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Item ID Number	01846
Author	Goldberg, Jack
Corporate Author	
Report/Article Title	Typescript: The Vietnam Era Twin (VET) Registry: Ascertainment Bias
Journal/Book Title	
Year	0000
Month/Day	
Color	☐
Number of Images	38
Description Notes	Alvin L. Young filed this item under "Vietnam Veterans Twin Study."

The Vietnam Era Twin (VET) Registry: Ascertainment Bias

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Acknowledgment of Funding: Cooperative Studies Program, Study #256, Veterans Administration Medical Research Service

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Running Title: VET Registry: Ascertainment Bias

ABSTRACT

An examination of ascertainment bias in the identification of twin pairs in the Vietnam Era Twin Registry has been conducted. A complete listing of all male-male Vietnam era veteran twin pairs born in Connecticut between 1939 and 1955 was obtained (n=150). An attempt was made to match these pairs with a listing of Vietnam era veteran twin pairs derived from the United States Department of Defense's Defense Manpower Data Center (DMDC) computer files. The results indicate that the DMDC files identified only 46.7% of the 150 Connecticut born Vietnam era veteran pairs. Statistically significant differences ($p<.05$) between pairs found on the DMDC files and Connecticut veteran pairs missing from the DMDC files are observed for the following variables: a) year of discharge from military service, b) total length of active military service, c) branch of service, and d) foreign service. No consistent pattern of bias is observed for factors related to the physical and psychosocial health of veteran pairs. The implications of the ascertainment biases in the Vietnam Era Twin Registry are discussed.

Key Words: Twin registers, Vietnam veterans, Bias, Military service

INTRODUCTION

Veterans have claimed that service in Vietnam during the Vietnam War is associated with a wide variety of psychological and physiological illnesses (3,5,7,12). For example, exposure to combat in the war theater may cause Post-Traumatic Stress Disorder (PTSD) (2). Other features of the war having potential long-term effects include exposure to chemicals, diseases endemic to Southeast Asia, and certain medications and illicit drugs (8).

In spite of considerable effort to define the relationship between the Vietnam experience and adverse health effects, few well-designed studies exist. To a large extent, this reflects the problems involved with defining a group of veterans who can serve as an adequate non-Vietnam experienced control population. The Vietnam Era Twin Study (VETS) has been suggested as a method for minimizing this problem. In brief, the VETS will assess the effects of the Vietnam experience on health by studying twin pairs concordant on military service but discordant on service in Vietnam. Thus, maximum control of non-Vietnam related hereditary and environmental factors is obtained, since monozygotic twins are genetically identical and monozygotic and dizygotic twins share more common environmental experiences than any other pair of individuals.

The first step in the project was the development of a registry of Vietnam era twin pairs. In a companion paper, the rationale and method of construction of the Vietnam Era Twin

(VET) Registry are discussed (6); the purpose of this paper is to evaluate the potential for bias in the Registry.

METHODS AND MATERIALS

The examination of ascertainment bias in the VET Registry first required an unbiased source of veteran twin pairs. This unbiased source was provided by the State of Connecticut twin register (1). Based on an exhaustive manual search of hard copy military records at the National Personnel Records Center (NPRC) (6) veteran twin pairs born in Connecticut between 1939 and 1955 were identified (10,11). The completeness of the VET Registry is easily accomplished by attempting to link the veteran twin pairs identified using the Defense Manpower Data Center (DMDC) (9) database (the source of the VET Registry) with veteran twin pairs derived from the Connecticut twin register. Linkage is based on an exact match for social security number and date of birth; matched names were confirmed by manual review. The proportion of all Connecticut born veteran twins found on the DMDC database describes the completeness of VET Register ascertainment.

The next step in assessing bias in the VET Registry involved comparing Connecticut born veteran twins found on the DMDC database and those not found on the DMDC database. It is thereby possible to determine if the veteran pairs ascertained via the DMDC database are any different than the veteran pairs missing from the DMDC database. The variables used to compare the groups are derived from two sources: a) the military service record and b) a twenty-four page questionnaire which is administered to all veteran twin pairs as part of the VETS. The variables obtained

from the service record are shown in Table 1; those obtained from the questionnaire are shown in Table 2.

(Insert Tables 1 and 2 about here)

The statistical analysis presents the data in unpaired form for simplicity. Since the paired analysis of these data show no difference from the unpaired analysis only the unpaired analysis is presented. Hypothesis testing is done using the chi-squared statistic for categorical data except where indicated. For continuously distributed data the t-test is used for hypothesis testing.

RESULTS

Completeness of the Vietnam Era Twin Registry

A microdata tape transcript of the Connecticut twin register was obtained. This register contained 1,544 male-male twin pairs born between 1939 and 1955. Based on a manual search of hard copy military records at NPRC it was determined that 150 Connecticut born pairs both served on active military duty during the Vietnam era; for these 150 pairs social security numbers were ascertained from the military records.

A listing of 15,711 potential veteran twin pairs from the DMDC was also obtained; these potential twins were identified using a matching algorithm based on: a) same last name, different first name, b) same date of birth, and c) same first five digits of the social security number (6).

Using the social security number and date of birth an attempt was made to link the 150 Connecticut born veteran twins with the DMDC file of 15,711 potential veteran twin pairs. The record linkage identified 70 pairs that appeared on both files. Thus, the DMDC file contains approximately half (46.7%) of the total number of Vietnam era veteran twin pairs born in Connecticut. It was therefore important to evaluate the VET Register for possible ascertainment bias.

Demographic Factors

Table 3 presents the distribution of the demographic factors: age, race, education at enlistment, and marital status at

enlistment by DMDC status. Of the demographic factors examined, race demonstrated a marginally significant difference between the two DMDC groups. The non-DMDC group contains a smaller percentage of non-whites compared to the DMDC group (though this difference is difficult to evaluate due to the small number of non-whites).

(Insert Table 3 about here)

Enlistment Examination Factors

Table 4 presents the enlistment examination factors by DMDC status. Both systolic and diastolic blood pressure are measured during the enlistment physical examination. The Department of Defense classifies fitness for military duty on six dimensions: physical, upper extremities, lower extremities, hearing, vision, and neuropsychiatric.

For each dimension a rating of 1 (no limitations) to 4 (unfit for duty) is assigned. These six variables have been dichotomized into no limitations versus any limitations. An examination of the enlistment examination factors shows that there are no significant differences between individuals on the DMDC compared to individuals not on the DMDC.

(Insert Table 4 about here)

Military Service Factors

Military service factors (Table 5) are strongly related to the presence of an individual on the DMDC. The mean year of discharge for individuals that appear on the DMDC ($\bar{x}_1$ = 1971) is

significantly later that the mean year of discharge for individuals who do not appear on DMDC ($\bar{x}_2$ = 1969). Likewise, mean year of enlistment is significantly later in the DMDC group ($\bar{x}_1$ = 1968) compared to the non-DMDC group ($\bar{x}_2$ = 1966). Somewhat more surprising is the significant difference in the mean length of military service; the DMDC group served longer ($\bar{x}_1$ = 1,175 days) compared to the non-DMDC group ($\bar{x}_2$ = 1,027 days). Branch of service is strongly associated with DMDC status. Those individuals who appeared on the DMDC, by comparison with those who did not appear on the DMDC, were more likely to be Navy (33.6 vs 23.1) or Air Force (19.3 vs 10.6) personnel. Lastly, the percent of foreign service was significantly greater for men who appeared on the DMDC (87.0) compared to those who did not (66.0).

(Insert Table 5 about here)

Vietnam Experience Factors

Table 6 presents the distribution of Vietnam experience factors by DMDC status. No significant differences were observed for the percent who served in Vietnam or the mean length of service in Vietnam by DMDC group. However, a marginally significant association exists between the mean year of first rotation through Vietnam and DMDC group, with the DMDC group entering Vietnam an average of one year later than the non-DMDC group. The specific combat roles/experiences are worthy of special discussion. Eighteen specific combat roles/experiences were developed with the assistance of expert consultants in the area

of war stress. The respondent was asked to indicate whether he had experienced a particular combat role/experience while serving in Vietnam. The combat index is created by taking the sum of all positive responses to the 18 combat role/experience questions. The results indicate that four combat role/experiences exhibit an association with DMDC status. For the combat role/experiences of firing an artillery on enemy and receiving incoming fire, sharp differences exist between DMDC and non-DMDC veterans. Nearly 20% of the veterans not found on the DMDC fired artillery on the enemy compared to 2.1% of the veterans found on DMDC; and 80% of the non-DMDC veterans received incoming fire compared to 56.3% of DMDC veterans. Veterans not found on the DMDC are also more likely to have served on a river patrol and engaged the enemy in a firefight. While only four of the combat roles/experiences exhibited at least marginally significant differences, a general pattern of increased combat exposure in the non-DMDC group compared to the DMDC group is displayed in 14 of the 18 possible combat roles/experiences. However, the mean combat intensity index was not significantly greater in the non-DMDC group compared to the DMDC group.

(Insert Table 6 about here)

Physical Health Factors

Table 7 presents the distribution of the physical health factors by DMDC status. Each of 15 physical health questions were asked in the form: "Since active military duty 1965 - 1975, have you

had this problem?" Only the prevalence of nerve disorders demonstrated a statistically significant association with DMDC status; a greater proportion of men found on the DMDC database reported nerve disorders compared to men not found on the DMDC database. It is interesting to note that no trend of increased or decreased prevalence of physical health factors is associated with DMDC status. Of the 15 conditions examined, seven had an increased prevalence associated with the DMDC database while eight had decreased (or no difference) in prevalence associated with DMDC database.

(Insert Table 7 about here)

Health Habit Factors

Table 8 presents the relationship between health habits and DMDC status. No significant differences were observed between the two DMDC groups and the following variables: current smoking status, mean number of cigarettes smoked per day, current alcohol drinking status, and mean number of alcoholic drinks per week.

(Insert Table 8 about here)

Psychosocial Health Factors

The relationship between psychosocial health factors and DMDC status is presented in Table 9. Fifteen indicators of the PTSD, derived from the American Psychiatric Association's most recent revision of the Diagnostic and Statistical Manual (DSM-III) (12), are included in the survey. Veterans were asked to rank the frequency of occurrence of each symptom during the preceding six

months on a five-point scale from very often to never. Only one of the fifteen indicators of PTSD symptomatology, trouble concentrating, demonstrated a significant association with DMDC status. Individuals on the DMDC database reported a statistically significant lower frequency of difficulty concentrating by comparison with individuals not found on the DMDC database. The final psychosocial health factor examined was whether servicemen had sought professional help for emotional problems following discharge. No significant association with DMDC status was demonstrated.

(Insert Table 9 about here)

DISCUSSION

The preceding analysis demonstrates that the VET Registry contains about half of the total cohort of twin pairs who meet the eligibility criteria for inclusion. By comparison with all veteran twin pairs, the Registry is biased in terms of certain aspects of military service but not in terms of the physical and psychosocial variables of importance to the VETS.

Pairs found on DMDC are more likely to have served at a later period during the Vietnam era and to have had their first rotation in Vietnam at a later date. These results are expected, based on our knowledge of when the DMDC database was developed (6). Somewhat more difficult to explain are the DMDC biases toward a longer length of active duty service, a greater proportion of Navy and Air Force personnel, a greater proportion of foreign service, and a possibly lower combat exposure. One explanation of these biases might be that individuals in the Navy and Air Force typically serve longer tours of duty (4 years) and are less likely to be combat exposed. For example, an Army draftee who served two years beginning in 1965 would not appear in the DMDC database, since the DMDC began collecting data with men discharged in 1968; conversely, a Navy enlisted man who served aboard a ship off the coast of Vietnam for four years (beginning in 1965) would appear in the DMDC database. A second possible explanation is that the quality of discharge data submitted to DMDC headquarters varied by the branch of service.

If the Marines and Army submitted data that had a greater number of errors in the spelling of last name, dates of birth or social security numbers by comparison with Navy and Air Force data, then fewer potential Army and Marine twins would be identified by the matching algorithm. The observed biases in duration of service, foreign service and combat exposure would result.

In contrast to the several biases in the DMDC database related to the military service experience, relatively few biases were observed for the variables that pertained to physical and psychosocial health. It is possible that the rarity of many specific health outcomes made it unlikely to detect differences between the DMDC and non-DMDC groups. However, the great similarity between the DMDC and non-DMDC groups for variables such as alcohol consumption, marital status, cigarette smoking, physical health, and psychosocial health suggest that major biases are not present.

In summary, there is no reason to believe that the observed military service biases in the DMDC data tapes will substantially affect the validity of the analyses of the physical and psychosocial variables of twin pairs identified using the DMDC data files.

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Table 1. Variables Obtained From the Military Service Record

Demographic Factors

Age

Race

Education at Enlistment

Marital Status at Enlistment

Enlistment Examination Factors

Blood Pressure

Fitness for Military Duty

Military Service Variables

Branch

Year of Enlistment

Year of Discharge

Length of Service

Foreign Service

Table 2. Variables Obtained From the Survey

Vietnam Experience Factors

Service in Vietnam

Year First Sent to Vietnam

Length of Service in Vietnam

Fired Artillery on Enemy

Flew in Aircraft

Flew in Helicopter

Stationed at Forward Observation Post

Served as a Tunnel Rat

Served on a River Patrol

Field Demolitions Expert

Retrieved Dead Bodies From Field

Served as a Medic in Combat

Received Incoming Fire

Encountered Mines and Booby Traps

Received Sniper or Sapper Fire

Unit Patrol Ambushed

Aircraft Shot Down

Engaged Enemy in Firefight

Saw Soldiers Killed

Wounded

Captured by the Enemy

Table 2. Variables Obtained From the Survey

(continued)

Combat Exposure Index

Physical Health Factors

Hypertension

Respiratory Condition

Cancer

Heart Disease

Stroke

Kidney Problems

Skin Disorders

Diabetes

Stomach Disorders

Liver Disorders

Blood Disorders

Nerve Disorders

Joint Disorders

Hearing Problems

Other Health Problems

Table 2. Variables Obtained From the Survey

(continued)

Health Habits Factors

Current Smoking Status

Total Pack Years of Smoking

Current Alcohol Drinking Status

Number of Alcoholic Drinks Consumed Per Week

Psychosocial Health Factors

Trouble Sleeping

Dreams or Nightmares About Military Service

Painful Memories About Military Service

Avoided Activities That Brought Back Memories of Military Service

Experienced Flashbacks

Strong Feelings About Military Memories

Felt Guilt About Actions In The Military

Had Trouble Concentrating

Had Trouble With Memory

Irritable and Short-Tempered

Angry or Agressive Behavior

Lost Interest in Usual Daily Activities

Felt Distant From Everyone

Table 2. Variables Obtained From the Survey

(continued)

Felt Life is Not Meaningful
Easily Startled or on Guard All The Time
Sought Help For Emotional Problems After Discharge

Table 3. DMDC Status by the Demographic Factors

Demographic Factors	Found on DMDC	Not Found on DMDC
Mean Age at Enlistment	20 (n=139)	20 (n=159)
Race* White (%)	92.8 (n=138)	97.5 (n=160)
Mean Education Grade at Enlistment	12 (n=139)	12 (n=154)
Martial Status at Enlistment Single (%)	98.6 (n=138)	94.7 (n=151)

*p<.10 by Fisher's Exact Test

Table 4. DMDC Status by the Enlistment Examination Factors

Enlistment Examination Factors	Found on DMDC	Not Found on DMDC
Mean Systolic Blood Pressure	124 (n=119)	124 (n=146)
Mean Diastolic Blood Pressure	73 (n=119)	75 (n=146)
Fitness for Military Duty		
Physical Limitations (%)	0.8 (n=128)	0.7 (n=150)
Upper Extremities Limitations (%)	1.6 (n=128)	.7 (n=150)
Lower Extremities Limitations (%)	3.9 (n=128)	2.0 (n=150)

Table 4. DMDC Status by the Enlistment Examination Factors

(Continued)

	Found on DMDC	Not Found on DMDC
Hearing - Limitations (%)	2.3 (n=128)	2.7 (n=150)
Visual - Limitations (%)	34.4 (n=128)	32.0 (n=150)
Neuropsychiatric - Limitations (%)	0.0 (n=128)	0.0 (n=150)

Table 5. DMDC Status by Military Service Factors

Military Service Factors	Found on DMDC	Not Found on DMDC
Mean Year of Discharge*	1971 (n=139)	1969 (n=158)
Mean Year of Enlistment*	1968 (n=139)	1966 (n=159)
Mean Length of Active Duty Service in days*	1,175 (n=139)	1,027 (n=158)
Branch*		
Army (%)	45.0	56.3
Navy (%)	33.6	23.1
Marines (%)	2.1	10.0
Air Force (%)	19.3 (n=140)	10.6 (n=160)

Table 5. DMDC Status by Military Service Factors

(Continued)

	Found on DMDC	Not Found on DMDC
Foreign Service (%)*	87.0 (n=138)	66.0 (n=156)

*p<.001

Table 6. DMDC Status by Vietnam Experience Factors

Vietnam Experience Factors	Found on DMDC	Not Found on DMDC
Vietnam Service (%)	40.3 (n=119)	30.8 (n=133)
Mean Year of First Service in Vietnam***	1969 (n=48)	1968 (n=41)
Mean Length of Vietnam Service in days	327 (n=43)	343 (n=36)
Fired Artillery on Enemy* (%)	2.1 (n=47)	19.5 (n=41)
Flew in Aircraft (%)	14.6 (n=48)	12.2 (n=41)
Flew in Helicopter (%)	14.6 (n=48)	22.0 (n=41)

Table 6. DMDC Status by Vietnam Experience Factors

(Continued)

Vietnam Experience Factors	Found on DMDC	Not Found on DMDC
Stationed at a Forward Observation Post (%)	16.7 (n=48)	19.5 (n=41)
Served as a Tunnel Rat (%)	4.2 (n=48)	4.9 (n=41)
Served as a River Patrol** (%)	0.0 (n=48)	7.3 (n=41)
Field Demolitions Expert (%)	8.3 (n=48)	5.0 (n=40)
Retrieved Dead Bodies From Field (%)	0.0 (n=48)	4.9 (n=41)
Served as a Medic in Combat (%)	2.1 (n=48)	2.4 (n=41)

Table 6. DMDC Status by Vietnam Experience Factors

(Continued)

Vietnam Experience Factors	Found on DMDC	Not Found on DMDC
Wounded (%)	27.1 (n=48)	29.3 (n=41)
Captured by Enemy (%)	2.1 (n=48)	0.0 (n=41)
Mean Combat Exposure Index	3.2 (n=48)	4.3 (n=41)

*p<.05 by Fisher's Exact Test

**p<.10 by Fisher's Exact Test

***p<.10 by Unpaired t-test Test

Table 7. DMDC Status by the Physical Health Factors

Physical Health Factors	Found on DMDC	Not Found on DMDC
Hypertension (%)	16.4 (n=116)	15.5 (n=129)
Respiratory Condition (%)	6.9 (n=116)	10.9 (n=129)
Cancer (%)	0.0 (n=116)	0.0 (n=128)
Heart Disease (%)	1.7 (n=116)	3.1 (n=129)
Stroke (%)	0.0 (n=115)	0.0 (n=129)
Kidney Problems (%)	8.6 (n=116)	5.4 (n=129)
Skin Disorder (%)	12.9 (n=116)	11.0 (n=127)

Table 7. DMDC Status by the Physical Health Factors

(Continued)

Physical Health Factors	Found on DMDC	Not Found on DMDC
Diabetes (%)	0.0 (n=116)	2.3 (n=129)
Stomach Disorders (%)	15.5 (n=116)	15.5 (n=129)
Liver Disorders	2.6 (n=116)	3.9 (n=129)
Blood Disorders	0.9 (n=116)	2.3 (n=129)
Nerve Disorders* (%)	12.9 (n=116)	3.9 (n=129)
Joint Disorder (%)	12.7 (n=118)	12.4 (n=129)

Table 7. DMDC Status by the Physical Health Factors

(Continued)

Physical Health Factors	Found on DMDC	Not Found on DMDC
Hearing Problem (%)	16.2 (n=117)	14.6 (n=130)
Other Health Problems (%)	28.4 (n=102)	24.3 (n=107)

*p=.01 by Fisher's Exact Test

Table 8. DMDC Status by the Health Habits Factors

Health Habits Factors	Found on DMDC	Not Found on DMDC
Currently Smoking (%)	37.9 (n=116)	45.0 (n=132)
Mean Number of Cigarettes Per Day Among Smokers	26 (n=80)	27 (n=101)
Currently Drinks Alcoholic Beverages (%)	89.6 (n=115)	82.7 (n=127)
Mean Number of Alcoholic Beverages Consumed Per Week Among Drinkers	17 (n=101)	16 (n=103)

Table 9. DMDC Status by The Psychosocial Health Factors

Psychosocial Health Factors	Found on DMDC	Not Found on DMDC
Mean Value for Trouble Sleeping	3.5 (n=117)	3.6 (n=132)
Mean Value for Dreams or Nightmares about Military Service	4.5 (n=119)	4.5 (n=132)
Mean Value for Painful Memories about Military Service	4.4 (n=119)	4.5 (n=132)
Mean Value for Avoided Activities that Brought Back Memories of Military Service	4.5 (n=118)	4.5 (n=132)
Mean Value for Experienced Flashbacks	4.6 (n=119)	4.4 (n=132)

Table 9. DMDC Status by The Psychosocial Health Factors

(Continued)

Psychosocial Health Factors	Found on DMDC	Not Found on DMDC
Mean Value for Strong Feelings about Military Memories	4.3 (n=119)	4.4 (n=132)
Mean Value for Felt Guilt About Actions in the Military	4.3 (n=119)	4.4 (n=132)
Mean Value for Trouble* Concentrating	4.1 (n=119)	4.4 (n=132)
Mean Value for Trouble With Memory	4.1 (n=119)	4.3 (n=132)
Mean Value for Being Irritable or Short-Tempered	3.7 (n=119)	3.8 (n=132)

Table 9. DMDC Status by The Psychosocial Health Factors

(Continued)

Psychosocial Health Factors	Found on DMDC	Not Found on DMDC
Mean Value for Angry or Aggressive Behavior	4.1 (n=118)	4.1 (n=132)
Mean Value for Lost Interest in Usual Daily Activities	4.1 (n=119)	4.2 (n=132)
Mean Value for Felt Distant From Everyone	4.1 (n=119)	4.2 (n=132)
Mean Value for Life is Not Meaningful	4.5 (n=119)	4.4 (n=132)

Table 9. DMDC Status by The Psychosocial Health Factors

(Continued)

Psychosocial Health Factors	Found on DMDC	Not Found on DMDC
Mean Value for Easily Startled or on Guard All The Time	4.2 (n=119)	4.3 (n=132)
Sought Help for Emotional Problems After Discharge (%)	17.7 (n=119)	21.2 (n=132)

*$p<.05$