUSSION

3-1. INTRODUCTION. This chapter describes and discusses the results of applying the method described in paragraph 2-8 to some of the published data on personnel attrition rates. All of the data that lent itself to such an analysis are used, except that only data that are based on the number of wounded are used, rather than data on the number of wounds. The published data used to estimate the susceptibility and vulnerability of major anatomical regions are presented in Appendix B for ease of reference. Since most of the important problems and considerations involved in using published data on personnel attrition rates have already been mentioned in Chapter 2, they will not be repeated here.

3-2. SUSCEPTIBILITY. The principal results regarding susceptibility are displayed in Figure 3-1, which shows the estimated probability of being hit in a given anatomical region (given a hit on the whole body). The abbreviations for the basic data sources used in Figure 3-1 are as follows. The RVNAF (Republic of Vietnam Armed Forces) values are for the Vietnam Army, Navy, Air Force, and Marines during the year 1962, based on Tables 4 and 8 together with page 23 of Parker-1965. The RVN-CG (Republic of Vietnam-CG) values are for the Vietnam paramilitary forces or Bao An, then known as the CG, during the year 1962, based on Table B-1 and page 65 of Parker-1965. The Korea-All values are for the US Army during the Korean War (1950-1953), based on Table 21 and 22 of Reister-1969. The WWII-All values are for the US Army during World War II (December 1941 through 1945), all theaters, based on Tables 21 and 23 of Reister-1975. The NewG-Burma values are for the operations of three infantry battalions participating in the New Georgia and Burma campaigns (30 June 1943 to 22 September 1943 and February 1944 to May 1944, respectively), based on the casualty survey information contained in Table 36 on page 258 of Beyer-1962. The Bougain values are for US Army ground forces during the Bougainville campaign (15 February to 21 April 1944), based on the casualty survey information contained in Table 57 on page 317 of Beyer-1962. The EighthAF values are for the heavy bombardment groups of the US Eighth Air Force operating from the United Kingdom during parts of the European campaign (June through August of 1944), based on the casualty survey information in Table 186 on page 563 of Beyer-1962.

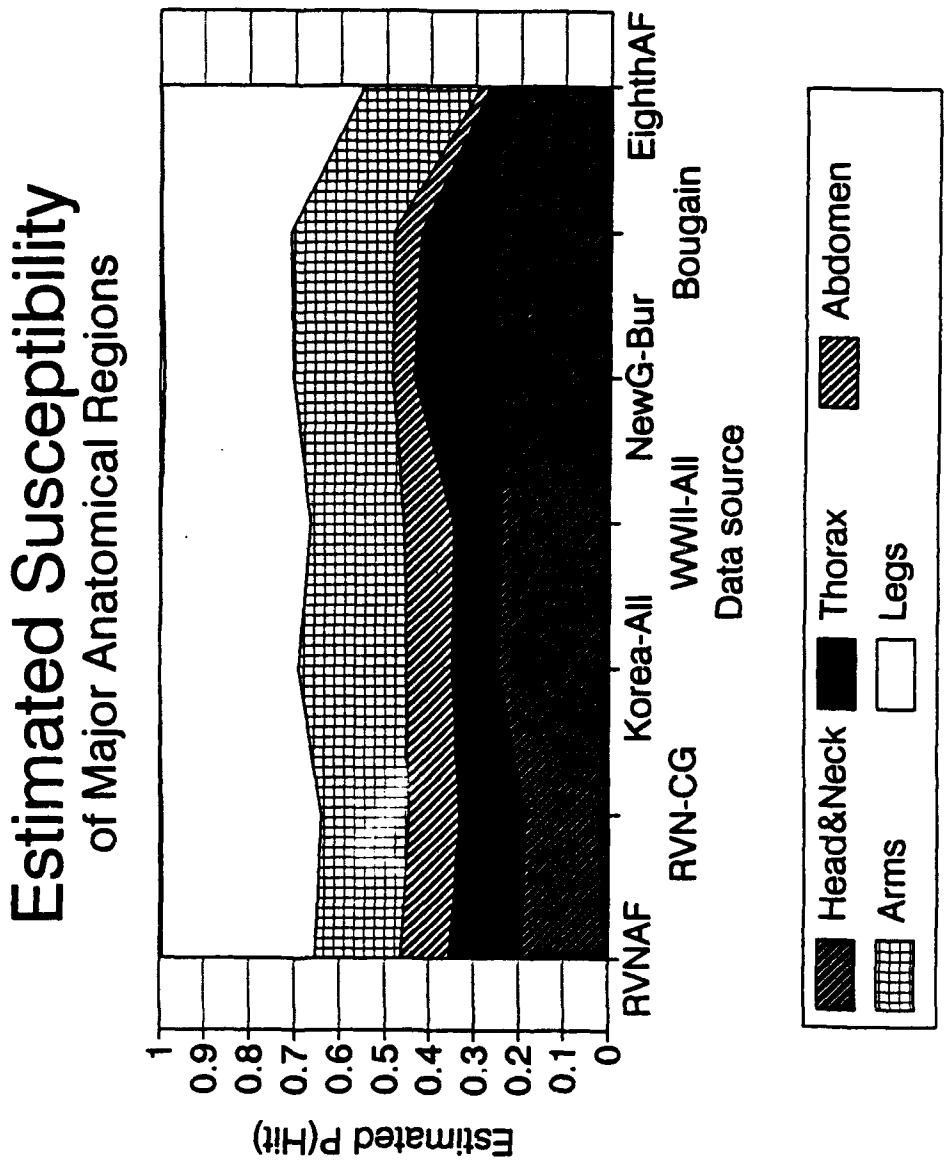

Figure 3-1. Estimated Susceptibility of Major Anatomical Regions.

Considering the kinds of errors that affect the basic data and the varieties of tactical situations represented, as well as the differences in sample sizes, in total number of cases, and in the number of cases listed as "other/unknown" or "multiple," Figure 3-1 shows a remarkable consistency in estimated susceptibility among the various data sources used. The body armor worn by Eighth Air Force personnel covered the thorax and abdomen, and it presumably reduced the probability that a "hit" would be recorded in those anatomical regions.

The consistency of these susceptibility values is further confirmed by Figures 3-2 and 3-3, which show the variation in susceptibility for various years during WWII and various tactical situations during the Korean War. Suggested representative nominal values of the probability of being hit in a given anatomical region (given a hit on the whole body) are provided in Table 3-1. They are consistent with the values in Figures 3-2 and 3-3, but are otherwise more or less arbitrary.

Table 3-1. Suggested Nominal Values of Susceptibility

Anatomical region	Nominal P(Hit)
Head&Neck	0.23
Thorax	0.15
Abdomen	0.10
Arms	0.20
Legs	0.32
Total	1.00

3-3. VULNERABILITY. The first principal result regarding vulnerability is shown in Figure 3-4, which gives the estimated conditional probability of being KIA given a hit on each of the major anatomical regions. (The estimated conditional probability of being WIA given a hit on each of the major anatomical regions is, of course, given by the complementary probability.) It is clear from this figure that the bulk of the KIA are due to hits in the central regions (head, neck, thorax, and abdomen). Personnel hit in the extremities (arms or legs) are seldom KIA.

The vulnerability estimates for the RVN-CG data are lower than for most of the other data sources used. The published data on this paramilitary force indicate that it had a much lower fraction of KIA cases (about 9 percent versus 20 to 25 percent) than did the other sources. This suggests that all of its P(KIA | Hit) values are reduced or diluted by a relatively high number of only lightly wounded cases. If its estimated vulnerability values are doubled to approximately correct for this dilution effect, they fall pretty much in line with the other values.

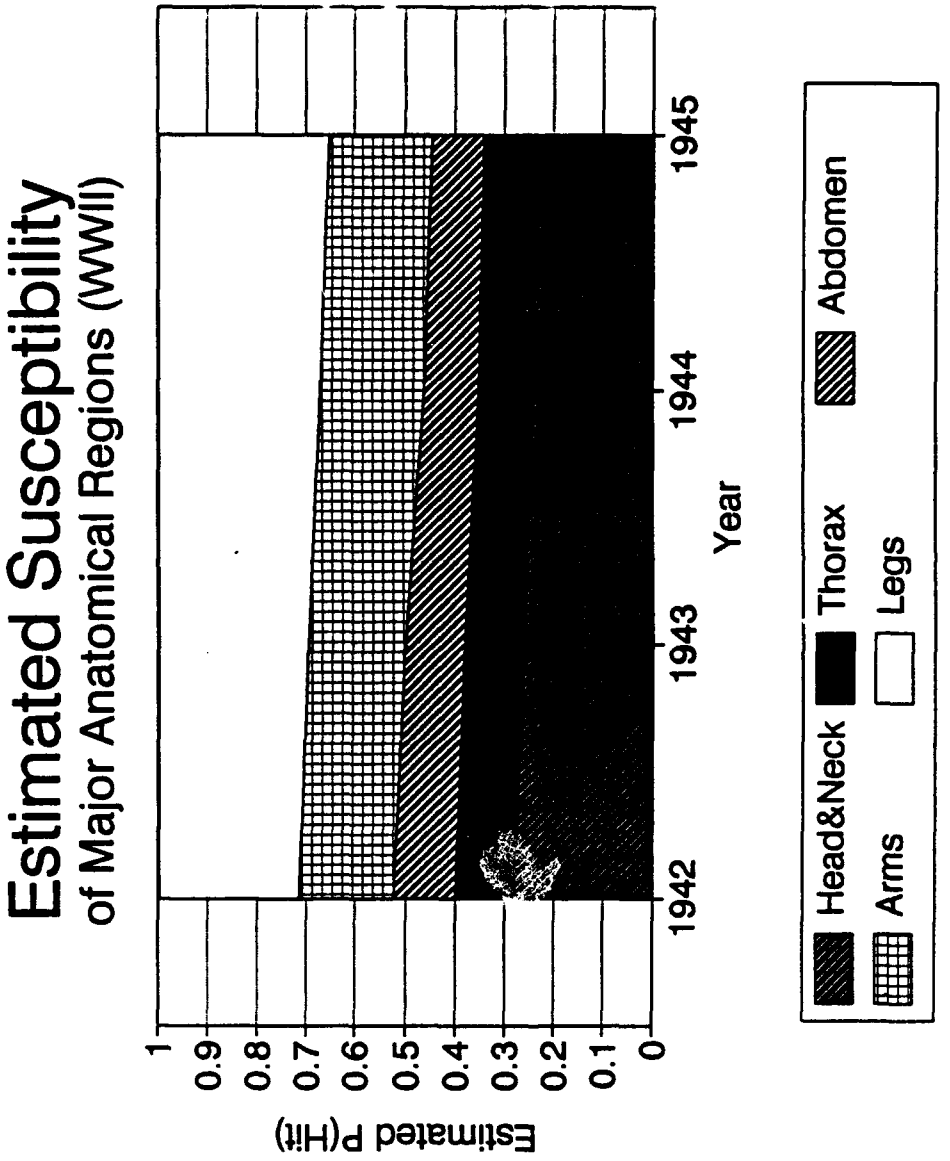

Figure 3-2. Estimated Susceptibility of Major Anatomical Regions During World War II.

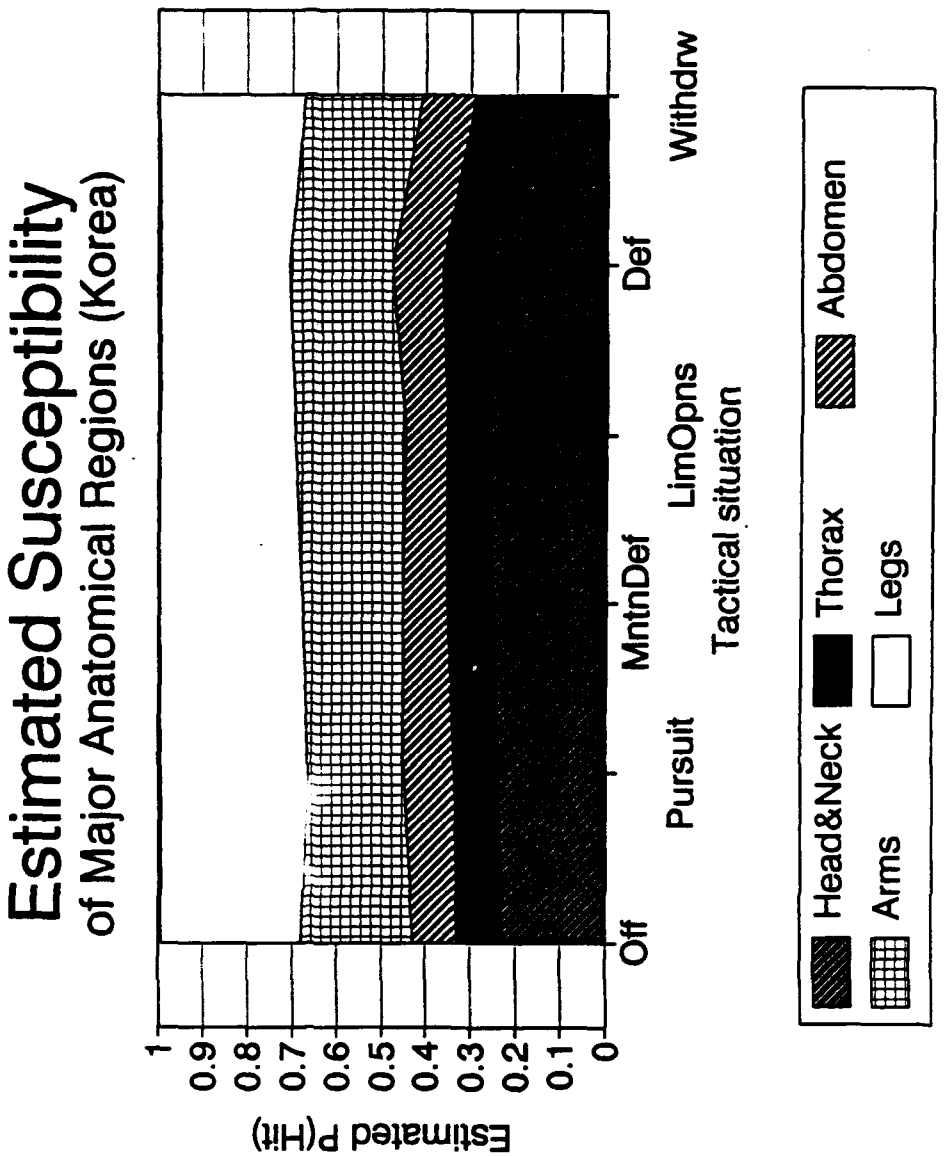

Figure 3-3. Estimated Susceptibility of Major Anatomical Regions During the Korean War.

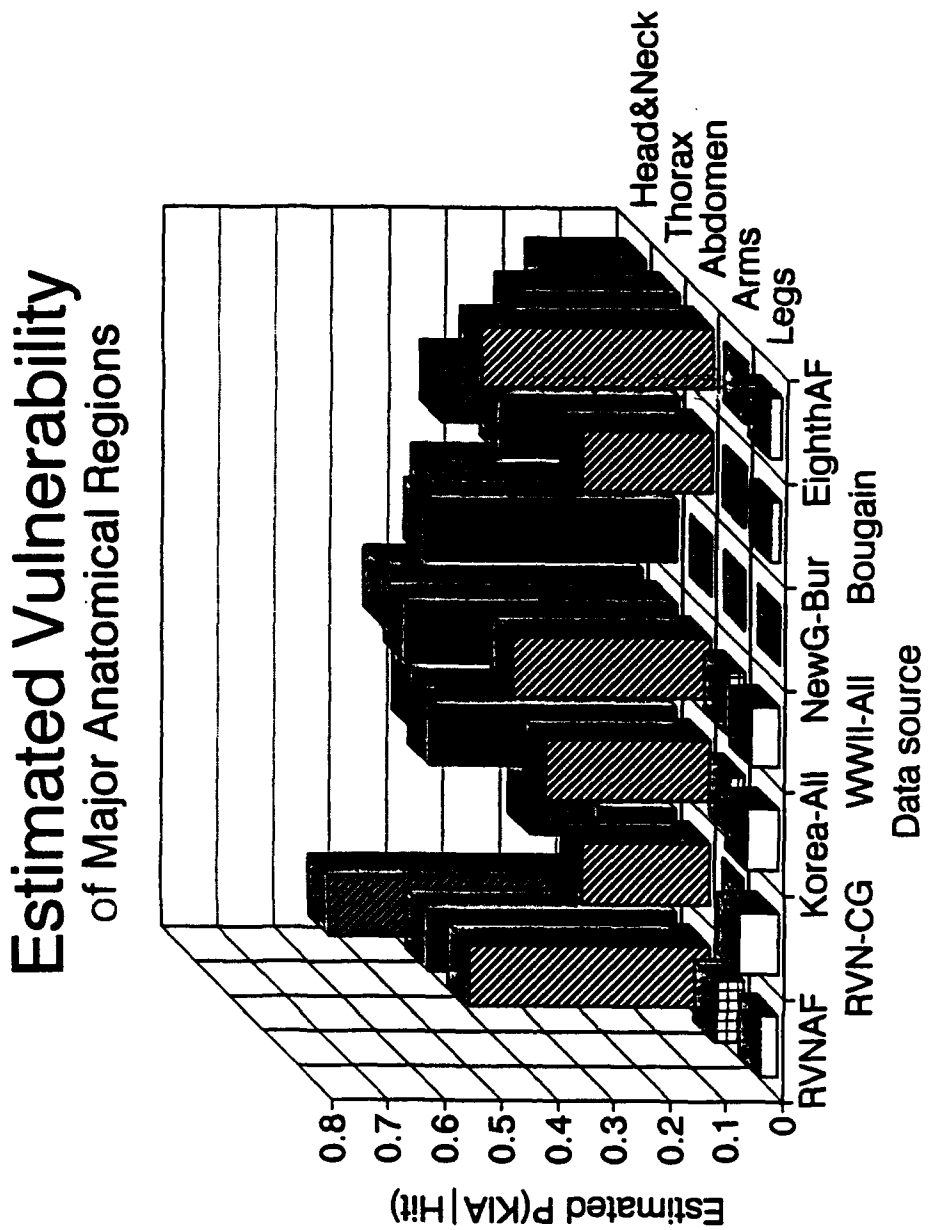

Figure 3-4. Estimated Vulnerability of Major Anatomical Regions.

The published data on the Eighth Air Force also show a lower fraction of KIA cases (about 10 percent versus 20 to 25 percent) than do the other sources. Accordingly, its estimated vulnerability values should be about doubled to approximately correct for this dilution effect. When this is done, its estimated head-and-neck, arm, and leg vulnerability values fall pretty much in line with the other estimates. However, its estimated thorax and abdomen vulnerabilities would then be much higher than the other estimates. This can be understood when we consider that a "hit" in the thorax or abdomen region usually had to be powerful enough to overwhelm the protective armor worn by Eighth Air Force crews—and that such a powerful hit usually resulted in a KIA. Less powerful "hits" turned back by the armor would not even be recorded in published data on personnel attrition in the Eighth Air Force.

The published data on the New Georgia-Burma campaign indicate no personnel KIA due to a hit in the abdomen, arms, or legs. This may be due, in part, to the relatively small sample size for this campaign (about 333 casualties in all, of which only 14 were recorded as hit in the abdomen). In addition, some of its KIA may have been misclassified as DOW. The estimated probability of+14XKIA *or* DOW given a hit on each of the major anatomical regions is shown in Figure 3-5. Here the New Georgia-Burma values for the abdomen, arms, and legs fall pretty much in line with the other values, considering their greater uncertainty due to their relatively smaller sample size.

As World War II progressed, the vulnerability of US personnel decreased, as shown in Figure 3-6. The reasons for this fact are not clear. Presumably, it is due in part to speedier and more effective medical care of the wounded (faster recovery of wounded from the battlefield, wider use of blood plasma and antibiotic medicines such as sulfa and penicillin, increased surgical skill, and more fully equipped medical facilities). The change from being on the losing defensive earlier in the war to being on the winning offensive may also have affected these values. Perhaps changes in the size and composition of friendly forces relative to enemy forces also influenced these values (specifically, the increased Air Force component, which has a lower proportion of KIA). But what factors are operating here is not certain.

The hypothesis that the decline in World War II vulnerability values may be related to the difference between defensive and offensive operations is somewhat supported by the Korean War data shown in Figure 3-7. In this figure, the types of tactical operations identified in the source are abbreviated as follows. Off stands for "offensive operations." Pursuit for "pursuit operations." MntnDef for "maintain defensive lines." LimOpns for "limited operations from the MBP (main battle position)." Def for "defensive operations." and Withdrw for "withdrawal operations." The highest values of vulnerability are those for Def and Withdrw, which tends to support the hypothesis that personnel vulnerability values are higher for defensive and/or losing operations than for offensive and/or winning ones.

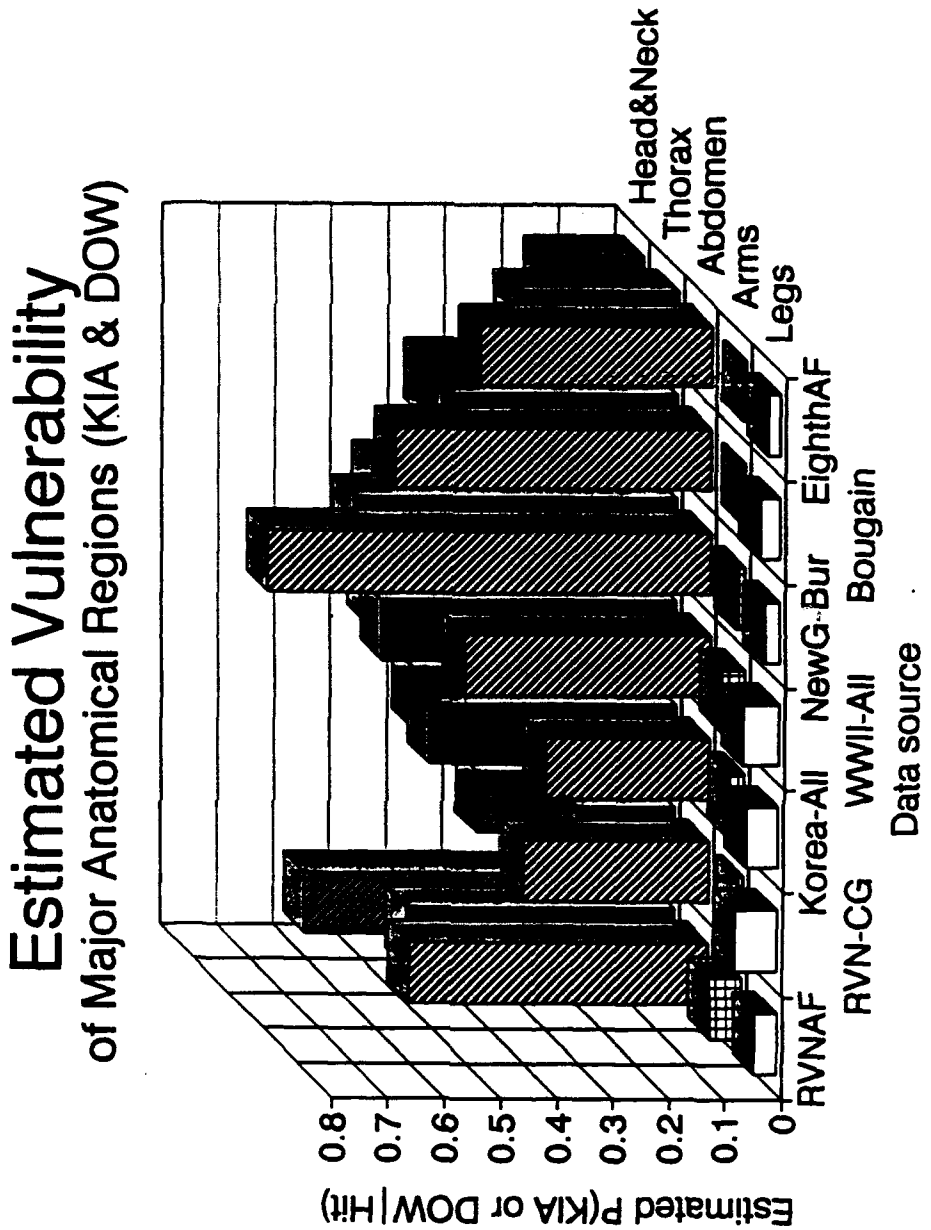

Figure 3-5. Estimated Vulnerability of Major Anatomical Regions (KIA or DOW).

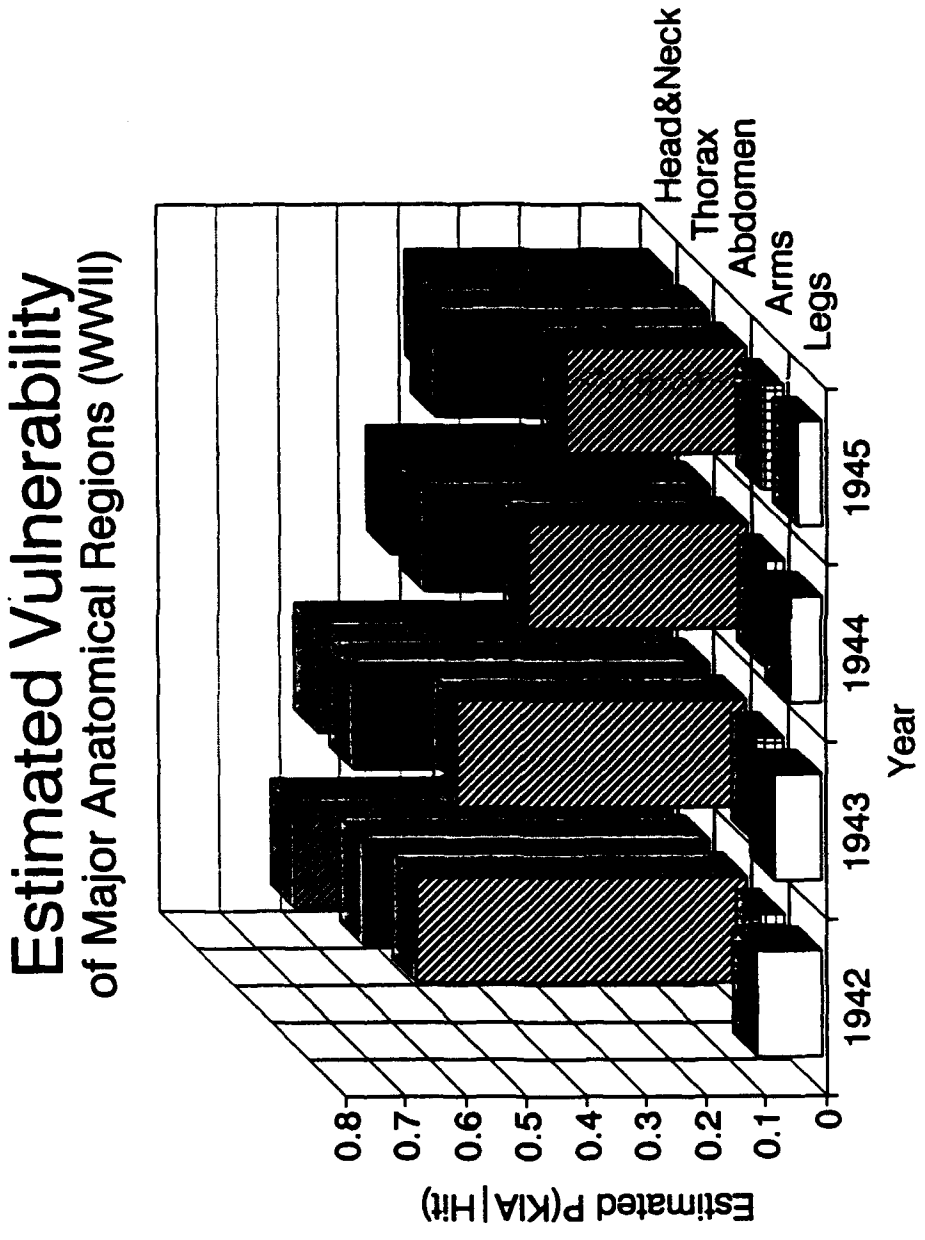

Figure 3-6. Estimated Vulnerability of Major Anatomical Regions During World War II.

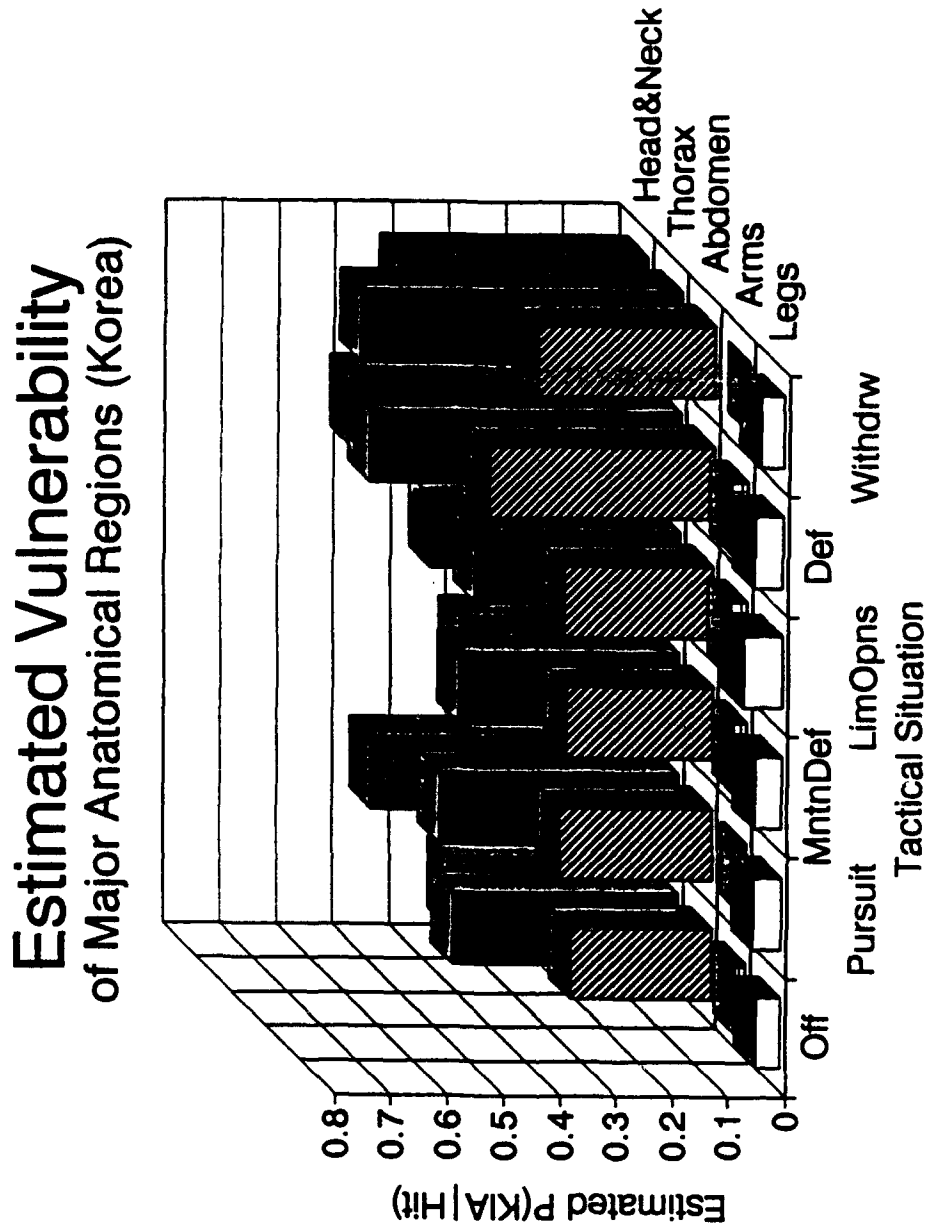

Figure 3-7. Estimated Vulnerability of Major Anatomical Regions During the Korean War.

Considering the quality of the data and the values obtained from it, and the estimates given in Appendix B, the nominal values of personnel vulnerability for contemporary conditions given in Table 3-2 are suggested. The vulnerabilities for KIA and WIA must sum to unity, and the vulnerabilities for DOW and NFW (nonfatal wounds) must sum to the vulnerability for WIA. The values proposed are consistent with those found in Appendix B, but are otherwise more or less arbitrary.

Table 3-2. Suggested Nominal Values of Vulnerability

Anatomical region	Nominal P(KIA|Hit)	Nominal P(WIA|Hit)	Nominal P(DOW|Hit)	Nominal P(NFW|Hit)
Head&Neck	0.45	0.55	0.03	0.52
Thorax	0.45	0.55	0.04	0.51
Abdomen	0.35	0.65	0.10	0.55
Arms	0.03	0.97	0.01	0.96
Legs	0.05	0.95	0.02	0.93

3-4. OTHER REMARKS AND OBSERVATIONS

a. Using the suggested nominal susceptibility and vulnerability values given in Tables 3-1 and 3-2, the implied unconditional probability of a KIA (given a hit on the whole body) is 0.228, computed from the formula

$$P(\text{KIA}) = \sum P(\text{KIA}|\text{Hit}) \times P(\text{Hit}),$$

where the sum is taken over all of the major anatomical regions. This value is close to the traditional rule of thumb that about 1/4 to 1/5 of those hit are KIA.

b. Note that the nominal hit probabilities suggested in Table 3-1 are not what would be expected from the relative areas of the major anatomical regions given in Table 2-1 and the hypothesis that hits are uniformly distributed over the body. This is shown in Figure 3-8, where the nominal values are from Table 3-1 and the JMEM* values are obtained from the JMEM values given in Table 2-1 by lumping the pelvic region in with the abdominal region and assuming that the susceptibility of major anatomical regions is proportional to their areas. As can be seen, the JMEM* values tend to underrepresent the susceptibility of the head and neck region, and to overrepresent the susceptibility of the abdominal region. The JMEM* representation of the other major anatomical regions is reasonably consistent with those in Table 3-1.

c. It is not meaningful to compare the JMEM vulnerabilities with those estimated from the published data on personnel attrition because their definitions are not comparable. The casualty criteria in JMEM-1991 refer to the probability of being able to complete various infantry tasks (such as being able to conduct a defense for a specified minimum period of time, *etc.*), and have no known relation to those used in the published attrition data (*i.e.*, KIA, WIA, *etc.*).

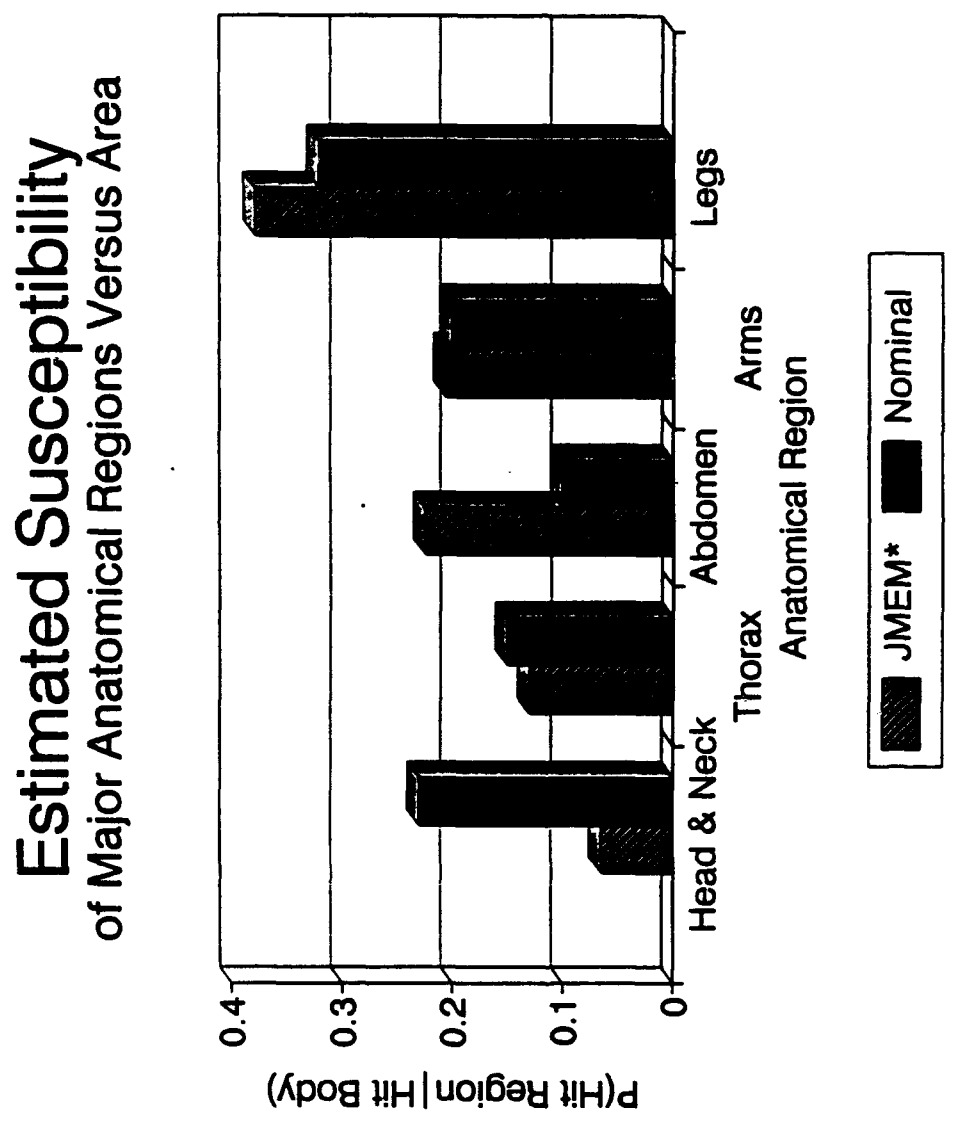

Figure 3-8. Estimated Susceptibilities of Major Anatomical Regions Versus Their Presented Areas.

CHAPTER 4

CONCLUSIONS AND OBSERVATIONS

4-1. INTRODUCTION. This chapter presents our principal conclusions and observations.

4-2. CONCLUSIONS

a. The principal findings of this work are that published personnel attrition data can be used to estimate the susceptibility and vulnerability of major anatomical regions. The susceptibility estimates based on various sources are generally similar, which suggests that they are influenced only slightly by variations in the tactical situation. The vulnerability estimates appear to be somewhat more sensitive to the tactical situation, but clearly indicate that a hit in one of the central regions (head, thorax, and abdomen) is far more likely to result in a killed in action than a hit on the extremities (arms and legs).

b. Based on our results, we suggest the nominal values in Table 4-1 as applicable to US Army combat operations under contemporary conditions (see the Glossary for the abbreviations KIA, WIA, *etc.*). All values in this table presume a hit on *some* anatomical region. They are consistent with the results obtained in Appendix B, but are otherwise more or less arbitrary.

Table 4-1. Suggested Nominal Values of Personnel Susceptibility and Vulnerability

Anatomical Region	Nominal P(Hit)	Nominal P(KIA|Hit)	Nominal P(WIA|Hit)	Nominal P(DOW|Hit)	Nominal P(NFW|Hit)
Head&Neck	0.23	0.45	0.55	0.03	0.52
Thorax	0.15	0.45	0.55	0.04	0.51
Abdomen	0.10	0.35	0.65	0.10	0.55
Arms	0.20	0.03	0.97	0.01	0.96
Legs	0.32	0.05	0.95	0.02	0.93
Total	1.00	----	----	----	----

The implied probability of KIA given a hit on *some* anatomical region is P(KIA) = 0.228, obtained from the formula,

$$P(KIA) = \sum P(KIA|Hit) \times P(Hit),$$

where the sum is taken over all of the major anatomical regions. This value is close to the traditional rule of thumb that about 1/4 to 1/5 of those hit are KIA.

c. These nominal hit probabilities are not the same as those implied by the hypothesis that hits are uniformly distributed over the body when the relative areas of the major anatomical regions are taken to be those given in the JMEM (see JMEM-1991). In addition, the JMEM casualty criteria (such as being able to conduct a defense for some specified minimum period of time) have no known relation to the conventional casualty categories used in the published data on personnel attrition (such as KIA, WIA, and so forth).

4-3. OBSERVATIONS

a. The lack of standardization in the definition of anatomical regions, the differences among sources regarding their presented areas, the varying definitions of casualty, the relatively poor quality of the basic data, the issue of whether to count wounds or wounded, and the question of whether—and if so, how—to allocate values recorded as "other" or "multiple" make the data (in my view) unsuited to highly refined statistical analysis or to overly-precise conclusions.

b. Only a few sources report data in a form that supports application of the method used here.

c. It would be of interest to determine the anatomical distribution of hits under at least the following variations in basic conditions, in order to determine how sensitive the recorded data are to such variations:

(1) Terrain.

(2) Weather.

(3) Type of tactical operation (at least attack and defense, with pursuit and delay or withdrawal operations if possible).

(4) Mix of weapons used (or, as a surrogate, at least the epoch in which the data were gathered).

(5) Conventions on defining anatomical regions and classifying hits as KIA, WIA, CRO, and "not wounded."

APPENDIX A

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APPENDIX B

REFERENCE TABLES

B-1. INTRODUCTION. This appendix contains several tables referred to in the main body, grouped together for ease of reference and to avoid unnecessarily interrupting the presentation in the main body. The nature of the information they contain and the abbreviations used are presented below.

B-2. TABLES B-1 AND B-2. These tables give the distribution of hits in major anatomical regions given that the data are for WIA or KIA (respectively). The column for source identifies the reference from which the data were taken (see Appendix A for a list of sources). The column for date of the data is a nominal date giving the year applicable to most of the data. The column for page gives the page of the source from which the data were taken. The column headed "Note" refers to the table notes given in the continuations of these tables. The next eight columns refer to major anatomical regions (or to the other/unknown and whole body "regions"). The columns for the number of casualties and number of wounds indicate the number of casualties or number of wounds for this group of data. The column headed "Based On%Of" indicates whether the listed percentages are based on the number of wounds (#Wnds) or on the number of wounded (#Cas). Entries of "??" indicate that the item in question is not given in the source consulted. Entries of the form "w/Xxxx" indicate that the source combined the corresponding anatomical region with anatomical region Xxxx.

B-3. TABLES B-3 THROUGH B-19. These tables contain the initial and adjusted data on hits by anatomical region and casualty category (as described in connection with Tables 2-4 and 2-5 of the main body), together with the resultant estimated susceptibility and vulnerability values derived therefrom (as described in connection with Table 2-6 of the main body). The analog of these three tables is combined into a single combined table, enclosed in a single-line border. Dashes (--) indicate that the source does not provide the corresponding value, or that the item is meaningless (as is the case for the total of the estimated vulnerability probabilities). The source of the data, the force to which it applies, and the specific location in the source from which the data were taken are also indicated.

In the combined table, the abbreviations in column for "Region" are as follows.

- U stands for "upper," and L for "lower."
- Multi means that multiple regions (not further specified) were wounded.
- Other means that the source gives no data on the anatomical location of wounds.

The combined table gives the estimated susceptibility and vulnerability values after adjustment for the other/unknown entries. However, for most of the work presented in the main body, it was felt desirable to use susceptibility and vulnerability estimates after adjustment for *both* the "multi" *and* the

"other/unknown" entries. One of the reasons for this is that some of the sources used only the "multi" entry and gave no values in the "other/unknown" entry. The susceptibility and vulnerability estimates obtained after adjusting the initial values for both the "multi" and the "other/unknown" entries are referred to as "fully adjusted," and are given in the smaller table enclosed in a double-line border.

Table B-1. Distribution of Hits in Major Anatomical Regions, Given WIA
(page 1 of 2 pages)

WIA Source/ Reference	Date of the Data	WIA Page	WIA Note	Head Neck	Thorax	Abdomen	Pelvis	Arms	Legs	Other/ Unknown	Whole Body	No. Cas.	No. Wnds.	Based On/Of
Beyer-1992	1944	573	1	13.1%	4.9%	1.9%	0.0%	31.0%	46.0%	0.0%	100.0%	??	1014	#Wnds
Beyer-1992	1944	573	1	11.1%	3.1%	1.3%	w/Unk	27.2%	44.9%	12.5%	100.0%	885	??	#Cas
Beyer-1992	1950	695	2	16.4%	7.9%	6.2%	0.8%	25.0%	43.7%	0.0%	100.0%	4800	7773	#Wnds
Beyer-1992	1951	707	2,3	11.6%	6.2%	4.0%	0.9%	22.0%	52.4%	0.0%	100.0%	4800	2851	#Wnds
Beyer-1992	1950	715	4	8.6%	14.6%	4.9%	0.0%	19.5%	52.7%	0.0%	100.0%	205	699	#Wnds
Beyer-1992	1951	733	5	7.9%	5.1%	3.2%	0.0%	25.2%	58.1%	0.0%	100.0%	2000	??	#Cas
Beyer-1992	1951	733	6	17.4%	10.9%	11.1%	0.7%	24.4%	27.7%	0.0%	100.0%	808	1474	#Wnds
Beyer-1992	1951	733	7	10.9%	6.7%	10.6%	0.6%	34.0%	28.4%	0.0%	100.0%	892	699	#Wnds
Beyer-1992	1952	844	8	8.1%	11.7%	6.0%	0.0%	35.0%	39.0%	0.0%	100.0%	??	??	??
Beyer-1992	1946	844	9	11.4%	3.6%	3.4%	0.0%	35.2%	46.4%	0.0%	100.0%	??	??	??
Beyer-1992	1946	844	10	16.8%	7.9%	4.7%	0.0%	30.4%	40.3%	0.0%	100.0%	??	??	??
Beyer-1992	1942	844	11	11.0%	11.0%	4.0%	0.0%	31.0%	43.0%	0.0%	100.0%	??	489	#Wnds
Beyer-1992	1943	844	12	13.0%	7.0%	5.0%	0.0%	25.0%	50.0%	0.0%	100.0%	476	789	#Wnds
Beyer-1992	1943	844	13	14.0%	6.0%	3.0%	0.0%	28.0%	49.0%	0.0%	100.0%	112	282	#Wnds
Beyer-1992	1946	844	14	9.0%	9.0%	3.0%	0.0%	49.0%	30.0%	0.0%	100.0%	370	804	#Wnds
Beyer-1992	1943	844	15	10.0%	11.0%	7.0%	0.0%	35.0%	38.0%	0.0%	100.0%	189	382	#Wnds
Beyer-1992	1943	844	16	16.2%	13.5%	6.1%	0.0%	27.0%	35.2%	0.0%	100.0%	230	??	#Cas
Beyer-1992	1943	844	17	20.7%	12.4%	5.7%	0.0%	27.4%	33.8%	0.0%	100.0%	1162	??	#Cas
Beyer-1992	1943	844	18	20.0%	11.0%	7.0%	0.0%	25.0%	40.0%	0.0%	100.0%	100	139	#Wnds
Beyer-1992	1943	844	19	16.1%	9.6%	5.6%	0.0%	28.2%	40.3%	0.0%	100.0%	33000	??	#Wnds
Beyer-1992	1943	844	20	18.6%	4.6%	2.2%	0.0%	28.4%	46.7%	0.0%	100.0%	1007	1288	#Wnds
Beyer-1992	1943	844	21	8.1%	11.4%	6.2%	0.0%	28.0%	46.3%	0.0%	100.0%	??	??	#Wnds
Reister-1989	1951	66	22	18.2%	7.2%	7.0%	0.6%	40.6%	36.3%	1.9%	100.0%	72343	??	#Cas
Reister-1989	1951	66	23	17.9%	7.4%	6.6%	0.8%	28.6%	38.6%	1.5%	100.0%	19815	??	#Cas
Reister-1989	1951	66	24	15.8%	7.2%	7.4%	1.0%	27.2%	39.4%	2.3%	100.0%	2889	??	#Cas
Reister-1989	1951	67	25	20.2%	7.9%	6.8%	0.9%	28.4%	36.5%	1.4%	100.0%	17548	??	#Cas
Reister-1989	1951	67	26	19.6%	7.4%	6.7%	0.6%	28.6%	34.6%	1.1%	100.0%	12886	??	#Cas
Reister-1989	1951	67	27	16.4%	6.6%	7.4%	0.7%	30.5%	36.6%	1.9%	100.0%	19476	??	#Cas
Reister-1989	1951	67	28	13.1%	5.4%	6.0%	0.4%	32.4%	39.6%	2.1%	100.0%	1280	??	#Cas
Reister-1989	1951	70	29	11.2%	2.1%	5.4%	0.6%	21.6%	52.5%	6.5%	100.0%	36280	??	#Cas
Reister-1989	1951	70	30	6.2%	1.9%	5.4%	0.6%	16.9%	61.4%	6.1%	100.0%	6169	??	#Cas
Reister-1989	1951	70	31	12.7%	3.1%	7.0%	0.9%	22.6%	47.0%	6.6%	100.0%	2276	??	#Cas
Reister-1989	1951	71	32	14.6%	2.4%	6.1%	0.6%	24.6%	48.1%	5.6%	100.0%	18570	??	#Cas
Reister-1989	1951	71	33	15.0%	3.0%	6.0%	0.7%	25.3%	44.0%	6.0%	100.0%	1500	??	#Cas
Reister-1989	1951	71	34	5.4%	2.6%	3.7%	0.4%	16.1%	58.7%	11.1%	100.0%	3885	??	#Cas
Reister-1989	1951	71	35	6.2%	0.7%	3.2%	0.1%	13.1%	69.6%	7.0%	100.0%	3770	??	#Cas
Woodward-1976	1952	A11	36	35.9%	5.6%	5.6%	0.4%	22.6%	30.0%	0.0%	100.0%	169	270	#Wnds
Woodward-1976	1952	A288	37	11.0%	6.2%	1.7%	0.4%	29.3%	51.5%	0.0%	100.0%	??	3102	#Wnds
Uthershals-1992	1991	33	38	17.0%	4.0%	4.0%	2.0%	23.0%	49.0%	1.0%	99.0%	204	472	#Wnds
Rich-1969	1968	20	39	10.4%	5.1%	5.7%	0.0%	28.9%	36.9%	11.4%	100.0%	790	1178	#Wnds
Meggitt-1977	1950	108	40	6.6%	28.9%	3.3%	3.3%	16.4%	41.0%	0.0%	100.0%	??	61	#Wnds
Otis-1993	1992	691	41	10.7%	10.6%	6.0%	1.3%	35.7%	35.2%	0.3%	100.0%	245760	??	#Cas
Otis-1993	1950	693	42	6.4%	10.7%	w/Thorx	w/Thorx	33.6%	44.2%	0.0%	100.0%	667	??	#Cas
Otis-1993	1946	693	43	11.1%	16.6%	w/Thorx	w/Thorx	28.1%	42.1%	0.0%	100.0%	413	??	#Cas
Otis-1993	1950	693	44	14.9%	15.9%	w/Thorx	w/Thorx	28.4%	40.8%	0.0%	100.0%	6995	??	#Cas
Otis-1993	1955	693	45	20.1%	19.0%	w/Thorx	w/Thorx	31.6%	29.3%	0.0%	100.0%	8971	??	#Cas
Otis-1993	1955	693	46	20.2%	19.0%	w/Thorx	w/Thorx	31.7%	29.1%	0.0%	100.0%	25959	??	#Cas
Otis-1993	1950	693	47	15.5%	17.5%	w/Thorx	w/Thorx	16.6%	49.2%	0.0%	100.0%	1402	??	#Cas
Otis-1993	1955	693	48	10.5%	9.3%	w/Thorx	w/Thorx	38.0%	41.9%	0.0%	100.0%	688	??	#Cas
Otis-1993	1950	693	49	12.0%	21.9%	w/Thorx	w/Thorx	35.4%	30.7%	0.0%	100.0%	17056	??	#Cas
Otis-1993	1950	693	50	9.6%	14.7%	w/Thorx	w/Thorx	34.9%	40.8%	0.0%	100.0%	18401	??	#Cas
Otis-1993	1955	693	51	16.7%	31.3%	w/Thorx	w/Thorx	25.0%	27.1%	0.0%	100.0%	48	??	#Cas
Otis-1993	1954	693	52	16.7%	15.2%	w/Thorx	w/Thorx	30.3%	37.9%	0.0%	100.0%	66	??	#Cas
Otis-1993	1954	693	53	14.4%	19.4%	w/Thorx	w/Thorx	28.2%	37.0%	0.0%	100.0%	3171	??	#Cas
Otis-1993	1955	693	54	9.6%	15.0%	w/Thorx	w/Thorx	25.9%	48.6%	0.0%	100.0%	2892	??	#Cas
Otis-1993	1955	693	55	11.8%	15.6%	w/Thorx	w/Thorx	27.1%	42.3%	0.0%	100.0%	2811	??	#Cas
Otis-1993	1955	693	56	15.7%	14.6%	w/Thorx	w/Thorx	37.0%	32.4%	0.0%	100.0%	109	??	#Cas
Otis-1993	1955	693	57	21.4%	37.5%	w/Thorx	w/Thorx	20.4%	20.7%	0.0%	100.0%	387	??	#Cas
Otis-1993	1970	693	58	14.7%	16.5%	w/Thorx	w/Thorx	33.3%	35.5%	0.0%	100.0%	53462	??	#Cas
Otis-1993	1970	693	59	14.1%	17.5%	w/Thorx	w/Thorx	27.0%	41.1%	0.0%	100.0%	4344	??	#Cas
Otis-1993	1970	693	60	13.1%	28.3%	w/Thorx	w/Thorx	27.4%	31.1%	0.0%	100.0%	71443	??	#Cas
Otis-1993	1975	693	61	12.7%	11.1%	w/Thorx	w/Thorx	38.4%	36.9%	0.0%	100.0%	371	??	#Cas
Noel-1973	1966	34	62	14.0%	7.0%	5.0%	w/Unk	18.0%	38.0%	20.0%	100.0%	??	??	#Wnds
Mitchell-1991	1916	42	63	14.3%	15.8%	5.1%	??	17.3%	34.2%	13.8%	100.0%	22132	??	#Cas
Mitchell-1991	1916	42	64	20.2%	14.2%	1.9%	??	24.6%	33.8%	5.6%	100.0%	29168	??	#Cas
McBride-1991	1969	12	65	11.1%	9.3%	4.0%	4.0%	70.4%	w/Arm	1.3%	100.0%	253	378	#Wnds
Love-1955	1916	1024	66	11.3%	3.4%	2.7%	0.8%	35.7%	44.6%	1.7%	100.0%	174288	??	#Cas
Beebe-1952	1944	181	67	14.0%	11.0%	5.0%	0.0%	28.0%	42.0%	0.0%	100.0%	131888	??	#Cas
Beebe-1952	1944	181	68	13.0%	11.0%	5.0%	0.0%	27.0%	44.0%	0.0%	100.0%	98000	??	#Cas
Beebe-1952	1944	181	69	14.0%	10.0%	5.0%	0.0%	28.0%	42.0%	0.0%	100.0%	82769	??	#Cas
Beebe-1952	1945	181	70	13.0%	10.0%	5.0%	0.0%	72.0%	w/Arm	0.0%	100.0%	59085	??	#Cas
Beebe-1952	1945	181	71	17.0%	10.0%	6.0%	0.0%	32.0%	35.0%	0.0%	100.0%	16912	??	#Cas
Beebe-1952	1900	181	72	12.0%	10.0%	11.0%	0.0%	30.0%	37.0%	0.0%	100.0%	4373	??	#Cas
Letterman-1969	1864	68	73	12.0%	7.2%	4.2%	5.4%	30.7%	36.4%	5.2%	100.0%	7100	??	#Cas
Reister-1975	1942	380	74	16.7%	7.9%	7.8%	0.8%	25.8%	40.2%	1.3%	100.0%	588724	??	#Cas
Parker-1995	1992	20	75	8.7%	9.2%	6.1%	0.0%	18.2%	33.3%	24.8%	100.0%	3180	3180	#Cas
Parker-1995	1992	20	76	10.3%	10.4%	7.6%	0.0%	16.1%	28.6%	26.9%	100.0%	1140	1140	#Cas

Table B-1 (Contd). Notes on the Distribution of Hits in Major Anatomical Regions, Given WIA
(page 2 of 2 pages)

WIA Notes:	
1	Always casualties.
2	Korea, 15 Nov 1950 to 6 May 1951.
3	Single head wounds, pp 707-708.
4	Korea, Turkish Brigade, 27-28 November 1950.
5	POW, Korea.
6	Not wearing body armor.
7	Wearing body armor.
8	US Civil War.
9	World War I, US.
10	World War I, British.
11	World War II, Canadians, at Dieppe Raid.
12	World War II, New Zealanders, in Tunisia.
13	World War II, British, in Tunisia.
14	World War II, Gaelers, in Tunisia.
15	World War II, Allies, Sicily.
16	World War II, US, New Georgia-Guinea.
17	World War II, US, Bougainville.
18	World War II, US, Cassino.
19	World War II, US, Normandy.
20	World War II, US, Eighth Air Force (heavy bomber crew wearing body armor).
21	World War II, USSR.
22	Korean War, all operations. Excludes deploy and reserve.
23	Korean War, offensive operations.
24	Korean War, pursuit operations.
25	Korean War, maintain defensive lines.
26	Korean War, limited operations from main battle position.
27	Korean War, defensive operations.
28	Korean War, withdrawal operations.
29	Korean War, all operations. Excludes deploy and reserve. Nonbattle injury admissions.
30	Korean War, offensive operations. Nonbattle injury admissions.
31	Korean War, pursuit operations. Nonbattle injury admissions.
32	Korean War, maintain defensive lines. Nonbattle injury admissions.
33	Korean War, limited operations from main battle position. Nonbattle injury admissions.
34	Korean War, defensive operations. Nonbattle injury admissions.
35	Korean War, withdrawal operations. Nonbattle injury admissions.
36	US Civil War, US Troops, Ball's Bluff.
37	US Civil War, US Troops, Stone's River.
38	US Forces, Operation Desert Storm.
39	Republic of Vietnam, 1968, missile wounds only.
40	Mae Enga clan and allies, engaged in primitive warfare, Arrow wounds.
41	Shot wounds to Union troops during the War of the Rebellion.
42	Revolution in Paris, 1830.
43	Revolution in Paris, 1848.
44	Schleswig-Holstein War, 1848-1851.
45	Crimean War, 1854-1857, English.
46	Crimean War, 1854-1857, French.
47	Campaign in Kabylie, 1854-1857.
48	Mutiny in India, 1858-1859.
49	Campaign in Italy, 1859, Austrian.
50	Campaign in Italy, 1859, French.
51	Campaign in New Zealand, 1863-1865.
52	French in Mexico, 1864.
53	Schleswig-Holstein War, 1864.
54	Austro-Prussian War, 1866, Germans.
55	Austro-Prussian War, 1866, Italians.
56	Revolt in Montenegro, 1869.
57	US Army, 1865-1870.
58	Franco-German War, 1870-1871, Prussians.
59	Franco-German War, 1870-1871, Saxonians.
60	Franco-German War, 1870-1871, French.
61	Russo-Turkish War, 1870-1877.
62	Vietnam War, US Army hospitalized wounded.
63	World War I, British forces, "severe" cases admitted to casualty clearing stations.
64	World War I, British forces, "slight" cases admitted to casualty clearing stations.
65	US Army forces, Operation Just Cause. Includes injuries as well as battle casualties.
66	World War I, US forces, admissions.
67	World War II, US First Army, Europe, 1944-1945.
68	World War II, US Third Army, Europe, 1944-1945.
69	World War II, US Fifth Army, Mediterranean, 1943-1944.
70	World War II, US Seventh Army, MTO & ETO, 1944-1945.
71	World War II, US XXIV Corps, Okinawa, Apr-Jun 1945.
72	Spanish-American War and Philippine Insurrection, 1898-1902, US forces.
73	US Civil War, Battle of Fredericksburg, Union Forces.
74	Table 24, pp 360-367, "Battle injury and wound admissions, died of wounds, and case fatality rates, by anatomical location of wound and nature of traumatism, U.S. Army, 1942-1945 (includes Dec 1941).
75	RVNAF for the year 1968.
76	RVN-CG for the year 1968.

Table B-2. Distribution of Hits in Major Anatomical Regions, Given KIA
(page 1 of 2 pages)

KIA Source/ Reference	Date of the Data	KIA Page	KIA Note	Head Neck	Thorax	Abdomen	Pelvis	Arms	Legs	Other/ Unknown	Whole Body	No. Cas.	No. Wnds.	Based On%Of
Beyer-1962	1944	573	1	36.7	11.2%	4.1%	0.0%	1.0%	9.2%	37.8%	100.0%	98	??	#Cas
Beyer-1962	1944	573	1	30.3	14.6%	5.6%	0.0%	29.3%	20.2%	0.0%	100.0%	??	178	#Wnds
Beyer-1962	1951	720	2	42.4	14.1%	22.4%	0.0%	21.2%	w/Arm	0.0%	100.0%	125	??	#Cas
Beyer-1962	1951	722	3	31.5	24.5%	9.5%	0.0%	4.1%	5.0%	25.4%	100.0%	1500	??	#Cas
Beyer-1962	1951	754	3	28.1	29.2%	5.2%	0.0%	15.4%	24.1%	0.0%	100.0%	346	1346	#Wnds
Beyer-1962	1951	756	3	12.5	60.2%	17.2%	0.0%	3.1%	7.0%	0.0%	100.0%	103	128	#Wnds
Beyer-1962	1951	736	4	44.6	34.9%	9.5%	0.0%	1.6%	6.9%	2.4%	100.0%	547	1047	#Cas
Beyer-1962	1951	757	5	17.8	28.7%	6.2%	0.8%	18.8%	28.7%	0.0%	100.0%	354	3528	#Wnds
Beyer-1962	1951	758	5	43.4	38.1%	9.4%	0.0%	2.0%	9.1%	0.0%	100.0%	354	490	#Wnds
Beyer-1962	1951	757	6	19.2	16.9%	5.1%	0.4%	22.2%	36.2%	0.0%	100.0%	355	2306	#Wnds
Beyer-1962	1951	758	6	50.0	24.0%	7.8%	0.0%	4.7%	13.5%	0.0%	100.0%	355	554	#Wnds
Beyer-1962	1951	760	7	17.5	57.8%	13.6%	0.0%	2.4%	8.7%	0.0%	100.0%	154	206	#Wnds
Beyer-1962	1951	760	8	55.8	22.0%	8.2%	0.0%	2.6%	11.4%	0.0%	100.0%	500	??	#Cas
Beyer-1962	1951	761	9	18.0	15.7%	7.4%	0.0%	20.0%	38.9%	0.0%	100.0%	500	3510	#Wnds
Beyer-1962	1944	844	10	10.5	22.9%	6.5%	0.0%	23.7%	36.4%	0.0%	100.0%	1000	6487	#Wnds
Beyer-1962	1944	844	11	23.3	12.9%	7.1%	0.0%	32.1%	24.6%	0.0%	100.0%	164	451	#Wnds
Beyer-1962	1943	845	12	31.7	31.7%	10.9%	0.0%	1.0%	2.0%	23.7%	101.0%	101	??	#Cas
Beyer-1962	1943	845	13	36.4	22.0%	12.2%	0.0%	0.3%	3.5%	25.6%	100.0%	395	??	#Cas
Beyer-1962	1944	845	14	17.4	14.0%	3.0%	0.0%	2.5%	6.3%	56.8%	100.0%	985	??	#Cas
Beyer-1962	1944	845	15	30.5	9.8%	1.8%	0.0%	??	6.7%	51.2%	100.0%	164	??	#Cas
Beyer-1962	1862	846	16	41.5	51.4%	w/Thorx	0.0%	2.6%	4.5%	0.0%	100.0%	1173	??	#Cas
Beyer-1962	1941	846	17	37.0	20.0%	33.0%	0.0%	4.0%	6.0%	0.0%	100.0%	??	??	#Cas
Beyer-1962	1943	846	18	41.0	41.0%	14.0%	0.0%	2.0%	2.0%	0.0%	100.0%	78	??	#Cas
Beyer-1962	1943	846	19	49.0	29.6%	16.3%	0.0%	0.3%	4.8%	0.0%	100.0%	294	??	#Cas
Beyer-1962	1944	846	20	43.7	36.7%	8.3%	0.0%	2.3%	9.0%	0.0%	100.0%	961	??	#Cas
Beyer-1962	1944	846	21	45.1	38.4%	7.4%	0.0%	??	9.1%	0.0%	100.0%	164	??	#Cas
Reister-1969	1951	62	22	21.4	9.8%	6.2%	0.1%	1.3%	3.7%	57.5%	100.0%	18498	??	#Cas
Reister-1969	1951	62	23	27.4	14.3%	8.3%	0.1%	1.6%	4.6%	43.7%	100.0%	3943	??	#Cas
Reister-1969	1951	62	24	13.7	5.0%	3.6%	0.1%	0.1%	1.9%	75.6%	100.0%	702	??	#Cas
Reister-1969	1951	63	25	34.5	17.1%	10.4%	0.1%	2.1%	6.2%	29.6%	100.0%	3629	??	#Cas
Reister-1969	1951	63	26	34.4	12.0%	8.2%	0.3%	2.7%	7.0%	35.5%	100.0%	3033	??	#Cas
Reister-1969	1951	63	27	6.9%	3.2%	2.4%	0.0%	0.3%	0.7%	86.5%	100.0%	6861	??	#Cas
Reister-1969	1951	63	28	4.2%	2.9%	1.9%	0.0%	0.0%	0.6%	90.3%	100.0%	310	??	#Cas
Otis-1883	1862	662	29	41.5	51.4%	w/Thorx	w/Thorx	2.6%	4.5%	0.0%	100.0%	1173	??	#Cas
Maughan-1970	1968	9	30	46.1	37.3%	9.2%	0.0%	1.7%	5.7%	0.0%	100.0%	2800	??	#Cas
Beebe-1952	1944	177	31	53.0	31.0%	12.0%	0.0%	0.0%	4.0%	0.0%	100.0%	387	??	#Cas
Beebe-1952	1944	177	32	37.0	50.0%	10.0%	0.0%	0.0%	3.0%	0.0%	100.0%	118	??	#Cas
Beebe-1952	1944	177	33	41.0	14.0%	24.0%	0.0%	4.0%	17.0%	0.0%	100.0%	97	??	#Cas
JTCG-1970	1967	2-7	34	37.2	36.4%	9.2%	0.0%	1.2%	5.4%	10.6%	100.0%	500	??	#Cas
Reister-1975	1942	350	35	19.7	9.4%	6.6%	0.1%	1.3%	2.9%	58.9%	100.0%	192220	??	#Cas
Parker-1965	1962	24	36	27.5	18.6%	11.8%	0.0%	2.5%	2.5%	37.0%	100.0%	559	??	#Cas
Parker-1965	1962	65	37	23.6	13.4%	16.5%	0.0%	0.0%	15.7%	30.7%	100.0%	127	??	#Cas

Table B-2 (Contd). Notes on the Distribution of Hits in Major Anatomical Regions, Given KIA
(page 2 of 2 pages)

KIA Notes:	
1	Aircrew casualties.
2	DOW casualties, Korea.
3	Korea.
4	Lethal wounds.
5	US Army in Korea. Pg 758 is for lethal wounds only. (w/o body armor)
6	US Marine Corps in Korea. Pg 758 is for lethal wounds only. (w/body armor)
7	Not wearing body armor.
8	Wearing body armor (only lethal wounds counted).
9	Wearing body armor.
10	World War II, US Fifth Army.
11	World War II, US Eighth Air Force.
12	World War II, New Georgia-Burma. Includes DOW as well as KIA.
13	World War II, Bougainville.
14	World War II, US Fifth Army, Italy.
15	World War II, US Eighth Air Force, Europe.
16	US Civil War, by cause of death.
17	World War II, British civilians in London killed by bomb splinters during the 1941 Blitz.
18	World War II, New George-Burma.
19	World War II, Bougainville.
20	World War II, US Fifth Army, Italy.
21	World War II, US Eighth Air Force, Italy.
22	Korean War, all operations. Excludes deploy and reserve. By fatal wounds.
23	Korean War, offensive operations. By fatal wounds.
24	Korean War, *pursuit operations*. By fatal wounds.
25	Korean War, maintain defensive lines. By fatal wounds.
26	Korean War, limited operations from main battle position.By fatal wounds.
27	Korean War, defensive operations. By fatal wounds.
28	Korean War, withdrawal operations. By fatal wounds.
29	US Civil War, Union troops.
30	Allied forces, Vietnam, 1968. Using single and multiple wounds.
31	Schleswig-Holstein War, 1864.
32	New Zealand War, 1863-1866.
33	World War II. Civilians killed during the London Blitz.
34	Vietnam, based on 500 US fatalities.
35	Table 22, pp 350-351, Number killed in action, by causative agent and anatomical location of wound, U.S. Army, 1942-1945 (Includes Dec 1941).
36	RVNAF for the year 1962.
37	RVN-CG for the year 1962.

Table B-3. Adjusted and Fully Adjusted Estimates of Susceptibility and Vulnerability.

SOURCE: Parker-1965
Vietnam, RVNAF, 1962.
Using Tables 4 & 8, w/page 23.

Region	Casualty category					Adj	Adj	Adj	Adj	Adj	P(Hit|	P(KIA|	P(WIA|	P(DOW|	P(NFW|
	KIA	WIA	DOW	NFW	Total	KIA	WIA	DOW	NFW	Total	Region)	Region)	Region)	Region)	Region)
Head	154	274	26	248	428	344.3	280.1	26.8	253.5	624.5	0.1447	0.5514	0.4486	0.0429	0.4059
Face	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Eye	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Neck	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Thorax	104	291	18	273	395	232.5	297.5	18.5	279.0	530.0	0.1228	0.4387	0.5613	0.0350	0.5264
Abdomen	66	194	35	159	260	147.6	198.3	36.0	162.5	345.9	0.0801	0.4266	0.5734	0.1042	0.4698
Pelvis	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Spine	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
UArm	14	576	5	571	590	31.3	588.9	5.1	583.6	620.2	0.1437	0.0505	0.9495	0.0083	0.9410
LArm	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Hand	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Hip&Buttock	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
ULeg	14	1051	11	1040	1065	31.3	1074.5	11.3	1062.9	1105.8	0.2562	0.0283	0.9717	0.0102	0.9612
LLeg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Foot	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Multi	165	705	41	664	870	368.9	720.7	42.2	678.6	1089.7	0.2525	0.3386	0.6614	0.0387	0.6228
Other	639	69	4	65	708	--	--	--	--	--	--	--	--	--	--
Total	1156	3160	140	3020	4316	1156	3160	140	3020	4316	1.0000	--	--	--	--
Proportion	0.2678	0.7322	0.0324	0.6997	1.0000	0.2678	0.7322	0.0324	0.6997	1.0000					
Frac. Known	0.4472	0.9782	0.9714	0.9785	0.8360	--	--	--	--	--	--	--	--	--	--

Fully adjusted	P(Hit| Region)	P(KIA| Region)	P(WIA| Region)	P(DOW| Region)	P(NFW| Region)
Head	0.1936	0.5514	0.4486	0.0429	0.4059
Thorax	0.1643	0.4387	0.5613	0.0350	0.5264
Abdomen	0.1072	0.4266	0.5734	0.1042	0.4698
Arms	0.1922	0.0505	0.9495	0.0083	0.9410
Legs	0.3427	0.0283	0.9717	0.0102	0.9612

Table B-4. Adjusted and Fully Adjusted Estimates of Susceptibility and Vulnerability.

SOURCE: Parker-1965
Vietnam, RVN-CG, 1962.
Using Table B-1, pg 65.

Region	Casualty category					Adj KIA	Adj WIA	Adj DOW	Adj NFW	Adj Total	P(Hit| Region)	P(KIA| Region)	P(WIA| Region)	P(DOW| Region)	P(NFW| Region)
	KIA	WIA	DOW	NFW	Total										
Head	30	160	19	141	190	41.9	167.9	19.3	148.2	209.8	0.1414	0.1996	0.8004	0.0922	0.7063
Face	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Eye	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Neck	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Thorax	17	141	6	135	158	23.7	148.0	6.1	141.9	171.7	0.1157	0.1382	0.8618	0.0356	0.8263
Abdomen	21	95	13	82	116	29.3	99.7	13.2	86.2	129.0	0.0869	0.2272	0.7728	0.1026	0.6680
Pelvis	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Spine	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
UArm	0	214	2	212	214	0.0	224.6	2.0	222.8	224.6	0.1513	0.0000	1.0000	0.0091	0.9920
LArm	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Hand	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Hip&Buttock	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
ULeg	20	358	2	356	378	27.9	375.7	2.0	374.1	403.6	0.2720	0.0692	0.9308	0.0050	0.9269
LLeg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Foot	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Multi	3	325	14	311	328	4.2	341.1	14.3	326.8	345.3	0.2327	0.0121	0.9879	0.0413	0.9466
Other	36	64	1	63	100	--	--	--	--	--	--	--	--	--	--
Total	127	1357	57	1300	1484	127	1357	57	1300	1484	1.0000	--	--	--	--
Proportion	0.0856	0.9144	0.0384	0.8760	1.0000	0.0856	0.9144	0.0384	0.8760	1.0000	--	--	--	--	--
Frac. known	0.7165	0.9528	0.9825	0.9515	0.9326	--	--	--	--	--	--	--	--	--	--

Fully adjusted	P(Hit| Region)	P(KIA| Region)	P(WIA| Region)	P(DOW| Region)	P(NFW| Region)
Head	0.1842	0.1996	0.8004	0.0922	0.7063
Thorax	0.1508	0.1382	0.8618	0.0356	0.8263
Abdomen	0.1133	0.2272	0.7728	0.1026	0.6680
Arms	0.1972	0.0000	1.0000	0.0091	0.9920
Legs	0.3545	0.0692	0.9308	0.0050	0.9269

Table B-5. Adjusted and Fully Adjusted Estimates of Susceptibility and Vulnerability.

SOURCE: Reister-1969.
Korea, US Army, All Operations.
Using Tables 21 and 22.

Region	Casualty Category					Adj	Adj	Adj	Adj	Adj	P(Hit|	P(KIA|	P(WIA|	P(DOW|	P(NFW|
	KIA	WIA	DOW	NFW	Total	KIA	WIA	DOW	NFW	Total	Region)	Region)	Region)	Region)	Region)
Head	3128	5068	--	--	8196	7070	5081.7	--	--	12151.8	0.1338	0.5818	0.4182	--	--
Face	377	4599	--	--	4976	852.1	4611.4	--	--	5463.5	0.0601	0.1560	0.8440	--	--
Eye	25	2032	--	--	2057	56.5	2037.5	--	--	2094.0	0.0231	0.0270	0.9730	--	--
Neck	428	1472	--	--	1900	967.4	1476.0	--	--	2443.4	0.0269	0.3959	0.6041	--	--
Thorax	1809	5241	--	--	7050	4088.8	5255.2	--	--	9344.0	0.1029	0.4376	0.5624	--	--
Abdomen	1147	5045	--	--	6192	2592.5	5058.6	--	--	7651.2	0.0842	0.3388	0.6612	--	--
Pelvis	18	564	--	--	582	40.7	565.5	--	--	606.2	0.0067	0.0671	0.9329	--	--
Spine	27	855	--	--	882	61.0	857.3	--	--	918.3	0.0101	0.0665	0.9335	--	--
UArm	246	21002	--	--	21248	556.0	21058.8	--	--	21614.8	0.2379	0.0257	0.9743	--	--
LArm	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Hand	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Hip&Buttock	91	2678	--	--	2769	205.7	2685.2	--	--	2890.9	0.0318	0.0711	0.9289	--	--
ULeg	184	10665	--	--	10849	415.9	10693.8	--	--	11109.7	0.1223	0.0374	0.9626	--	--
LLeg	410	12927	--	--	13337	926.7	12961.9	--	--	13888.6	0.1529	0.0667	0.9333	--	--
Foot	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Multi	294	0	--	--	294	664.5	0.0	--	--	664.5	0.0073	1.0000	0.0000	--	--
Other	10314	195	--	--	10509	--	--	--	--	--	--	--	--	--	--
Total	18498	72343	--	--	90841	18498	72343	--	--	90841	1.0000	--	--	--	--
Proportion	0.2036	0.7964	--	--	1.0000	0.2036	0.7964	--	--	1.0000	--	--	--	--	--
Frac. known	0.4424	0.9973	--	--	0.8843	--	--	--	--	--	--	--	--	--	--

Fully adjusted	P(Hit| Region)	P(KIA| Region)	P(WIA| Region)	P(DOW| Region)	P(NFW| Region)
Head	0.2457	0.4038	0.5962	--	--
Thorax	0.1036	0.4376	0.5624	--	--
Abdomen	0.1018	0.2936	0.7064	--	--
Arms	0.2397	0.0257	0.9743	--	--
Legs	0.3093	0.0555	0.9445	--	--

Table B-6. Adjusted and Fully Adjusted Estimates of Susceptibility and Vulnerability.

SOURCE: Reister-1969
Korea, US Army, Offensive Operations.
Using Tables 21 and 22.

Region	Casualty category					Adj	Adj	Adj	Adj	Adj	P(Hit|	P(KIA|	P(WIA|	P(DOW|	P(NFW|
	KIA	WIA	DOW	NFW	Total	KIA	WIA	DOW	NBI	Total	Region)	Region)	Region)	Region)	Region)
Head	824	1412	--	--	2236	1398.6	1415.3	--	--	2814.0	0.1200	0.4970	0.5030	--	--
Face	121	1195	--	--	1316	205.4	1197.8	--	--	1403.2	0.0598	0.1464	0.8536	--	--
Eye	7	460	--	--	467	11.9	461.1	--	--	473.0	0.0202	0.0251	0.9749	--	--
Neck	128	421	--	--	549	217.3	422.0	--	--	639.3	0.0273	0.3399	0.6601	--	--
Thorax	563	1440	--	--	2003	955.6	1443.4	--	--	2399.0	0.1023	0.3983	0.6017	--	--
Abdomen	326	1325	--	--	1651	553.3	1328.1	--	--	1881.5	0.0802	0.2941	0.7059	--	--
Pelvis	5	152	--	--	157	8.5	152.4	--	--	160.8	0.0069	0.0528	0.9472	--	--
Spine	11	245	--	--	256	18.7	245.6	--	--	264.2	0.0113	0.0707	0.9293	--	--
UArm	62	5784	--	--	5846	105.2	5797.7	--	--	5902.9	0.2516	0.0178	0.9822	--	--
LArm	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Hand	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Hip&Buttock	33	687	--	--	720	56.0	688.6	--	--	744.6	0.0317	0.0752	0.9248	--	--
ULeg	53	2884	--	--	2937	90.0	2890.8	--	--	2980.8	0.1271	0.0302	0.9698	--	--
LLeg	97	3464	--	--	3561	164.6	3472.2	--	--	3636.8	0.1550	0.0453	0.9547	--	--
Foot	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Multi	93	0	--	--	93	157.9	0.0	--	--	157.9	0.0067	1.0000	0.0000	--	--
Other	1620	46	--	--	1666	--	--	--	--	--	--	--	--	--	--
Total	3943	19515	--	--	23458	3943	19515	--	--	23458	1.0000	--	--	--	--
Proportion	0.1681	0.8319	--	--	1.0000	0.1681	0.8319	--	--	1.0000	--	--	--	--	--
Frac. known	0.5891	0.9976	--	--	0.9290	--	--	--	--	--	--	--	--	--	--

Fully adjusted	P(Hit| Region)	P(KIA| Region)	P(WIA| Region)	P(DOW| Region)	P(NFW| Region)
Head	0.2287	0.3440	0.6560	--	--
Thorax	0.1030	0.3983	0.6017	--	--
Abdomen	0.0990	0.2517	0.7483	--	--
Arms	0.2533	0.0178	0.9822	--	--
Legs	0.3160	0.0422	0.9578	--	--

Table B-7. Adjusted and Fully Adjusted Estimates of Susceptibility and Vulnerability.

SOURCE: Reister-1969
Korea, US Army, Pursuit Operations.
Using Tables 21 and 22.

Region	Casualty category					Adj KIA	Adj WIA	Adj DOW	Adj NBI	Adj Total	P(Hit| Region)	P(KIA| Region)	P(WIA| Region)	P(DOW| Region)	P(NFW| Region)
	KIA	WIA	DOW	NFW	Total										
Head	80	183	--	--	263	317.3	183.3	--	--	500.6	0.1503	0.6338	0.3662	--	--
Face	3	141	--	--	144	11.9	141.3	--	-	153.2	0.0460	0.0777	0.9223	--	--
Eye	1	56	--	--	57	4.0	56.1	--	--	60.1	0.0180	0.0660	0.9340	--	--
Neck	12	27	--	-	39	47.6	27.1	--	--	74.6	0.0224	0.6376	0.3624	--	--
Thorax	35	190	--	--	225	138.8	190.4	--	--	329.2	0.0988	0.4217	0.5783	--	--
Abdomen	25	194	--	--	219	99.2	194.4	--	--	293.5	0.0881	0.3378	0.6622	--	--
Pelvis	1	26	--	--	27	4.0	26.0	--	--	30.0	0.0090	0.1321	0.8679	--	--
Spine	0	55	--	--	55	0.0	55.1	--	--	55.1	0.0165	0.0000	1.0000	--	--
UArm	1	716	--	--	717	4.0	717.4	--	--	721.3	0.2166	0.0055	0.9945	--	--
LArm	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Hand	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Hip&Buttock	0	98	--	--	98	0.0	98.2	--	--	98.2	0.0295	0.0000	1.0000	--	--
ULeg	5	418	--	--	423	19.8	418.8	--	--	438.8	0.1317	0.0452	0.9548	--	--
LLeg	8	520	--	--	528	31.7	521.0	--	--	552.7	0.1659	0.0574	0.9426	--	--
Foot	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Multi	6	0	--	--	6	23.8	0.0	--	--	23.8	0.0071	1.0000	0.0000	--	--
Other	525	5	--	--	530	--	--	--	--	--	--	--	--	--	--
Total	702	2629	--	--	3331	702	2629	--	--	3331	1.0000	--	--	--	--
Proportion	0.2107	0.7893	--	--	1.0000	0.2107	0.7893	--	--	1.0000	--	--	--	--	--
Frac. known	0.2521	0.9981	--	--	0.8409	--	--	--	--	--	--	--	--	--	--

Fully adjusted	P(Hit| Region)	P(KIA| Region)	P(WIA| Region)	P(DOW| Region)	P(NFW| Region)
Head	0.2384	0.4829	0.5171	--	--
Thorax	0.0995	0.4217	0.5783	--	--
Abdomen	0.1145	0.2723	0.7277	--	--
Arms	0.2181	0.0055	0.9945	--	--
Legs	0.3294	0.0473	0.9527	--	--

Table B-8. Adjusted and Fully Adjusted Estimates of Susceptibility and Vulnerability.

SOURCE: Reister-1969
Korea, US Army, Maintain Defensive Lines Operations.
Using Tables 21 and 22.

	Casualty category					Adj	Adj	Adj	Adj	Adj	P(Hit|	P(KIA|	P(WIA|	P(DOW|	P(NFW|
Region	KIA	WIA	DOW	NFW	Total	KIA	WIA	DOW	NBI	Total	Region)	Region)	Region)	Region)	Region)
Head	989	1283	--	--	2272	1358.5	1287.1	--	--	2645.6	0.1249	0.5135	0.4865	--	--
Face	121	1263	--	--	1384	166.2	1267.0	--	--	1433.2	0.0677	0.1160	0.8840	--	--
Eye	9	607	--	--	616	12.4	608.9	--	--	621.3	0.0293	0.0199	0.9801	--	--
Neck	134	384	--	--	518	184.1	385.2	--	--	569.3	0.0269	0.3233	0.6767	--	--
Thorax	619	1334	--	--	1953	850.2	1338.3	--	--	2188.5	0.1033	0.3885	0.6115	--	--
Abdomen	378	1187	--	--	1565	519.2	1190.8	--	--	1710.0	0.0807	0.3036	0.6964	--	--
Pelvis	3	157	--	--	160	4.1	157.5	--	--	161.6	0.0076	0.0255	0.9745	--	--
Spine	12	192	--	--	204	16.5	192.6	--	--	209.1	0.0099	0.0788	0.9212	--	--
UArm	76	4636	--	--	4712	104.4	4650.8	--	--	4755.2	0.2245	0.0220	0.9780	--	--
LArm	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Hand	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Hip&Buttock	31	655	--	--	686	42.6	657.1	--	--	699.7	0.0330	0.0609	0.9391	--	--
ULeg	60	2692	--	--	2752	82.4	2700.6	--	--	2783.0	0.1314	0.0296	0.9704	--	--
LLeg	135	3103	--	--	3238	185.4	3112.9	--	--	3298.4	0.1557	0.0562	0.9438	--	--
Foot	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Multi	75	0	--	--	75	103.0	0.0	--	--	103.0	0.0049	1.0000	0.0000	--	--
Other	987	56	--	--	1043	--	--	--	--	--	--	--	--	--	--
Total	3629	17549	--	--	21178	3629	17549	--	--	21178	1.0000	--	--	--	--
Proportion	0.1714	0.8286	--	--	1.0000	0.1714	0.8286	--	--	1.0000	--	--	--	--	--
Frac. known	0.7280	0.9968	--	--	0.9508	--	--	--	--	--	--	--	--	--	--

Fully adjusted	P(Hit| Region)	P(KIA| Region)	P(WIA| Region)	P(DOW| Region)	P(NFW| Region)
Head	0.2500	0.3266	0.6734	--	--
Thorax	0.1038	0.3885	0.6115	--	--
Abdomen	0.0987	0.2594	0.7406	--	--
Arms	0.2256	0.0220	0.9780	--	--
Legs	0.3218	0.0458	0.9542	--	--

Table B-9. Adjusted and Fully Adjusted Estimates of Susceptibility and Vulnerability.

SOURCE: Reister-1969
Korea, US Army, Limited Operations from MBP.
Using Tables 21 and 22.

Region	Casualty category					Adj KIA	Adj WIA	Adj DOW	Adj NBI	Adj Total	P(Hit| Region)	P(KIA| Region)	P(WIA| Region)	P(DOW| Region)	P(NFW| Region)
	KIA	WIA	DOW	NFW	Total										
Head	845	940	--	--	1785	1268.8	941.6	--	--	2210.4	0.1388	0.5740	0.4260	--	--
Face	92	884	--	--	976	138.1	885.5	--	--	1023.6	0.0643	0.1349	0.8651	--	--
Eye	6	439	--	--	445	9.0	439.8	--	--	448.8	0.0282	0.0201	0.9799	--	--
Neck	99	286	--	--	385	148.6	286.5	--	--	435.1	0.0273	0.3416	0.6584	--	--
Thorax	363	958	--	--	1321	545.0	959.6	--	--	1504.7	0.0945	0.3622	0.6378	--	--
Abdomen	249	866	--	--	1115	373.9	867.5	--	--	1241.3	0.0779	0.3012	0.6988	--	--
Pelvis	8	101	--	--	109	12.0	101.2	--	--	113.2	0.0071	0.1061	0.8939	--	--
Spine	4	119	--	--	123	6.0	119.2	--	--	125.2	0.0079	0.0480	0.9520	--	--
UArm	83	3815	--	--	3898	124.6	3821.5	--	--	3946.1	0.2477	0.0316	0.9684	--	--
LArm	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Hand	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Hip&Buttock	23	530	--	--	553	34.5	530.9	--	--	565.4	0.0355	0.0611	0.9389	--	--
ULeg	51	1823	--	--	1874	76.6	1826.1	--	--	1902.7	0.1195	0.0402	0.9598	--	--
LLeg	137	2112	--	--	2249	205.7	2115.6	--	--	2321.3	0.1457	0.0886	0.9114	--	--
Foot	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Multi	60	0	--	--	60	90.1	0.0	--	--	90.1	0.0057	1.0000	0.0000	--	--
Other	1013	22	--	--	1035	--	--	--	--	--	--	--	--	--	--
Total	3033	12895	--	--	15928	3033	12895	--	--	15928	1.0000	--	--	--	--
Proportion	0.1904	0.8096	--	--	1.0000	0.1904	0.8096	--	--	1.0000	--	--	--	--	--
Frac. known	0.6660	0.9983	--	--	0.9350	--	--	--	--	--	--	--	--	--	--

Fully adjusted	P(Hit| Region)	P(KIA| Region)	P(WIA| Region)	P(DOW| Region)	P(NFW| Region)
Head	0.2600	0.3799	0.6201	--	--
Thorax	0.0950	0.3622	0.6378	--	--
Abdomen	0.0934	0.2648	0.7352	--	--
Arms	0.2492	0.0316	0.9684	--	--
Legs	0.3024	0.0661	0.9339	--	--

Table B-10. Adjusted and Fully Adjusted Estimates of Susceptibility and Vulnerability.

SOURCE: Reister-1969
Korea, US Army, Defensive Operations.
Using Tables 21 and 22.

Region	Casualty category					Adj KIA	Adj WIA	Adj DOW	Adj NBI	Adj Total	P(Hit| Region)	P(KIA| Region)	P(WIA| Region)	P(DOW| Region)	P(NFW| Region)
	KIA	WIA	DOW	NFW	Total										
Head	380	1181	--	--	1561	2638.5	1185.0	--	--	3823.5	0.1508	0.6901	0.3099	--	--
Face	37	1051	--	--	1088	256.9	1054.5	--	--	1311.4	0.0517	0.1959	0.8041	--	--
Eye	2	448	--	--	450	13.9	449.5	--	--	463.4	0.0183	0.0300	0.9700	--	--
Neck	55	342	--	--	397	381.9	343.2	--	--	725.0	0.0286	0.5267	0.4733	--	--
Thorax	220	1250	--	--	1470	1527.6	1254.2	--	--	2781.8	0.1097	0.5491	0.4509	--	--
Abdomen	163	1370	--	--	1533	1131.8	1374.6	--	--	2506.4	0.0988	0.4516	0.5484	--	--
Pelvis	1	123	--	--	124	6.9	123.4	--	--	130.4	0.0051	0.0533	0.9467	--	--
Spine	0	221	--	--	221	0.0	221.7	--	--	221.7	0.0087	0.0000	1.0000	--	--
UArm	24	5636	--	--	5660	166.6	5655.0	--	--	5821.6	0.2296	0.0286	0.9714	--	--
LArm	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Hand	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Hip&Buttock	4	662	--	--	666	27.8	664.2	--	--	692.0	0.0273	0.0401	0.9599	--	--
ULeg	14	2665	--	--	2679	97.2	2674.0	--	--	2771.2	0.1093	0.0351	0.9649	--	--
LLeg	32	3464	--	--	3496	222.2	3475.7	--	--	3697.9	0.1458	0.0601	0.9399	--	--
Foot	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Multi	59	0	--	--	59	409.7	0.0	--	--	409.7	0.0162	1.0000	0.0000	--	--
Other	5890	62	--	--	5952	--	--	--	--	--	--	--	--	--	--
Total	6881	18475	--	--	25356	6881	18475	--	--	25356	1.0000	--	--	--	--
Proportion	0.2714	0.7286	--	--	1.0000	0.2714	0.7286	--	--	1.0000	--	--	--	--	--
Frac. known	0.1440	0.9966	--	--	0.7653	--	--	--	--	--	--	--	--	--	--

Fully adjusted	P(Hit| Region)	P(KIA| Region)	P(WIA| Region)	P(DOW| Region)	P(NFW| Region)
Head	0.2535	0.5205	0.4795	--	--
Thorax	0.1115	0.5491	0.4509	--	--
Abdomen	0.1146	0.3984	0.6016	--	--
Arms	0.2334	0.0286	0.9714	--	--
Legs	0.2871	0.0485	0.9515	--	--

Table B-11. Adjusted and Fully Adjusted Estimates of Susceptibility and Vulnerability.

SOURCE: Reister-1969
Korea, US Army, Withdrawal Ope. ..ions.
Using Tables 21 and 22.

Region	Casualty category					Adj KIA	Adj WIA	Adj DOW	Adj NBI	Adj Total	P(Hit| Region)	P(KIA| Region)	P(WIA| Region)	P(DOW| Region)	P(NFW| Region)
	KIA	WIA	DOW	NFW	Total										
Head	10	69	--	--	79	100.0	69.2	--	--	169.2	0.1064	0.5910	0.4090	--	--
Face	3	65	--	--	68	30.0	65.2	--	--	95.2	0.0599	0.3151	0.6849	--	--
Eye	0	22	--	--	22	0.0	22.1	--	--	22.1	0.0139	0.0000	1.0000	--	--
Neck	0	12	--	--	12	0.0	12.0	--	--	12.0	0.0076	0.0000	1.0000	--	--
Thorax	9	69	--	--	78	90.0	69.2	--	--	159.2	0.1001	0.5653	0.4347	--	--
Abdomen	6	103	--	--	109	60.0	103.3	--	--	163.3	0.1027	0.3674	0.6326	--	--
Pelvis	0	5	--	--	5	0.0	5.0	--	--	5.0	0.0032	0.0000	1.0000	--	--
Spine	0	23	--	--	23	0.0	23.1	--	--	23.1	0.0145	0.0000	1.0000	--	--
UArm	0	415	--	--	415	0.0	416.3	--	--	416.3	0.2618	0.0000	1.0000	--	--
LArm	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Hand	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Hip&Buttock	0	46	--	--	46	0.0	46.1	--	--	46.1	0.0290	0.0000	1.0000	--	--
ULeg	1	183	--	--	184	10.0	183.6	--	--	193.6	0.1217	0.0517	0.9483	--	--
LLeg	1	264	--	--	265	10.0	264.8	--	--	274.8	0.1728	0.0364	0.9636	--	--
Foot	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Multi	1	0	--	--	1	10.0	0.0	--	--	10.0	0.0063	1.0000	0.0000	--	--
Other	279	4	--	--	283	--	--	--	--	--	--	--	--	--	--
Total	310	1280	--	--	1590	310	1280	--	--	1590	1.0000	--	--	--	--
Proportion	0.1950	0.8050	--	--	1.0000	0.1950	0.8050	--	--	1.0000	--	--	--	--	--
Frac. known	0.1000	0.9969	--	--	0.8220	--	--	--	--	--	--	--	--	--	--

Fully adjusted	P(Hit| Region)	P(KIA| Region)	P(WIA| Region)	P(DOW| Region)	P(NFW| Region)
Head	0.1889	0.4355	0.5645	--	--
Thorax	0.1008	0.5653	0.4347	--	--
Abdomen	0.1211	0.3135	0.6865	--	--
Arms	0.2635	0.0000	1.0000	--	--
Legs	0.3257	0.0389	0.9611	--	--

Table B-12. Adjusted and Fully Adjusted Estimates of Susceptibility and Vulnerability.

SOURCE: Reister-1975
World War II, US Army, 1942-1945 (including Dec 1941).
All theaters.
Using Tables 21 and 23.

Region	Casualty category					Adj	Adj	Adj	Adj	Adj	P(Hit|	P(KIA|	P(WIA|	P(DOW|	P(NFW|
	KIA	WIA	DOW	NFW	Total	KIA	WIA	DOW	NFW	Total	Region)	Region)	Region)	Region)	Region)
Head	30599	46267	3932	42335	76866	68429.7	46745.0	3967.3	42766.7	115174.8	0.1454	0.5941	0.4059	0.0346	0.3713
Face-Eye	2988	32423	623	31800	35411	6682.2	32758.0	631.8	32124.3	39440.2	0.0498	0.1694	0.8306	0.0160	0.8145
Eye	278	11774	66	11708	12052	621.7	11895.6	66.9	11827.4	12517.4	0.0158	0.0497	0.9503	0.0053	0.9449
Neck	3990	9804	456	9348	13794	8923.0	9905.3	462.4	9443.3	18828.3	0.0238	0.4739	0.5261	0.0246	0.5016
Thorax	17957	43427	3615	39812	61384	40157.9	43875.7	3665.8	40218.0	84033.6	0.1061	0.4779	0.5221	0.0436	0.4786
Abdomen	12917	41170	5986	35184	54087	28886.8	41595.4	6070.2	35542.8	70482.2	0.0890	0.4098	0.5902	0.0861	0.5043
Pelvis	122	5253	240	5013	5375	272.8	5307.3	243.4	5064.1	5580.1	0.0070	0.0489	0.9511	0.0436	0.9075
Spine	278	7715	712	7003	7993	621.7	7794.7	722.0	7074.4	8416.4	0.0106	0.0739	0.9261	0.0858	0.8405
UArm	2511	153015	999	152016	155526	5615.4	154596.0	1013.0	153566.2	160211.4	0.2023	0.0351	0.9649	0.0063	0.9585
LArm	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Hand	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Hip&Buttock	970	19487	381	19106	20457	2169.2	19688.3	386.4	19300.8	21857.6	0.0276	0.0992	0.9008	0.0177	0.8830
ULeg-Hip	4522	221355	3183	218172	225877	10112.7	223642.0	3227.8	220396.9	233754.8	0.2952	0.0433	0.9567	0.0138	0.9429
LLeg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Foot	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Multi	8821	1901	430	1471	10722	19726.7	1920.6	436.0	1486.0	21647.4	0.0273	0.9113	0.0887	0.0201	0.0686
Other	106267	6133	290	5843	112400	--	--	--	--	--	--	--	--	--	--
Total	192220	599724	20913	578811	791944	192220	599724	20913	57881.1	791944	1.0000	--	--	--	--
Proportion	0.2427	0.7573	0.0264	0.7309	1.0000	0.2427	0.7573	0.0264	0.7309	1.0000	--	--	--	--	--
Frac. known	0.4472	0.9898	0.9861	0.9899	0.8581	--	--	--	--	--	--	--	--	--	--

Fully adjusted	P(Hit| Region)	P(KIA| Region)	P(WIA| Region)	P(DOW| Region)	P(NFW| Region)
Head	0.2414	0.4552	0.5448	0.0277	0.5171
Thorax	0.1091	0.4779	0.5221	0.0436	0.4786
Abdomen	0.1097	0.3525	0.6475	0.0833	0.5644
Arms	0.2080	0.0351	0.9649	0.0063	0.9585
Legs	0.3318	0.0480	0.9520	0.0141	0.9377

Table B-13. Adjusted and Fully Adjusted Estimates of Susceptibility and Vulnerability.

SOURCE: Reister-1975
World War II, US Army, 1942 (including Dec 1941).
All Theaters.
Using Tables 21 and 23.

Region	Casualty category					Adj	Adj	Adj	Adj	Adj	P(Hit|	P(KIA|	P(WIA|	P(DOW|	P(NFW|
	KIA	WIA	DOW	NFW	Total	KIA	WIA	DOW	NFW	Total	Region)	Region)	Region)	Region)	Region)
Head	144	334	30	301	478	1001.3	339.8	40.6	305.7	1341.1	0.1967	0.7466	0.2534	0.0302	0.2280
Face-Eye	9	209	5	204	218	62.6	212.6	6.8	205.2	275.2	0.0404	0.2274	0.7726	0.0246	0.7454
Eye	0	66	1	65	66	0.0	67.1	1.4	65.4	67.1	0.0098	0.0000	1.0000	0.0201	0.9735
Neck	12	62	4	58	74	83.4	63.1	5.4	58.3	146.5	0.0215	0.5695	0.4305	0.0369	0.3981
Thorax	65	328	33	295	393	452.0	333.7	44.6	296.7	785.7	0.1152	0.5753	0.4247	0.0568	0.3776
Abdomen	60	270	36	234	330	417.2	274.7	48.7	235.3	691.9	0.1015	0.6030	0.3970	0.0703	0.3401
Pelvis	0	30	0	0	30	0.0	30.5	0.0	0.0	30.5	0.0045	0.0000	1.0000	0.0000	0.0000
Spine	4	61	2	59	65	27.8	62.1	2.7	59.3	89.9	0.0132	0.3095	0.6905	0.0301	0.6602
UArm	7	1182	4	1178	1189	48.7	1202.6	5.4	1184.7	1251.3	0.1835	0.0389	0.9611	0.0043	0.9468
LArm	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Hand	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Hip&Buttock	0	150	3	147	150	0.0	152.6	4.1	147.8	152.6	0.0224	0.0000	1.0000	0.0266	0.9687
ULeg-Hip	28	1472	21	1451	1500	194.7	1497.6	28.4	1459.2	1692.3	0.2482	0.1151	0.8849	0.0168	0.8623
LLeg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Foot	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Multi	38	29	3	26	67	264.2	29.5	4.1	26.1	293.7	0.0431	0.8996	0.1004	0.0138	0.0890
Other	2185	73	50	23	2258	--	--	--	--	--	--	--	--	--	--
Total	2552	4266	192	4044	6818	2552.0	4266.0	192.0	4043.8	6818.0	1.0000	--	--	--	--
Proportion	0.3743	0.6257	0.0282	0.5975	1.0000	0.3743	0.6257	0.0282	0.5931	1.0000	--	--	--	--	--
Frac. known	0.1438	0.9829	0.7396	0.9944	0.6688	--	--	--	--	--	--	--	--	--	--

Fully adjusted	P(Hit| Region)	P(KIA| Region)	P(WIA| Region)	P(DOW| Region)	P(NFW| Region)
Head	0.2805	0.6270	0.3730	0.0296	0.3468
Thorax	0.1204	0.5753	0.4247	0.0568	0.3776
Abdomen	0.1245	0.5479	0.4521	0.0633	0.3627
Arms	0.1918	0.0389	0.9611	0.0043	0.9468
Legs	0.2828	0.1055	0.8945	0.0176	0.8711

Table B-14. Adjusted and Fully Adjusted Estimates of Susceptibility and Vulnerability.

SOURCE: Reister-1975
World War II, US Army, 1943.
All Theaters.
Using Tables 21 and 23.

Region	Casualty category					Adj	Adj	Adj	Adj	Adj	P(Hit|	P(KIA|	P(WIA|	P(DOW|	P(NFW|
	KIA	WIA	DOW	NFW	Total	KIA	WIA	DOW	NFW	Total	Region)	Region)	Region)	Region)	Region)
Head	2422	2820	229	2591	5242	7715.4	2953.8	231.0	2717.2	10669.2	0.1772	1.0000	0.2769	0.0217	0.2547
Face-Eye	120	2122	43	2079	2242	382.3	2222.7	43.4	2180.3	2604.9	0.0433	0.1467	0.8533	0.0167	0.8370
Eye	0	402	2	400	402	0.0	421.1	2.0	419.5	421.1	0.0070	0.0000	1.0000	0.0048	0.9962
Neck	258	611	17	594	869	821.9	640.0	17.2	622.9	1461.9	0.0243	0.5622	0.4378	0.0117	0.4261
Thorax	1323	2791	216	2575	4114	4214.5	2923.4	217.9	2700.4	7137.9	0.1185	0.5904	0.4096	0.0305	0.3783
Abdomen	1034	2615	313	2302	3649	3293.9	2739.1	315.8	2414.1	6032.9	0.1002	0.5460	0.4540	0.0523	0.4002
Pelvis	6	270	14	256	276	19.1	282.8	14.1	268.5	301.9	0.0050	0.0633	0.9367	0.0468	0.8892
Spine	20	617	31	586	637	63.7	646.3	31.3	614.5	710.0	0.0118	0.0897	0.9103	0.0441	0.8656
UArm	159	10474	60	10414	10633	506.5	10970.9	60.5	10921.3	11477.4	0.1906	0.0441	0.9559	0.0053	0.9516
LArm	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Hand	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Hip&Buttock	69	1400	22	1378	1469	219.8	1466.4	22.2	1445.1	1686.2	0.0280	0.1304	0.8696	0.0132	0.8570
ULeg-Hip	354	14110	249	13861	14464	1127.7	14779.4	251.2	14536.2	15907.0	0.2642	0.0709	0.9291	0.0158	0.9138
LLeg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Foot	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Multi	503	197	36	161	700	1602.3	206.3	36.3	168.8	1808.7	0.0300	0.8859	0.1141	0.0201	0.0934
Other	13699	1823	11	1812	15522	--	--	--	--	--	--	--	--	--	--
Total	19967	40252	1243	39009	60219	19967.0	40252.0	1243.0	39009.0	60219.0	1.0000	--	--	--	--
Proportion	0.3316	0.6684	0.0206	0.6478	1.0000	0.3316	0.6684	0.0206	0.6478	1.0000	--	--	--	--	--
Frac. known	0.3139	0.9547	0.9912	0.9535	0.7422	--	--	--	--	--	--	--	--	--	--

Fully adjusted	P(Hit| Region)	P(KIA| Region)	P(WIA| Region)	P(DOW| Region)	P(NFW| Region)
Head	0.2595	0.5885	0.4115	0.0194	0.3919
Thorax	0.1222	0.5904	0.4096	0.0305	0.3783
Abdomen	0.1206	0.4793	0.5207	0.0513	0.4680
Arms	0.1965	0.0441	0.9559	0.0053	0.9516
Legs	0.3012	0.0766	0.9234	0.0155	0.9084

Table B-15. Adjusted and Fully Adjusted Estimates of Susceptibility and Vulnerability.

SOURCE: Reister-1975
World War II, US Army, 1944.
All Theaters.
Using Tables 21 and 23.

Region	Casualty category					Adj	Adj	Adj	Adj	Adj	P(Hit|	P(KIA|	P(WIA|	P(DOW|	P(NFW|
	KIA	WIA	DOW	NFW	Total	KIA	WIA	DOW	NFW	Total	Region)	Region)	Region)	Region)	Region)
Head	18826	25815	2247	23568	44641	39223.2	25975.2	2284.8	23705.0	65198.5	0.1462	0.6016	0.3984	0.0350	0.3636
Face-Eye	1935	17737	378	17359	19672	4031.5	17847.1	384.4	17459.9	21878.6	0.0491	0.1843	0.8157	0.0176	0.7980
Eye	189	6260	31	6229	6449	393.8	6298.9	31.5	6265.2	6692.6	0.0150	0.0588	0.9412	0.0047	0.9361
Neck	2480	5625	278	5347	8105	5167.0	5659.9	282.7	5378.1	10826.9	0.0243	0.4772	0.5228	0.0261	0.4967
Thorax	10885	25065	2012	23053	35950	22678.5	25220.6	2045.8	23187.0	47899.0	0.1074	0.4735	0.5265	0.0427	0.4841
Abdomen	8112	23143	3407	19736	31255	16901.0	23286.6	3464.3	19850.7	40187.7	0.0901	0.4206	0.5794	0.0862	0.4940
Pelvis	85	2904	140	2764	2989	177.1	2922.0	142.4	2780.1	3099.1	0.0069	0.0571	0.9429	0.0459	0.8971
Spine	171	4289	375	3914	4460	356.3	4315.6	381.3	3936.8	4671.9	0.0105	0.0763	0.9237	0.0816	0.8426
UArm	1459	87607	636	86971	89066	3039.8	88150.7	646.7	87476.5	91190.5	0.2045	0.0333	0.9667	0.0071	0.9593
LArm	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Hand	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Hip&Buttock	599	11668	268	11400	12267	1248.0	11740.4	272.5	11466.3	12988.4	0.0291	0.0961	0.9039	0.0210	0.8828
ULeg-Hip	2838	122345	1932	120413	125183	5912.9	123104.4	1964.5	121112.9	129017.2	0.2893	0.0458	0.9542	0.0152	0.9387
LLeg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Foot	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Multi	5344	1214	253	961	6558	11134.0	1221.5	257.3	966.6	12355.5	0.0277	0.9011	0.0989	0.0208	0.0782
Other	57340	2071	201	1870	59411	--	--	--	--	--	--	--	--	--	--
Total	110263	335743	12158	323585	446006	110263	335743	12158	323585	446006	1.0000	--	--	--	--
Proportion	0.2472	0.7528	0.0273	0.7255	1.0000	0.2472	0.7528	0.0273	0.7255	1.0000	--	--	--	--	--
Frac. known	0.4800	0.9938	0.9835	0.9942	0.8668	--	--	--	--	--	--	--	--	--	--

Fully adjusted	P(Hit| Region)	P(KIA| Region)	P(WIA| Region)	P(DOW| Region)	P(NFW| Region)
Head	0.2412	0.4667	0.5333	0.0285	0.5049
Thorax	0.1105	0.4735	0.5265	0.0427	0.4841
Abdomen	0.1106	0.3635	0.6365	0.0832	0.5540
Arms	0.2103	0.0333	0.9667	0.0071	0.9593
Legs	0.3275	0.0504	0.9496	0.0158	0.9336

Table B-16. Adjusted and Fully Adjusted Estimates of Susceptibility and Vulnerability.

SOURCE: Reister-1975
World War II, US Army, 1945.
All Theaters.
Using Tables 21 and 23.

Region	Casualty category					Adj KIA	Adj WIA	Adj DOW	Adj NFW	Adj Total	P(Hit| Region)	P(KIA| Region)	P(WIA| Region)	P(DOW| Region)	P(NFW| Region)
	KIA	WIA	DOW	NFW	Total										
Head	9207	17298	1426	15872	26505	20732.9	17470.4	1431.5	16033.6	38203.4	0.1370	0.5427	0.4573	0.0375	0.4197
Face-Eye	924	12355	197	12158	13279	2080.7	12478.2	197.8	12281.8	14558.9	0.0522	0.1429	0.8571	0.0136	0.8436
Eye	89	5046	32	5014	5135	200.4	5096.3	32.1	5065.0	5296.7	0.0190	0.0378	0.9622	0.0061	0.9563
Neck	1240	3506	157	3349	4746	2792.3	3540.9	157.6	3383.1	6333.3	0.0227	0.4409	0.5591	0.0249	0.5342
Thorax	5684	15243	1354	13889	20927	12799.6	15394.9	1359.2	14030.4	28194.5	0.1011	0.4540	0.5460	0.0482	0.4976
Abdomen	3711	15142	2230	12912	18853	8356.7	15292.9	2238.6	13043.5	23649.6	0.0848	0.3534	0.6466	0.0947	0.5515
Pelvis	31	2049	86	1963	2080	69.8	2069.4	86.3	1983.0	2139.2	0.0077	0.0326	0.9674	0.0404	0.9270
Spine	83	2748	304	2444	2831	186.9	2775.4	305.2	2468.9	2962.3	0.0106	0.0631	0.9369	0.1030	0.8334
UArm	886	53752	299	53453	54638	1995.2	54287.8	300.1	53997.2	56282.9	0.2018	0.0354	0.9646	0.0053	0.9594
LArm	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Hand	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Hip&Buttock	330	3269	88	3181	3599	743.1	3301.6	88.3	3213.4	4044.7	0.0145	0.1837	0.8163	0.0218	0.7945
ULeg-Hip	1274	86428	981	85447	87702	2868.9	87289.5	984.8	86316.9	90158.4	0.3233	0.0318	0.9682	0.0109	0.9574
LLeg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Foot	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Multi	2936	461	138	323	3397	6611.5	465.6	138.5	326.3	7077.1	0.0254	0.9342	0.0658	0.0196	0.0461
Other	33043	2166	28	2138	35209	--	--	--	--	--	--	--	--	--	--
Total	59438	219463	7320	212143	278901	59438	219463	7320	212143	278901	1.0000	--	--	--	--
Proportion	0.2131	0.7869	0.0262	0.7606	1.0000	0.2131	0.7869	0.0262	0.7606	1.0000	--	--	--	--	--
Frac. known	0.4441	0.9901	0.9962	0.9899	0.8738	--	--	--	--	--	--	--	--	--	--

Fully adjusted	P(Hit| Region)	P(KIA| Region)	P(WIA| Region)	P(DOW| Region)	P(NFW| Region)
Head	0.2369	0.4008	0.5992	0.0282	0.5709
Thorax	0.1037	0.4540	0.5460	0.0482	0.4976
Abdomen	0.1058	0.2996	0.7004	0.0915	0.6085
Arms	0.2071	0.0354	0.9646	0.0053	0.9594
Legs	0.3466	0.0383	0.9617	0.0114	0.9504

Table B-17. Adjusted and Fully Adjusted Estimates of Susceptibility and Vulnerability.

SOURCE: Beyer-1962
New Georgia-Burma, US Army.
Using Table 36, page 258.

Region	Casualty category					Adj KIA	Adj WIA	Adj DOW	Adj NFW	Adj Total	P(Hit| Region)	P(KIA| Region)	P(WIA| Region)	P(DOW| Region)	P(NFW| Region)
	KIA	WIA	DOW	NFW	Total										
Head	25	42	7	35	67	25.0	42.0	7.0	35.0	67.0	0.2012	0.3731	0.6269	0.1045	0.5224
Face-Eye	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Eye	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Neck	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Thorax	25	31	7	24	56	25.0	31.0	7.0	24.0	56.0	0.1682	0.4464	0.5536	0.1250	0.4286
Abdomen	0	14	11	3	14	0.0	14.0	11.0	3.0	14.0	0.0420	0.0000	1.0000	0.7857	0.2143
Pelvis	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Spine	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
UArm	0	62	1	61	62	0.0	62.0	1.0	61.0	62.0	0.1862	0.0000	1.0000	0.0161	0.9839
LArm	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Hand	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Hip&Buttock	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
ULeg-Hip	0	81	2	79	81	0.0	81.0	2.0	79.0	81.0	0.2432	0.0000	1.0000	0.0247	0.9753
LLeg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Foot	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Multi	15	38	8	30	53	15.0	38.0	8.0	30.0	53.0	0.1592	0.2830	0.7170	0.1509	0.5660
Other	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total	65	268	36	232	333	65	268	36	232	333	1.0000	--	--	--	--
Proportion	0.1952	0.8048	0.1081	0.6967	1.0000	0.1952	0.8048	0.1081	0.6967	1.0000	--	--	--	--	--
Frac. known	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	--	--	--	--	--

Fully adjusted	P(Hit| Region)	P(KIA| Region)	P(WIA| Region)	P(DOW| Region)	P(NFW| Region)
Head	0.2393	0.3731	0.6269	0.1045	0.5224
Thorax	0.2000	0.4464	0.5536	0.1250	0.4286
Abdomen	0.0500	0.0000	1.0000	0.7857	0.2143
Arms	0.2214	0.0000	1.0000	0.0161	0.9839
Legs	0.2893	0.0000	1.0000	0.0247	0.9753

Table B-18. Adjusted and Fully Adjusted Estimates of Susceptibility and Vulnerability.

SOURCE: Beyer-1962
Bougainville, US Army.
Using Table 67, page 317.

Region	Casualty category					Adj	Adj	Adj	Adj	Adj	P(Hit|	P(KIA|	P(WIA|	P(DOW|	P(NFW|
	KIA	WIA	DOW	NFW	Total	KIA	WIA	DOW	NFW	Total	Region)	Region)	Region)	Region)	Region)
Head	134	240	10	230	374	134.0	240.0	10.0	230.0	374.0	0.2183	0.3583	0.6417	0.0267	0.6150
Face-Eye	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Eye	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Neck	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Thorax	66	144	21	123	210	66.0	144.0	21.0	123.0	210.0	0.1226	0.3143	0.6857	0.1000	0.5857
Abdomen	20	66	2d	38	86	20.0	66.0	28.0	38.0	86.0	0.0502	0.2326	0.7674	0.3256	0.4419
Pelvis	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Spine	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
UArm	1	319	0	0	320	1.0	319.0	0.0	0.0	320.0	0.1868	0.0031	0.9969	0.0000	0.0000
LArm	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Hand	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Hip&Buttock		--	--	--	--	--	--	--	--	--	--	--	--	--	--
ULeg-Hip	6	393	8	385	399	6.0	393.0	8.0	385.0	399.0	0.2329	0.0150	0.9850	0.0201	0.9649
LLeg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Foot	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Multi	93	231	8	223	324	93.0	231.0	8.0	223.0	324.0	0.1891	0.2870	0.7130	0.0247	0.6883
Other	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total	320	1393	75	1318	1713	320	1393	75	999	1713	1.0000	--	--	--	--
Proportion	0.1868	0.8132	0.0438	0.7694	1.0000	0.1868	0.8132	0.0438	0.5832	1.0000	--	--	--	--	--
Frac. known	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	--	--	--	--	--

Fully adjusted	P(Hit| Region)	P(KIA| Region)	P(WIA| Region)	P(DOW| Region)	P(NFW| Region)
Head	0.2693	0.3583	0.6417	0.0267	0.6150
Thorax	0.1512	0.3143	0.6857	0.1000	0.5857
Abdomen	0.0619	0.2326	0.7674	0.3256	0.4419
Arms	0.2304	0.0031	0.9969	0.0000	0.0000
Legs	0.2873	0.0150	0.9850	0.0201	0.9649

Table B-19. Adjusted and Fully Adjusted Estimates of Susceptibility and Vulnerability.

SOURCE: Beyer-1962
Eighth Air Force.
Using Table 186, page 563.

Region	Casualty category					Adj	Adj	Adj	Adj	Adj	P(Hit|	P(KIA|	P(WIA|	P(DOW|	P(NFW|
	KIA	WIA	DOW	NFW	Total	KIA	WIA	DOW	NFW	Total	Region)	Region)	Region)	Region)	Region)
Head	39	182	--	--	221	39.0	182.0	--	--	221.0	0.1979	0.1765	0.8235	--	--
Face-Eye	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Eye	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Neck	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Thorax	11	27	--	--	38	11.0	27.0	--	--	38.0	0.0340	0.2895	0.7105	--	--
Abdomen	7	10	--	--	17	7.0	10.0	--	--	17.0	0.0152	0.4118	0.5882	--	--
Pelvis	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Spine	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
UArm	1	246	--	--	247	1.0	246.0	--	--	247.0	0.2211	0.0040	0.9960	--	--
LArm	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Hand	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Hip&Buttock	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
ULeg-Hip	9	419	--	--	428	9.0	419.0	--	--	428.0	0.3832	0.0210	0.9790	--	--
LLeg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Foot	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Multi	43	123	--	--	166	43.0	123.0	--	--	166.0	0.1486	0.2590	0.7410	--	--
Other	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total	110	1007	--	--	1117	110	1007	--	--	1117	1.0000	--	--	--	--
Proportion	0.0985	0.9015	--	--	1.0000	0.0985	0.9015	--	--	1.0000	--	--	--	--	--
Frac. known	1.0000	1.0000	--	--	1.0000	1.0000	1.0000	--	--	1.0000	--	--	--	--	--

Fully adjusted	P(Hit| Region)	P(KIA| Region)	P(WIA| Region)	P(DOW| Region)	P(NFW| Region)
Head	0.2324	0.1765	0.8235	--	--
Thorax	0.0400	0.2895	0.7105	--	--
Abdomen	0.0179	0.4118	0.5882	--	--
Arms	0.2597	0.0040	0.9960	--	--
Legs	0.4501	0.0210	0.9790	--	--

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APPENDIX C

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GLOSSARY

GLOSSARY-1. Some of the abbreviations and special terms used in this document are listed below. If the definition given is an official one, the organizations that have adopted it are given in parentheses; otherwise, no indication of its adoption are given. Note that the definitions used by other countries or by the US in earlier times may differ more or less from those given below, and may be interpreted in various ways even within the US Department of Defense.

GLOSSARY-2. Definitions of terms and abbreviations.

Battle casualty.- (DOD) Any casualty incurred in action. "In action" characterizes the casualty status as having been the direct result of hostile action, sustained in combat or relating thereto, or sustained going to or returning from a combat mission provided that the occurrence was directly related to hostile action. Included are persons killed or wounded mistakenly or accidentally by friendly fire directed at a hostile force or what is thought to be a hostile force. However, not to be considered as sustained in action and thereby not to be interpreted as battle casualties are injuries due to the elements, self-inflicted wounds, and, except in unusual cases, wounds or death inflicted by friendly forces while the individual is in absent-without-leave or dropped-from-rolls status or is voluntarily absent from a place of duty. See also died of wounds received in action; nonbattle casualty; wounded.

Bloody losses.- The sum of the KIA and WIA.

Casualty.- (DOD, IADB) Any person who is lost to the organization by reason of having been declared dead, wounded, injured, diseased, interned, captured, retained, missing, missing in action, beleaguered, besieged or detained; see also battle casualty; nonbattle casualty; wounded.

CMIA.- Captured or missing in action. *See* POW and MIA.

CRO.- Carded for record only. (Adapted from Beebe, Gilbert W.; and De Bakey, Michael E., *Battle Casualties: Incidence, Mortality, and Logistic Considerations*, Charles C. Thomas (publisher), 1952.) Basically, admissions to a medical treatment facility include all cases admitted for medical care and not returned to duty on the same calendar day as that on which first seen. Cases which are treated on an outpatient (duty) status, are designated as carded for record only (CRO).

DNBI.- Disease and nonbattle injury. Personnel treated for diseases and for injuries not received in action. *See* Nonbattle casualty.

DOW.- Died of wounds received in action (DOD, NATO). A battle casualty who dies of wounds or other injuries received in action, after having reached a medical treatment facility. See also killed in action.

DTIC.- Defense Technical Information Center.

KIA.- Killed in action (DOD, NATO, IADB). A battle casualty who is killed outright or who dies as a result of wounds or other injuries before reaching a medical treatment facility. See also died of wounds received in action.

Losses.- (Adapted from FM 101-10-1/2, Staff Officers' Field Manual Organizational, Technical, and Logistical Data Planning Factors, October 1987). A personnel loss is any reduction in the assigned strength of a unit. Personnel losses are recorded in three general categories: battle, nonbattle, and administrative.

- Battle losses are those incurred in action. They include wounded or injured in action (including those who died of wounds and died of injuries received in action), killed in action, and missing in action or captured by the enemy.

- Nonbattle losses are those not directly attributable to action regardless of when sustained. They include nonbattle dead, nonbattle accident/injury, nonbattle missing, and illness/disease.

- Administrative losses are those resulting from transfer from the unit, absence without leave, desertion, personnel rotation, and discharges.

LWIA.- Lightly wounded in action (*cf.* Slightly Wounded).

MIA.- (adapted from FM 101-10-1/2, Staff Officers' Field Manual Organizational, Technical, and Logistical Data Planning Factors, October 1987). Missing in action describes battle casualties whose whereabouts or fate cannot be determined and who are not known to be in an unauthorized absence status (desertion or absence without leave). Missing in action (MIA) casualties are not usually included in medical statistical records or reports received by The Surgeon General, but are reportable to The Adjutant General.

NFW.- Nonfatal wound. A person who is wounded in action (WIA), but who does not die of wounds (DOW).

Nonbattle casualty.- (DOD, NATO, IADB) A person who is not a battle casualty, but who is lost to his organization by reason of disease or injury, including persons dying from disease or injury, or by reason of being missing where the absence does not appear to be voluntary or due to enemy action. See also battle casualty; wounded.

Nonbloody loss.- Battle casualties other than KIA and WIA; includes (for example) MIA, POW, absent without leave, stragglers, and deserters.

NP.- Neuropsychiatric.

POW.- *Prisoner of war. Detainee (DOD). A term used to refer to any person captured or otherwise* detained by an armed force. (According to FM 101-10-1/2, Staff Officers' Field Manual Organizational, Technical, and Logistical Data Planning Factors, October 1987, captured describes all battle casualties known to have been taken into custody by a hostile force as a result of and for reasons arising out of any armed conflict in which US armed forces are engaged. Captured casualties are not usually included in medical statistical records or reports received by The Surgeon General but are reported to The Adjutant General.)

Seriously wounded.- (DOD, IADB) A stretcher case. See also WIA.

Slightly wounded.- (DOD, IADB) A casualty that is a sitting or walking case. See also WIA.

SWIA.- Seriously wounded in action (*cf.* Seriously Wounded).

WIA.- Wounded in action (DOD, NATO, IADB). A battle casualty other than "killed in action" who has incurred an injury due to an external agent or cause. The term encompasses all kinds of wounds and other injuries incurred in action, whether there is a piercing of the body, as in a penetrating or perforated wound, or none, as in the contused wound; all fractures, burns, blast concussions, all effects of biological and chemical warfare agents, the effects of exposure to ionizing radiation, or any other destructive weapon or agent.