Psychosocial Risk Factors for Upper Respiratory Infection: DEMOGRAPHIC AND HEALTH HISTORY PREDICTORS OF URI DURING BASIC TRAINING*

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SUMMARY

Upper respiratory infections are common in Navy and Marine Corps personnel. The direct costs associated with these illnesses are substantial, and knowledge about susceptibility to URIs may provide information regarding general susceptibility to infectious disease. A risk profile for upper respiratory infections, therefore, may help develop methods for predicting and controlling the influence of infectious diseases in general, and upper respiratory infections in particular, in Navy and Marine Corps personnel.

Past research has shown that a history of frequent colds and cold sores is associated with greater susceptibility to upper respiratory illness (URI) under the relatively controlled conditions of basic training. Ethnicity and age also may be related to susceptibility to URI in basic training. This study attempted to replicate these prior results and to extend them by considering additional demographic and health history variables to improve the prediction of URI.

Four samples of Navy recruits were studied. Recruit volunteers in each sample completed a demographic questionnaire and a health history questionnaire on the first day of basic training. Symptom checklists were completed at approximately weekly intervals during basic training to measure upper respiratory illness which presumably reflected the presence of URIs and the occurrence of other minor health problems. The other minor health problems were employed to construct an assessment of generalized symptom reporting. URI symptom reports were adjusted for the effects of concurrent allergies and musculoskeletal problems. Analysis of variance, correlation, and regression procedures were employed to predict URI. Estimates of associations controlling for general symptom reporting also were determined.

Ethnicity was the only demographic attribute that reliably predicted URI. Whites consistently reported more URI symptoms than non-Whites, but the difference was modest accounting for only about 1% of the variance in URI, a value which dropped to an average of 0.7% controlling for General Symptom Reporting.

Typical severity of past colds and frequency of past respiratory or infectious diseases were the best health history predictors of URI. These two health history predictors explained an average of 9.8% and 1.2% of the variance, respectively. However, controlling for general symptom reporting

tendencies reduced the predictive power for these variables to 4.2% and less than 0.1%, respectively.

Health history and demographic variables can provide useful elements for a risk profile for infectious disease. Additional research is needed to determine whether the strength of the associations involved increases substantially if health outcomes are cumulated over a wider range of infectious disease categories and longer time periods. At this time, it seems unlikely that improving the criterion will substantially improve on the strength of the associations reported here. Attempts to identify additional risk factors, therefore, are needed. In general, the results of this study indicate that a risk profile is feasible, but it remains to be determined whether a profile with sufficient predictive accuracy for practical applications can be produced.

INTRODUCTION

Upper respiratory infections generally are mild, self-limiting illnesses which, nevertheless, have significant cumulative social and economic costs (Harlan, et al., 1986; Lowenstein & Parrino, 1987). In Navy and Marine Corps populations upper respiratory infections also are a significant source of hospitalizations (e.g., Palinkas, 1987). Upper respiratory infections also are of interest as commonplace diseases which may provide clues to general mechanisms of resistance to infection (Reynolds, 1985). Thus, identifying risk factors for upper respiratory infections can help understand significant health problems.

This study was undertaken to extend prior findings that health history and demographic variables help identify high and low risk individuals in military recruit populations (Voors, Stewart, Gutekunst, Moldow & Jenkins, 1968; Vickers, 1986; Vickers, Hervig & Edwards, 1986). Military basic training provides a good setting for identifying URI risk factors because recruits have standardized working and living conditions, free access to health care, and a high probability of exposure to new pathogens. These factors make it possible to study infectious diseases holding constant a number of factors which otherwise might reduce the likelihood of finding significant associations and complicate the interpretation of any associations that were found. The conditions of basic training should maximize the potential for identifying personal characteristics associated with differences in susceptibility to infections.

A preliminary clarification of terminology related to the disease outcome is needed. The occurrence of infectious disease is assessed by symptom reports in this study. Although such reports are correlated with other indicators of infection, including clinical ratings of URI (Roden, 1958; Totman, Reed & Craig, 1977), viral shedding (Forsyth, Bloom, Johnson & Chanock, 1963; Totman, Kiff, Reed & Craig, 1980), and serum proteins related to infection (Lytle, Rytel & Edwards, 1966; Lytel & McNamara, 1967; Naclerio, et al., 1988), symptom reports are not direct indicators of infection or physiological pathology. Therefore, the term upper respiratory illness (hereafter, URI) is applied to the criterion in case any actual disjunctions between experienced symptoms, i.e., illness and infection/pathology, influence the findings.

One hypothesis tested in this study was that past history of

respiratory disease and other infectious diseases would predict susceptibility to URI in basic training. Vickers, et al. (1986) demonstrated such an association with single item measures of past URI and past cold sores. The present study replaced the single item measures used in that prior work with multi-item measures that would be expected to be better predictors of the criterion because of increased measurement precision (Lord & Novick, 1968). The range of health history factors considered was broadened relative to that earlier effort by adding measures of past history of other respiratory diseases, chronic respiratory symptoms, and non-respiratory infectious diseases.

A second hypothesis was that below average education and Hispanic ethnicity would be associated with increased susceptibility to URIs. These predictions were based on prior findings in recruit training (Voors, et al., 1968; Vickers, et al., 1986; Vickers, 1986). In addition to this explicit hypothesis, exploratory analyses were undertaken to test for associations to other demographic attributes which there was reason to believe might be related to susceptibility for URI. Number of siblings was studied because the probability of exposure to viral pathogens is higher in large families, at least for some types of virus (Chanock, Kim, Brandt & Parrott, 1982; Gwaltney, 1982). The past exposure would determine the range and type of pathogens the individual was susceptible to and possibly could affect the development of the immune system. It was expected that past exposure would reduce the probability of clinical illness if reinfection occurred during basic training. Parental education level was employed as an index of socioeconomic status (SES), because SES has been related to URI frequency in national samples (National Center for Health Statistics, 1983, 1986).

METHODS

Sample

Two studies, referred to as Study 1 and Study 2 below, were conducted, each involving two samples of Navy recruits. Data were collected from four samples of Navy recruits who gave informed consent when asked to participate in studies to identify predictors of URI. Although two studies with slightly different sets of predictors are involved, the four samples have been labelled consecutively by the letters A through D to simplify identification in the text (Table 1). Analysis of variance indicated significant sample differences in age ($p < .001$), despite the small absolute magnitude of the differences. Chi-square analyses indicated significant sample differences in racial composition ($p < .002$) and educational level ($p < .001$). Loglinear analysis (Brown, 1983) indicated that the significant chi-squares were attributable largely to the low proportion of Whites and the high proportion of recruits without diplomas in Sample A of Study 1.

Table 1

Demographic Characteristics of the Samples

	Study 1:		Study 2:	
	Sample A	Sample B	Sample C	Sample D
Age				
Mean	18.82	19.06	19.51	19.31
S.D.	2.24	2.49	2.86	2.63
Range	16-35	17-33	16-33	17-33
Ethnicity				
Hispanic	8%	4%	7%	7%
Black	21%	14%	16%	17%
White	65%	78%	71%	70%
Other	7%	5%	6%	5%
Education				
No Diploma	13%	4%	5%	3%
G.E.D.[a]	5%	3%	3%	2%
H.S. Diploma	83%	93%	92%	95%

[a]G.E.D. = Graduate Equivalence Diploma

Health History Measures

Respiratory Health History Questionnaire. This questionnaire, administered in Study 1, included sections on past respiratory diseases, chronic respiratory symptoms, and past susceptibility to common colds and cold sores. General respiratory health history items were adapted from the standardized respiratory disease history questionnaire developed by the American Thoracic Society and the Division of Lung Disorders, National Heart Lung and Blood Institute (Ferris, 1978) with two additional questions modeled after items in the respiratory disease section of the Cornell Medical Index (Brodman, Erdmann, Lorge, Deutschberger & Wolff, 1954). Items regarding past experiences with the common cold were adapted from Vickers, et al. (1986) and Jackson, Dowling, Anderson, Riff, Saporta, and Turck (1960). Scales constructed from this questionnaire were:

(a) Respiratory Disease: Eight true-false questions asked whether the recruit had ever had bronchitis, pneumonia, hay fever, sinus trouble, pulmonary tuberculosis, emphysema, asthma, and "any other chest illnesses." "True" responses were assigned a value of 1 and "False" responses a value of 0.

(b) URI Impact: Four true-false questions, scored as above, asked whether frequent colds made the person miserable all winter, whether colds usually settled to his chest, whether colds usually were severe enough to require bed rest, and whether chest illness had kept him at home at any time during the past three years.

(c) URI Probability: Three five-point Likert scale items asked about the number of colds per year (scored 1 = No colds to 5 = 4 or more per year), severity of colds relative to others the same age (scored 1 = Not at all severe to 5 = Extremely severe), and the probability of getting colds relative to others the same age (scored 1 = Not likely to 5 = Extremely likely). Despite differences in the response options, these three items were moderately intercorrelated and were summed to form a scale on the assumption that they all reflected an underlying dimension of past susceptibility to colds.

(d) Typical Cold: Ten-item scale asking about the typical severity of symptoms when the person had a cold. Specific symptoms were stuffed-up nose, runny nose, sore throat, general physical

discomfort or weakness, headache, cough and/or sputum, fever, chilliness, sneezing, wheezing, and stuffy head. These symptoms were components of the URI symptom measure developed by Jackson, Dowling, Spiesman, and Boand (1958). Response options ranged from "Not at all severe" (scored 1) to "Extremely severe" (scored 5).

(e) Past Cold Sores: Two-item scale asking about the frequency of cold sores and their severity when they occurred using the five-point response options employed for the comparable URI questions.

(f)-(h) Chronic Cough, Chronic Phlegm, and Chronic Wheeze: Scales with 3 or 4 true-false items concerning the frequency and time of day of the indicated types of symptoms.

Scales (a) through (e) were constructed from a priori classifications. The chronic symptom scales ((f) through (h)) were derived from principle components analyses with oblimin rotation. These analyses showed three clearly defined, moderately intercorrelated ($r = .40$ to $r = .50$) dimensions in both samples.

Respiratory, Infectious Disease, and Allergy Health History Questionnaire. This questionnaire, administered in Study 2, added questions about 36 other types of disease to the 8 respiratory disease questions from the first study. A further 7 items were added to determine types of allergies. The questionnaire also included the items required for the URI Probability, Typical Cold, and Past Cold Sores scales from Study 1. New or modified scales included:

(a) Infectious Disease History: Twenty-six true-false items concerning common types of infectious disease identified from textbooks on infectious disease (Youmans, Paterson & Sommers, 1980; Mandell, Douglas & Bennett, 1985; Hoeprich, 1983) and non-technical definitions of symptoms and their origins (Miller, 1976).

(b) Other Immune-related Diseases: Thirteen true-false items concerning common types of disease believed to be immunologically-mediated or at least related to immune dysfunction (e.g., migraine). Identified from the same sources as the infectious disease history items. Referred to as "Other Diseases" in the following pages.

(c) Allergies: Seven true-false items dealing with past allergies. The item content for each scale is given in Appendix A. Some scales from Study 1 were dropped to keep the time required to administer the questionnaire within limits imposed by the recruits' training schedule. The scales carried over from Study 1 were those which prior evidence suggested would be the most useful predictors of URI in basic training. However, the information used in this decision did not include the findings from Study 1, as the second study had to be initiated prior to completing that first study to meet research milestones. In retrospect, no major predictors of URI were lost by this choice (see Results).

Health Assessment

Symptom checklists were completed at seven data collection sessions. These sessions were conducted 4, 12, 19, 26, 37, 46, and 53 days after beginning training for approximately 50% of the participants. The sessions were conducted two days later for the remaining participants, because a weekend intervened between the start of the study and the fourth day of the training schedule for these participants. This schedule was the closest possible approximation to a weekly assessment within the constraints of the training schedule.

At each session, recruits indicated the severity of each symptom over the preceding three days of basic training. Severity was indicated by marking the appropriate space on an optical scanning sheet with response options ranging from "Not at all severe" (1) to "Extremely severe" (5). Items were read aloud to eliminate any effects of reading problems and to encourage recruits to ask for definitions and elaboration if needed. The instructions successfully stimulated questions, as requests for repetition, explanation, and definitions were common, particularly during the early administrations of the checklist.

URI was assessed by an 8-item composite of responses to questions asking about the severity of fever, sore throat, dry cough, productive cough, stuffed-up nose, sneezing, hoarseness, and sinus pain. Raw scores were adjusted to allow for the influence of concurrent allergies and musculoskeletal illnesses. The details of the development of this URI composite, including the justification for the adjustments, are given in Vickers and Hervig (1988).

Cumulative URI scores were computed for each participant from his

responses during the second through fourth administrations of the questionnaire. After the first month of training, training schedule requirements meant that many recruits missed one or more sessions. The recruits most likely to be absent during the later testing sessions were those with above average scores on intelligence tests and/or positions of leadership within the training companies. This selective loss was a potential source of bias in study results which could be circumvented by restricting analysis to the first four weeks. Across the four samples the average correlation between scores from the first four weeks and the total over the full eight week period was .90 for those individuals who completed all seven data collection sessions. The minor loss in precision of estimating overall illness experience implied by this correlation was considered acceptable because the loss was accompanied by a substantial increase in representativeness of the sample of participants used in the analyses.

A measure of General Symptom Reporting was constructed from responses to items concerning skin irritation, vomiting, diarrhea, and trouble hearing. This composite consisted of relatively infrequent symptoms and was intended to be similar to that employed by Vickers, et al. (1986). With the possible exception of vomiting and diarrhea, the specific symptoms did not appear to represent any common illness syndrome occurring in basic training. Vomiting and diarrhea might be expected to co-occur in some illnesses, such as infections of the gastrointestinal tract. However, these two symptoms are infrequent in conjunction with infections in both military and civilian populations (Forsyth, et al., 1963; Gwaltney, Hendley, Simon & Jordan, 1967). Furthermore, vomiting and diarrhea were empirically only weakly related in the recruit samples studied here. In fact, both were more strongly related to trouble hearing than to each other. Given the generally low frequency of occurrence and relative independence of the four symptoms, it seemed reasonable to assume that high scores would occur only among individuals who had a strong tendency to report symptoms.

Analysis Procedures

Analyses were performed with the Statistical Package for the Social Sciences (SPSSX, 1983). One-way analyses of variance (ANOVAs) were conducted for each predictor using the groupings shown in Appendix B. Tests for linear and higher order trends determined that linear associations

adequately described the relationships. These tests were necessary because URI risk might increase only beyond some threshold value for a predictor. The ethnicity and education analyses included planned comparisons to test the specific hypotheses stated in the introduction.

Because the initial analyses demonstrated that the linear trend adequately represented the relationships, Pearson product moment correlations were used to describe associations. Stepwise multiple regressions determined the combined predictive power of the demographic and health history measures. Tests for possible influential data points and outliers (Stevens, 1984) were included to ensure that the resulting equations were not influenced excessively by any extraordinary individual cases. Stepwise entry of predictors was chosen for the regression analyses, because the health history measures, particularly the chronic symptom measures, were correlated. The resulting collinearity would produce interpretive problems if all the predictors were included in a single equation. Stepwise regression avoided this problem and identified the most useful predictors to represent the overall set. To minimize any problems associated with capitalization on chance in the selection of predictors in a single sample, the order of entry for predictors was fixed prior to analysis as described in the presentation of the results.

Further analyses were conducted to determine whether prediction could be improved by applying group-specific regression weights for the health history measures. Multivariate analyses of variance (MANOVAs) were performed with demographic attributes as the group classification variables and selected health history measures entered as continuous covariates. The actual MANOVA design specification called for, first, the estimation of the regression lines for the entire sample, then, the estimation of mean group differences for the deviations from these regression lines, and, finally, estimation of the increment in variance explained by applying group-specific regression coefficients. The logic behind this approach is that of a standard analysis of covariance test for nonparallelism of regression lines (Tatsuoka, 1971). However, the selected health history predictors were entered into the analyses as a set, thereby obtaining significance tests for the set of covariates. Significance estimates for the combined set of predictors were determined for each sample and the combined significance across the four samples was estimated. If this combined probability

suggested a significant ($p < .05$) effect, within-group bivariate correlations between the predictors and the dependent variable were examined to determine whether any specific groups consistently produced exceptionally high or low correlations between specific predictors and the criterion. If there were no consistently exceptional correlations, it was concluded that the cumulative significance estimate represented a coincidental occurrence of chance effects, rather than a meaningful moderator effect.

In all of the analyses, there was a need to pool results across two or more samples, and estimates of the cumulative significance of individual tests for associations were needed. Whenever these estimates were required, the method of adding probabilities (Rosenthal, 1978) was employed. This approach to significance testing permitted moderate, but consistent, associations to be identified as significant and ensured a reasonably systematic basis for evaluating overall trends in the data. A pooled significance estimate of $p < .005$ was set to define a significant finding, except where otherwise noted. This criterion value balanced the potential for capitalizing on chance in a large number of computations with the need for reasonably sensitive tests of cumulative trends in the data.

RESULTS

Demographic Predictors. No demographic variable reliably predicted URI, but the trend for ethnicity was consistent with the prediction that Hispanics would have a low URI rate. The four groups produced a consistent rank ordering of mean differences (Kendall's coefficient of concordance = .825). Hispanics had the lowest URI rate, followed by Others, Blacks, and Whites (Table 2). The overall F-test comparing the ethnic groups achieved statistical significance only in Sample B ($p < .023$), but the cumulative trend for the four samples just missed the standard set for accepting a result as statistically significant ($p < .006$). Given trends that appeared to be consistent with prior findings in other samples, this near miss was adequate justification for further analysis of group differences.

The additional analyses contrasted the other three ethnic groups with Whites, because Whites were the largest group and other evidence suggested this group would differ at least from Blacks and Hispanics. Significant cumulative differences were found in the comparisons between Whites and Hispanics ($p < .002$) and between Whites and Blacks ($p < .005$); the

comparison between Whites and Others was marginally significant ($p < .06$). Exploratory contrasts between the three non-White groups were uniformly nonsignificant ($p > .21$). Because the non-White groups were small, the absence of statistically significant differences probably is less important than the fact that the difference between the average URI score for the White group and the average for the highest of the three non-White groups typically approximated the difference between the highest and lowest values for the non-White groups. These observations were the basis for creating a dichotomous variable contrasting Whites and non-Whites. This dichotomous ethnicity variable consistently explained more than 1% of the variance in the criterion (Sample A, $r = .11$; Sample B, $r = .10$; Sample C, $r = .13$; Sample D, $r = .11$). This dichotomous variable, therefore, was retained for further consideration.

Table 2

Ethnic Group Differences in URI

					Significance of Comparisons:			
Criterion	Hispanic	Black	Other	White	Over	W-H	W-B	W-O
Study 1								
Sample A	1.71	1.73	1.76	1.83	.30	.19	.13	.46
Sample B	1.52	1.73	1.71	1.88	.03	.02	.07	.15
Study 2								
Sample C	1.57	1.69	1.67	1.78	.16	.05	.27	.34
Sample D	1.62	1.65	1.55	1.76	.13	.16	.11	.13

NOTE: Indicated comparisons are: "Over" - Overall ANOVA, "W-H" - Whites versus Hispanics, "W-B" - Whites versus Blacks, and "W-O" - Whites versus Others.

Health History Predictors. Except for Past Cold Sores, each health history predictor was significantly ($p < .001$) related to URI each time it was administered. Past Cold Sores produced one correlation that exceeded the commonly accepted 5% significance level (Sample C, $p < .045$), but the

cumulative significance of the weak trends ($p < .017$) was well below the acceptance criterion set for this study.

Table 3

Correlations between Health History Measures and Symptom Composites

	Sample: A		B		C		D	
Composite[a]:	U	G	U	G	U	G	U	G
Typical Cold	.25	.22	.33	.35	.28	.26	.38	.20
URI Probability	.20	.19	.16	.19	.17	.18	.23	.11
Cold Sores	.03	.07	.02	.18	.10	.13	.06	.10
Respir. Disease	.15	.18	.14	.15	--	--	--	--
Chronic Cough	.12	.18	.19	.26	--	--	--	--
Chronic Phlegm	.15	.13	.16	.22	--	--	--	--
Chronic Wheeze	.17	.23	.11	.18	--	--	--	--
URI Impact	.17	.22	.20	.23	--	--	--	--
Infect. Disease	--	--	--	--	.21	.20	.22	.16
Other Disease	--	--	--	--	.20	.30	.17	.19
Allergy	--	--	--	--	-.01	.15	.13	.13

[a] U = URI composite; G = General Symptom composite

NOTE: Sample sizes vary from 422 to 461 for Sample A, from 352 to 376 for Sample B, from 315 to 331 for Sample C, and from 353 to 383 for Sample D. For a sample size of 315, the smallest one represented in the table, the critical value for the 5% significance level (one-tailed) is $r = .10$.

Correlations between health history measures and General Symptom Reporting were included in Table 3 as a basis for evaluating the potential bias of URI-health history correlations by general symptom reporting tendencies. Infectious Disease History produced larger correlations to URI than to General Symptom Reporting in both samples of Study 2. Typical Cold produced a larger correlation to URI than to General Symptom Reporting in 3 of 4 samples with similar trends observed for Probability of a Cold in 2 of 4 samples and Chronic Phlegm in 1 of 2 samples. All other predictors consistently were more strongly related to General Symptom Reporting than to URI.

Combined Predictive Equations. The combined predictive power of the health history and demographic variables was determined by multiple regression analyses. A fixed order of entry was employed with Typical Cold entered first in all samples. Respiratory Disease History then was entered for Samples A and B, and Infectious Disease History was entered for Samples C and D. For Samples A and B, subsequent entries were Chronic Phlegm, URI Impact, Chronic Cough, and Chronic Wheeze. For Samples C and D, Other Diseases was the only remaining candidate predictor. Finally, ethnicity (Non-White = 0; White = 1), was added.

The entry order for the health history measures was based on the typical ratio of the URI-General Symptom correlations for each predictor. Predictors with larger ratios were entered first, because they were assumed to be less likely to produce an equation based solely on general symptom reporting tendencies. For the purposes of these analyses, the Respiratory Disease History and Infectious Disease History measures were equated based on similarity of content. Past Cold Sores was not considered in these analyses because of its weak bivariate associations.

A second series of regression analyses was conducted with General Symptom Reporting added to the predictors. This addition evaluated the relationships between predictors and criteria controlling for the influence of general symptom reporting. In these analyses, General Symptom reporting was entered as the initial predictor, and the remaining predictors entered in the order given above.

The predictors retained for the regression equations included all those which increased the variance explained by an average of 1% or more when entered into the initial regression equation (Table 4). This criterion

Table 4

Multiple Regression Equations to Predict URI

Predictor	b	S.E.	r^2	t	Sig.	b	S.E.	r^2	t	Sig.
General Symptom Reporting										
Sample A	.--	.--	.--	.--	.--	.584	.069	.189	8.45	.000
Sample B	.--	.--	.--	.--	.--	.533	.069	.213	7.68	.000
Sample C	.--	.--	.--	.--	.--	.702	.082	.239	8.59	.000
Sample D	.--	.--	.--	.--	.--	.710	.083	.217	8.54	.000
Typical Cold										
Sample A	.175	.036	.065	4.91	.000	.114	.034	.024	3.39	.0005
Sample B	.264	.043	.110	6.14	.000	.158	.042	.033	3.73	.001
Sample C	.169	.041	.075	4.08	.001	.092	.038	.021	2.40	.009
Sample D	.250	.037	.147	6.69	.000	.201	.034	.087	5.82	.000
Resp/Infect. History										
Sample A	.039	.017	.012	2.22	.014	.018	.016	.002	1.08	.141
Sample B	.025	.020	.004	1.28	.101	.015	.018	.001	.83	.203
Sample C	.020	.012	.010	1.62	.054	.011	.011	.004	.97	.167
Sample D	.034	.011	.023	3.04	.002	.023	.010	.010	2.24	.013
Ethnicity										
Sample A	.089	.052	.007	1.73	.043	.059	.048	.003	1.24	.106
Sample B	.176	.065	.018	2.69	.004	.135	.061	.011	2.22	.014
Sample C	.096	.063	.007	1.53	.064	.109	.057	.009	1.93	.027
Sample D	.084	.055	.006	1.53	.064	.079	.050	.005	1.58	.058
Total R^2										
Sample A			.083					.219		
Sample B			.125					.284		
Sample C			.093					.274		
Sample D			.175					.319		

NOTE: One-tailed significance tests were used.

implied an average effect size in the "small" range, as defined by Cohen (1969). In the initial analysis, Typical Cold and Respiratory/Infectious Disease History met the criterion and Ethnicity barely failed the criterion (0.95%). Ethnicity was retained for the second series of regressions to ensure complete coverage of any reliable, unique predictors of the criterion. Each of these predictors produced a pooled significance estimate of $p < .0001$ or greater, well beyond the a priori criterion established to

define significant effects. The average proportion of criterion variance explained was 9.8% for Typical Cold, 1.2% for Respiratory/Disease History, and 0.9% for Ethnicity. The predictive equations were very similar across samples, as the 95% confidence intervals overlapped for each pairing of comparable regression coefficients.

Controlling for General Symptom Reporting, the health history and ethnicity predictors still produced a statistically significant improvement in prediction of URI ($p < .003$ for each by the method of adding probabilities), but only Typical Cold (4.1%) reliably accounted for more than 1% of the criterion variance. After taking General Symptom Reporting into account, the combined increment in variance explained by health history and ethnicity averaged only 5.2%. This figure was heavily influenced by the large increment in variance explained in Sample D (10.2%), so the median value of 4.0% of the criterion variance probably is more representative.

Tests for Subgroup Specific Regression Lines

As described under Analysis Procedures, MANOVA tests for subgroup-specific regression lines were performed. Demographic variables defined group membership, and the two significant health history predictors from the regression analyses described above were employed as covariates. These two health history predictors were selected to represent the overall set of health history measures on the basis of two facts. First, factor analysis indicated that the health history measures defined two empirically distinct factors with Typical Cold loading on one factor and Respiratory/ Infectious Disease loading on the other. Second, the preceding analyses indicated that, on the average, these two health history predictors adequately represented the predictive power of the full set of predictors. Adding other health history predictors, therefore, was likely to increase the problems of collinearity and capitalize on chance by performing multiple significance tests. These problems would not be accompanied by any substantial likelihood of improving overall prediction, so it was judged best to avoid them.

Only age produced a cumulative significance test suggesting group differences in regression lines ($p < .03$). This trend was weak as this significance level would be expected to occur by chance about 16.8% of the time when six significance tests are performed. None of the individual samples produced a statistically significant effect (Sample A, $p < .08$;

Sample B, $p < .48$; Sample C, $p < .19$; Sample D, $p < .16$). Finally, no age group consistently produced an exceptionally high or low bivariate correlation between either health history measure and URI. The cumulative significance, therefore, was judged to be the result of coincidental occurrence of several different, weak trends in individual samples.

DISCUSSION

The findings replicated previous observations relating a low past frequency of colds and being Hispanic with lower than average URI rates in basic training, but did not replicate the previously reported association between below average education and increased URI in basic training. Neither replicated association was incorporated into the final predictive equation, because Typical Cold was correlated with URI Probability and was a stronger predictor of URI and the Hispanic dichotomy was replaced by a White-Nonwhite dichotomy. Above average respiratory illness rates for whites have been noted in studies of hospitalization (Palinkas, 1987) and outpatient treatment (Vickers, 1986) in military populations, so the proposed ethnicity dichotomy should have predictive utility for other criterion measures as well.

These studies also identified an additional prediction of URI in basic training, while helping to rule out chronic symptoms as the basis for the observed relationships. Respiratory/Infectious Disease History was the newly identified predictor which improved overall prediction of URI. Given that even Infectious Disease History included items related to respiratory illness, it remains to be determined whether these two scales indicate general susceptibility to infection or specific susceptibility to respiratory infections. The fact that the scales representing chronic respiratory symptoms did not figure in the final regression equation was encouraging as this finding makes it more reasonable to interpret the URI criterion measure as an indicator of acute infectious disease episodes.

The general consistency of findings across samples within the present study and across studies where meaningful comparisons were possible was encouraging. These trends strongly suggest that a risk profile is feasible, but the strength of the associations in question was modest, at best, and

may have been inflated by general symptom repor ing differences. This latter observation makes it important to determine whether these adjustments remove nuisance variance in the criterion or remove true score variance. The former possibility would apply if General Symptom Reporting scores represent hypochondriasis, somatic responses to acute stress, or simple response biases in filling out questionnaires. The latter possibility would apply if General Symptom Reporting indicates the occurrence of real, infrequent symptoms of viral infection that occur primarily when a severe infection produces general systemic symptoms or if this measure indicates an influence of URI on general sensitivity to symptoms. Depending on how much each interpretation applies, the variance in actual disease explained by health history and demographics could range from as little as 3% to as much as 11%. There is evidence that URI symptom reports can be highly correlated to clinical ratings of URI (Roden, 1958; Totman, et al., 1977) and to physiological status (Lytle, et al., 1966; Lytel et al., 1967; Naclerio, et al., 1988), but these findings come from studies in laboratory settings which presumably are not as stressful as basic training and may tend, therefore, to minimize the expression of hypochondriasis, somatization, and related factors that could be important in basic training. However, the present findings make it clear that even if the upper limit of the observed range of prediction applies, the combination of health history and demographic variables yields modest predictive accuracy.

Further research is needed to address unresolved questions which might modify the foregoing conclusion by providing a broader basis for evaluating the relationship between health history and demographics and infectious disease. First, were the weak associations noted in this study attributable to the criterion? Assessing a wider range of infectious diseases over a longer time period would provide a better indicator of overall infectious disease experience which might be more strongly related to health history than the present assessment of a single type of illness over a short time period. Second, did the choice of research site affect the magnitude of associations? Recruits are exposed to a wide range of pathogens, which undoubtedly differ in pathogenicity. Differences between pathogens can obscure relationships between susceptibility and illness (e.g., Broadbent, Broadbent, Phillpotts & Wallace, 1984), so studies introducing controls for this possible problem would be useful. One possibility would be to conduct

studies in settings where illness could represent epidemic spread of a single virus, particularly if infection could be serologically confirmed. Finally, what other categories of predictors can be added to health history and demographics to predict illness? Health habits, family history of disease, and genetically-determined aspects of immune function, and personality are possibilities which merit consideration. The consistency of associations across samples in these studies and the general comparability of the findings to the results of related research suggest that a risk profile for susceptibility to infections is feasible. The preceding questions must be addressed to determine whether it is possible to produce a profile with sufficient predictive precision to have practical applications.

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Appendix A

ITEM CONTENT OF HEALTH HISTORY SCALES

Respiratory Disease: Eight items with a yes-no response format, including: (a) attacks of bronchitis, (b) pneumonia (including bronchopneumonia), (c) hay fever, (d) sinus trouble, (e) pulmonary tuberculosis, (f) emphysema, (g) asthma, or (h) other chest illnesses.

URI Impact: Four items with a true-false response format, including: (a) During the past 3 years, have you had any chest illnesses that have kept you off work or out of school, indoors at home, or in bed?, (b) When you catch a cold, do you always have to go to bed?, (c) When you get a cold, does it usually go to your chest?, (usually means more than 1/2 the time), and (d) Do frequent colds keep you miserable all winter?

URI Probability: Three items with different response formats, including: (a) How many colds do you usually get each year?, (scored "1" for no colds to "5" for four or more per year), (b) Relative to other people your age, when colds are going around how likely are you to get a cold?, (scored "1" for "Not likely" to "5" for "Extremely likely"), and (c) Relative to other people your age, how severe are your colds?, (scored "1" for "Not at all severe" to "5" for "Extremely severe").

Typical Cold: Eleven items regarding the severity of specific common cold symptoms during a typical cold for the respondent. Responses were made on a scale from "1" for "Not at all severe" to "5" for "Extremely severe." The specific symptoms were: (a) stuffed-up nose, (b) runny nose, (c) sore throat, (d) general physical discomfort or weakness, (e) headache, (f) cough and/or sputum, (g) feverishness, (i) chilliness, (j) sneezing, (k) wheezing, and (l) stuffy head.

Past Cold Sores: Two items with different response formats, including: (a) How many cold sores do you usually get each year?, (scored "1" for no colds to "5" for four or more per year), and (b) When you have cold sores, how severe are they usually?, (scored "1" for "Not at all severe" to "5" for "Extremely severe").

Chronic Cough: Four items with a "yes-no" response format, including: (a) Do you usually have a cough?, (count a cough with first smoke or on first going out-of-doors and exclude clearing of throat), (b) Do you usually cough as much as 4 to 6 times a day, 4 or more days out of the week?, (c) Do you usually cough at all on getting up, or first thing in the morning?, and (d) Do you usually cough at all during the rest of the day or at night?

Chronic Phlegm: Four items with a "yes no" response format, including: (a) Do you usually bring up phlegm from you chest?, (count phlegm with the first smoke or on first going out-of-doors and exclude phlegm from the nose), (b) Do you usually bring up phlegm like this as much as twice a day, 4 or more days out of the week?, (c) Do you usually bring up

phlegm at all during the rest of the day or at night?, and (d) If you usually have cough and/or phlegm, have you had periods or episodes of increased cough and phlegm lasting for 3 weeks or more each year?

Chronic Wheezing: Five items with a "yes-no" response format, including: (a) Does your chest ever sound wheezy or whistling when you have a cold?, (b) Does your chest ever sound wheezy or whistling occasionally apart from colds?, (c) Does your chest ever sound wheezy or whistling most days or nights?, (d) Have you ever had an attack of wheezing that has made you feel short of breath?, and (e) Are you troubled by shortness of breath when hurrying on the level or walking up a slight hill?

Infectious Disease History: Twenty-six items with a "true-false" response format. The items were: (a) scarlet fever, (b) diphtheria, (c) shingles, (d) chicken pox, (e) mumps, (f) small pox, (g) German or 3-day measles, (h) pneumonia, (i) polio, (j) meningitis, (k) red measles, (l) appendicitis, (m) tonsillitis, (n) serious or recurrent ear infections, (o) serious or recurrent eye infections, (p) serious or recurrent urinary tract infections (non-venereal), (q) abscessed teeth or gums, (r) recurrent sore throat, (s) recurrent boils, (t) encephalitis, (u) hepatitis (jaundice), (v) dysentery, (w) infectious mononucleosis, (x) warts, (y) whooping cough, and (z) bronchitis.

Other Diseases: Thirteen items with a "true-false" format, including: (a) arthritis, (b) rheumatism, (c) hives, (d) hayfever, (e) psoriasis, (f) neurodermatitis, (g) contact dermatitis, (h) acne, (i) migraine headaches, (j) asthma, (k) cancer, (l) sinus trouble, and (m) chronic cough.

Allergies: Seven items with a "true-false" format asking whether respondents had ever had an allergic reaction to: (a) any drugs, e.g., penicillin, sulfa, (b) any vaccinations, (c) any foods, (d) insect stings or bites, (e) any animals or animal products (e.g., wool), (f) any plants or plant products, and (g) any other allergy.

Appendix B

SPLIT POINTS FOR ONE-WAY ANALYSES OF VARIANCE

The score distributions were divided at the points indicated below to define the groups for one-way analyses of variance to test for linearity of associations as described in the Methods. Insofar as possible, the split points were chosen to approximate deciles of the overall frequency distribution. Where the observed frequency distribution made this impossible, the split points were chosen to ensure that even the smallest group included approximately 10% of the total sample. This constraint was introduced to ensure that each group had a sufficient number of participants to provide a stable estimate of the group average for the URI measure.

Age: 17, 18, 19, 20, 21-23, 24-35

Family Size: 0, 1, 2, 3, 4, 5-12

Respiratory Disease: 0, 1, 2, 3, 4-8

Chronic Cough: 0, 1, 2, 3, 4

Chronic Phlegm: 0, 1, 2, 3, 4

Chronic Wheeze: 0, 1, 2, 3-5

URI Impact: 0, 1, 2, 3-4

Past Cold Sores: 1.00, 1.50, 2.00, 2.50, 3.00, 3.50-5.00

URI Probability: 1.00-1.35, 1.60-1.70, 1.95-2.05, 2.30-2.40, 2.60-2.70, 2.95-3.05, 3.30-3.40, 3.60-3.70, 3.95-5.00

Typical Cold:

Study 1: 1.00-1.65, 1.66-1.93, 1.99-2.28, 2.29-2.41, [illegible]-2.56, 2.57-2.74, 2.75-2.92, 2.93-3.25, 3.26-5.00

Study 2: 1.00-1.65, 1.66-1.92, 1.93-2.19, 2.20-2.37, 2.38-2.56, 2.57-2.74, 2.75-2.92, 2.93-3.19, 3.20-3.46, 3.47-5.00

Allergy: 0, 1, 2, 3, 4, 5-7

Infectious Disease History: 0-1, 2, 3, 4, 5-8, 9-12

Other History: 0, 1, 2, 3, 4, 5-8

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(U) PSYCHOSOCIAL RISK FACTORS FOR UPPER RESPIRATORY INFECTION: Demographic and Health History Predictors of URI during Basic Training

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Health history and demographic attributes have been suggested as predictors of susceptibility to upper respiratory infections in basic training. This study attempted to replicate evidence that being white, less educated, and having past history of frequent colds and cold sores were related to higher upper respiratory illness (URI) rates in basic training. Additional demographic and health history predictors were considered in an attempt to extend these initial findings. Four samples of Navy recruits completed demographic and health history questionnaires at the beginning of basic training and health symptom checklists measuring illness at approximately weekly intervals during basic training. Higher URI rates were associated with a history of severe colds, a history of respiratory and infectious diseases, and White ethnicity. The strength of these associations appears to be influenced by general symptom reporting tendencies, but a history of severe colds is a useful predictor even controlling for this tendency, and ethnicity probably is of value given other evidence that Whites in the military generally

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19. > are more likely than other ethnic groups to seek outpatient treatment for URI and to be hospitalized for URI. (SDW)