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PREDICTORS OF COLD WEATHER HEALTH BEHAVIORS:
A REPLICATION AND EXTENSION

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Predictors of Cold Weather Health Behaviors: A Replication and Extension[†]

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SUMMARY

Background

In previous cold weather combat, preventable cold injuries have occurred. Failure to follow medical guidelines may contribute to these injuries. If so, developing methods to improve these behaviors would enhance operational effectiveness. This study extended prior research designed to identify health beliefs and attitudes which might be manipulated to modify cold weather health behaviors.

Approach

This study was undertaken to confirm earlier findings that health beliefs predict cold weather health behaviors. In an attempt to improve the precision of prediction of the cold weather behaviors, the original behavior and predictor measures were improved and new predictors were developed to evaluate the effects of additional predictors suggested by observations made during the initial study. Marines (n = 231) undergoing cold weather training in 1984 and 1985 completed questionnaires describing their daily food intake, water intake, foot care, physical symptoms, mood state, and the day's work load. Data from Marines completing these assessments on at least three days in 1984 and at least two days in 1985 were selected. Questionnaire measures of demographic characteristics, health and dietary habits, health beliefs, and factors that had affected field behaviors also were completed. In 1984, weight was measured before and after training and 40 men provided urine samples paired with the behavioral questionnaires; urine specific gravity was an indicator of dehydration.

Results

Median calorie intake was 2690 calories per day compared to a recommended 3200. Median water intake was 2.7 liters per day compared to a recommended 3.3 liters per day. Eleven per cent of the men failed to meet basic foot care guidelines. Food intake, water intake, and foot care had at most slight associations to physical or emotional symptoms. Physiological evidence suggested only minor food and water intake deficiencies. Foot care and food intake were higher among men who believed these behaviors would reduce the risk of illness. Multiple regression equations combining health beliefs and situation-specific attitudes explained an average of 14.3% of the variance in behavior. Issuing foot powder to the men in one 1984 company prior to training improved foot care 16% relative to the other 1984 company.

Conclusions

Combined with other cold weather research, the findings suggest that the typical marine's behavior in the cold approximates his actual needs. Minor deficiencies occur, but do not affect well-being. It is possible, however, that in more extreme environments substantial deficiencies might occur. Although the presence of reliable associations between health beliefs and attitudes means that it is possible to modify behaviors by addressing these psychological factors, the effects of such programs probably would be minor. Issuing foot care supplies or redesigning field rations appear simpler means to the same end.

INTRODUCTION

Cold-related health problems occur in cold weather military operations despite the guidelines which should prevent such illness (Hanson & Goldman, 1969; Hawryluk, 1977; Vaughn, 1980). Therefore, it is probable that at least some men do not follow the guidelines. This inference is supported by the fact that risk of cold injury is associated with characteristics that predict failure to follow medical regimens in other settings (Haynes, Taylor & Sackett, 1979; Sumner, Criblez & Doolittle, 1974). This research was undertaken to test the utility of the Health Belief Model (Becker, 1974; Rosenstock, 1966) for identifying psychological factors which are related to cold weather health behaviors.

An initial study partially supported the Health Belief Model (Vickers & Hervig, 1984). The belief that performing health behaviors reduced the risk of illness was related to better food intake and foot care as predicted. Also, better foot care was related to greater perceived severity of illness as predicted. However, lower food intake was related to higher perceived susceptibility to illness and to higher perceived severity of illness if it occurred; these two findings were contrary to Health Belief Model predictions.

Additional findings involving attributes which were not part of the basic Health Belief Model produced several interesting relationships. Cold weather health behaviors had little relationship to the demographic attributes that characterize individuals with cold injuries, but lower food intake was reported by older men in the sample. Health habits were useful predictors in two instances. Good preventive health habits in everyday life were related to better foot care and risk taking tendencies were related to lower water intake. Situational factors such as climate, work load, morale, and leadership were not related to health behaviors. Finally, negative mood was related to lower food intake, thereby supporting earlier field observations (Hedblom, 1965; McCarroll, Denniston, Pierce & Farese, 1977).

The studies described below were undertaken to replicate and extend these earlier findings with three important modifications. First, three-day retrospective reports of health behavior in the field were replaced by repeated administration of daily diaries to increase the sensitivity and reliability of the measures. Second, the health habit and health belief measures used in the earlier study were modified in an attempt to improve weak, but significant, predictors of cold weather health behaviors. Third, new measures of situation-specific beliefs about health behaviors

were added because interviews with marines suggested these were important determinants of cold weather behavior. Finally, dietary habit measures were added to test the possibility that poor nutrition in the field was an extension of generally bad eating habits.

METHOD

Sample

Data collected in FY84 and FY85 were combined for the analyses described in this report. Analyses were limited to individuals who completed 24-hour behavior diaries (see below) at least 3 days in FY84 and at least 2 days in FY85. The three-day criterion for FY84 was based on evidence that three days' data provides stable estimates of long-term behavioral trends for diet and simple behaviors such as foot care. The criterion was relaxed for FY85 because data collection difficulties limited the opportunities to administer the diaries. A trade-off therefore was necessary between sample size and criterion reliability.

The FY84 sample included 130 men and the FY85 sample 101 men. Median age was 21 years. Median education was 12 years. Self-reported racial composition was 66% White, 20% Black, 7% Hispanic, 5% American Indian, and 2% other. Median length of service was 24 months. Modal rank was E-3 (48%) with 21% below E-3 and 31% above E-3. The men who met the inclusion criteria were representative of their units with regard to each of these attributes.

Daily Diary Measurements

Food Intake. The diary listed each component of the Meal, Ready-to-Eat (hereafter, MRE), the standard field rations used during the training. Participants checked off the specific MRE components consumed for each meal during the last 24 hours and wrote in any non-MRE food consumed during that period, including hot meals provided in the field. The MRE reports were translated into estimated nutritional intake using values given in Hirsch, Meiselman, Popper, et al. (1984, pp. 162-176). Nutritional estimates for non-MRE food were determined from standard serving sizes provided by a Marine Corps dietitian and data from standard sources (Adams, 1975; Pennington & Church, 1985) or manufacturers of foods such as candy bars.

Water Intake. Water intake was assessed by participants' reports of the number of canteens of water consumed in the last 24 hours. Participants estimated intake to the nearest quarter of a canteen. The instructions indicated that water consumed as part of coffee, cocoa or other drinks be included in the estimate.

Foot Care Assessment. Participants reported the frequency of changing socks, washing one's feet, drying one's feet, and using foot powder during the last 24 hours. These specific behaviors are recommended for good foot care in the cold (Commanding General, Marine Corps Development and Education Command, 1979; Headquarters, Department of the Army, 1968).

Symptom Reports. Physical well-being was measured by item composites formed from self-reports of 58 symptoms reflecting a wide range of possible health problems (Appendix A). The instrument was modelled after the Environmental Symptom Questionnaire (Kobrick & Sampson, 1979; Sampson & Kobrick, 1980) with modifications to include symptoms specific to common cold weather health problems (Commanding General, Marine Corps Development and Education Command, 1968; Headquarters, Department of the Army, 1968; Hess, 1978).

Mood State and Perceived Workload. Mood and the perceived physical effort were reported as part of the diary questionnaires. Mood state was assessed by the 40-item questionnaire of Ryman, Biersner, and LaRocco (1974). This questionnaire provides measures of activity, anger, depression, fatigue, fear, and happiness. Perceived workload was measured with Borg's (1978) perceived effort scale.

Physiological Measurements

Physiological measurements were obtained for the FY84 sample. Weight was measured on a balance scale with the men attired in t-shirts, trousers and socks. One weighing was prior to cold weather training and a second after cold weather training. The post-training weight was obtained 3 days after the end of the training period, so the men had had time to rehydrate.

Volunteers from two platoons provided urine samples on the mornings following the daily diary administrations. Morning samples were taken to avoid acute dehydration which heavy work might have produced at the end of the work day. Urine specific gravity was determined by refractometer. Data analysis was limited to individuals who provided at least three urine samples during the course of the study (n = 40) to have a reasonable assessment of average long-term trends.

Predictors of Cold Weather Health Behaviors

Demographic Variables. Demographic variables included age, length of service, rank, years of education, self-ratings of family social class on Centers' (1949) scale ranging from "Lower class" (scored 1) to "Upper class" (scored 4), and ratings for general health with responses ranging from "Much below average" (scored 1) to "Much above average" (scored 5). Race was recoded from the categories described

under "Sample" to a White-Nonwhite dichotomy (scored 0 and 1, respectively). Measures of cold weather experience included reports of prior cold weather training (scored none = 0 and any other response = 1) and prior cold weather injury(ies) (scored none = 0 and any other response = 1).

Health Belief Model Variables. The Health Belief Model (Becker, 1974; Rosenstock, 1966) predicts that people will undertake health-supportive actions when they perceive themselves to be susceptible to illness which would have severe effects if it occurred, but which can be avoided by taking preventive action. A questionnaire to measure the three primary Health Belief Model concepts was administered to FY85 participants and approximately half the FY84 participants. Scheduling difficulties prevented administration of the questionnaire to the remainder of the FY84 sample.

Perceived susceptibility to illness (Susceptibility) was measured by ratings of the probability of developing each of 11 health problems during cold weather training. The specific problems included represented possible effects of cold exposure or common health problems for troops during cold weather training (Vickers & Hervig, 1984). The rating scale ranged from 0 (Never happen) to 100 (Absolutely Certain).

Perceived severity of illness (Severity) was measured by the estimated severity of each of the 11 problems with severity defined as expected impact of the indicated illness on performance in the cold. Ratings were made on a scale from "Not at all serious" (scored 1) to "Extremely serious" (scored 9).

The perceived efficacy of health behaviors for reducing illness (Efficacy) was measured by rating the effects of specific health behaviors on the risk of becoming ill in the cold. Participants provided efficacy assessments for several specific levels of each health behavior (Appendix B). The efficacy rating alternatives ranged from "Decrease a great deal" (scored 1) to "Increase a great deal" (scored 7). Initial analyses employed individual items as predictors of behavior because there was no a priori basis for determining which behavioral levels would produce useful efficacy ratings. These analyses indicated that items representing low frequencies of behavior were the most useful as predictors of behavior. Virtually all of the ratings for these items fell in the response range indicating that the behavior in question would increase the risk of illness. Therefore, individual differences on the efficacy rating scales represent differences in the perceived severity of behaviors that are, by consensus, maladaptive.

Health Habits. General health habits were measured in the FY84 sample, but not the FY85 sample. Exploratory analyses indicated that the initial findings showing these behaviors to be significant predictors of cold weather health behaviors did not replicate.

Dietary Habits. A dietary habits questionnaire asked participants to indicate how many days per week they ate breakfast, lunch, dinner, and snacks. Response alternatives ranged from "Less than once a day" (scored 1) to "More than 3 times per day" (scored 5). These questions were used to assess dietary habits because they have been shown to be related to morbidity and mortality (Breslow & Enstrom, 1980). Analyses employed the individual items separately and combined as a measure of total meal frequency.

Reported Reasons for Behavior. Based on interviews with marines during the preceding research, items were constructed to measure reasons why food intake was high or low, why water intake was high or low, and why foot care was high or low. The specific items are given in Appendix C. Response alternatives ranged from "Disagree strongly" (scored 1) to "Agree strongly" (scored 5).

Analysis Procedures

Analyses were conducted with the Statistical Package for the Social Sciences (SPSS^X, Inc., 1983). A series of analyses of covariance were performed with water consumption, food intake, or foot care as dependent variables. Each analysis paired a dependent variable with a potential predictor as a covariate and the FY84-FY85 samples as the group classification variable. A predictor-dependent variable association was accepted as significant if the analysis indicated a significant covariate effect and parallel within-group regression lines. The pooled FY84-FY85 correlation coefficients for those predictors which met this criterion have been reported.

Stepwise multiple regression determined the combined predictive power of the replicated predictors. These regression analyses were performed with pairwise and listwise deletion for missing data. Missing data did not substantially affect the findings. The results from the regressions with pairwise deletion have been reported.

RESULTS

Patterns of Cold Weather Health Behavior

The average calorie intake was selected as the sole indicator of nutrition because exploratory analyses indicated that individual differences in specific nutrients were highly correlated with one another and with total calorie intake. Also, food intake guidelines typically are phrased in terms of calorie intake. Average calorie intake was 2890.3 kcal/day (S.D. = 1272.3; Median = 2690.2). Average reported water intake was 2.80 liters/day (S.D. = 1.04; Median = 2.67). Average foot care was 3.75 activities per day (S.D. = 1.85; Median = 3.50). Details on the intake of specific nutrients are available from the authors.

Well-being and Physiological Correlates of Health Behaviors

Adjustments for body size were made prior to estimating the relationships between food intake and water intake and indicators of well-being and physiological status. This adjustment was made because changes in well-being and physiological status should arise only when behavior fails to meet needs and needs are affected by body size. Estimated food requirements were computed on the basis of Kleiber's (Lloyd, Crampton & McDonald, 1978, pp. 403-429) formula based on body size and age. The adjusted intake correlated $r = .19$ ($p < .01$) with activity and $r = .20$ ($p < .01$) with happiness, but was not related to physical symptoms.

The difference between reported water intake and estimated requirements (see Lloyd et al., 1978, pp. 29-31, for formula used to estimate water requirements) correlated with depressed mood ($r = .13$, $p = .05$) and fatigue ($r = .14$, $p < .05$) and symptoms of respiratory tract problems ($r = .15$, $p < .03$), upper respiratory infection ($r = .20$, $p < .01$), cardiorespiratory symptoms of exertion ($r = .22$, $p < .01$), and central nervous system symptoms ($r = .14$, $p < .04$).

FY84 physiological measurements were better correlates of health behaviors than were symptoms. Weight loss averaged 3.09 pounds in this sample. The correlation between weight loss and the difference between reported intake and estimated requirements was $r = .36$ ($p < .001$, one-tailed).

Urine specific gravity provided an index of dehydration. The average specific gravity was 1.026 (S.D. = .003, n = 40). The difference between reported water intake and estimated requirements correlated $r = -.28$ ($p < .08$, n = 35) with average specific gravity.

Foot care was not related to symptoms of foot problems, but was related to symptoms of upper respiratory infection ($r = -.13$, $p < .04$).

Test of the Health Belief Model

The fundamental Health Belief Model received weak support. This model predicts that people will engage in health behaviors when they perceive themselves to be susceptible to health problems which will have severe effects if they occur, but which can be avoided by taking appropriate preventive actions. The analyses indicated that:

(a) Perceived susceptibility to illness was not related to field behaviors.

(b) Perceived severity of illness had no reliable relationship to behavior. Although severity was related to higher water intake in the present study ($r = .18$, $p < .02$, one-tailed), this finding was not a replication of FY83 results (Vickers & Hervig, 1984).

(c) Perceived efficacy of behavior for preventing illness consistently predicted foot care and food intake. In the present study, the correlations were $r = .23$, ($p < .01$, one-tailed) for foot care and $r = .17$, ($p < .03$, one-tailed) for food intake. These associations replicated findings from FY83 research.

(d) There were no reliable interactions between the Health Belief Model components.

Reported Reasons for Health Behaviors

Situation-specific beliefs and attitudes had some influence on cold weather health behaviors. Results were:

(a) Water Intake: Lower water intake was reliably related to the individuals belief that his personal needs were less than specified by the guidelines ($r = -.20$, $p < .01$) and that he drank enough to avoid thirst ($r = .15$, $p < .04$).

(b) Food Intake: Lower calorie intake was associated with reported attempts to lose weight in the field ($r = -.2$), $p < .01$), to avoid foods which increase thirst ($r = -.16$ $p < .03$) and a belief that lower intake could be made up at base camp ($r = -.20$, $p < .01$). Marginally higher intake accompanied reports of eating enough to ensure adequate energy ($r = .13$, $p < .06$) and being uncertain about how much food was needed for well-being in the cold ($r = .13$, $p < .06$).

(c) Foot Care: Poorer foot care was associated with reports that proper foot care was too much trouble ($r = -.30$, $p < .01$), that foot care guidelines were too protective ($r = -.13$, $p < .05$), that feet were a concern only when symptoms developed ($r = -.20$, $p < .01$), and that significant problems were unlikely during short stays in the field ($r = -.2$, $p < .01$). In addition, better foot care was associated with reported attempts to follow the foot care guidelines ($r = .23$, $p < .01$).

Regression Equations for Health Behaviors

The regression analyses to combine the attitudes and beliefs into overall predictive equations for the health behaviors used individual reasons for field behaviors as predictors despite the low reliability which can be expected of single item measures. This decision was made because the correlations between significant predictors of behavior showed substantial independence between items. As a result, item composites formed from these significant predictors had estimated internal consistency coefficients below .40 for food and water intake. Results were:

Liquid Intake = (-.51*Race) + (-.18*"Personal Need Less than Guidelines") + (.14*"Drink Enough to Avoid Thirst") + 3.47

(R^2 = .14, $R^2_{adjusted}$ = .12)

Food Intake = (-146.8*"Try to Lose Weight") + (162.5*"Uncertain about Requirements") + (-146.7*"Avoid Thirst-inducing Foods") + 2887.5

(R^2=.10, $R^2_{adjusted}$ = .08)

Foot Care = (-.27*"Too Much Trouble") + (.32*"Followed Guidelines") + (.30*Efficacy) + 1.91

(R^2=.19, $R^2_{adjusted}$ = .17)

In these equations, "Race" was a dichotomous variable scored "White" = 0 and "Other" = 1. Phrases in parentheses refer to the reasons for field behavior described in the preceding pages. "Efficacy" was the Health Belief Model predictor.

Special attention should be paid to the adjusted R^2. This value indicates the expected shrinkage in the proportion of variance which the regression equations would explain if the present research were replicated in a representative sample of marines undergoing cold weather training. This statistic averaged 12.3% across the three behaviors. Even with allowance for measurement error, the multiple correlations obtained in these studies indicate imprecise predictions of actual behavior.

Additional Analyses

Foot care and food intake were composite variables including a number of specific behaviors. If the specific behaviors comprising these composites have different determinants, better understanding of the behavior might be achieved by developing predictive equations for each separate component and summing the predictions to estimate overall behavior. This hypothesis was not supported for either behavior.

The possibility of identifying specific symptoms which could be used by the men as indicators for increased food or water intake was considered. No reliable associations were found. Additional analyses tested the possibility that the presence of symptoms served as a cue to act on health beliefs. The sample was divided into low and high scorers on selected symptom composites by dividing the sample at the median for each composite. The selected symptom composites for each behavior were those which included symptoms associated with deficiencies in the target behavior. The hypothesis that stronger health belief-behavior correlations would be found in the high symptom group was supported with chance frequency.

The dietary history measures had been included to test the possibility that poor day-to-day habits left some men ill-prepared to meet the rigors of the training program. This hypothesis was tested by dividing the sample into groups with good and bad dietary habits. Calorie intake then was correlated with reported symptoms in these two groups. The hypothesized pattern of significant negative correlations in the group with poor dietary habits, but not the group with good dietary habits was not found. Meal regularity did correlate with cold weather calorie intake ($r = .20$, $p < .01$), but this predictor did not improve the regression equation reported above for calorie intake.

Measures of general health habits were administered to the FY84 sample because FY83 research had shown these habits to be weak predictors of all three health behaviors. These findings did not replicate in initial analyses of the FY84 data. These measures were dropped from the FY85 data to reduce the length of the questionnaires to meet time constraints for data collection.

Further analyses examined the effects of a serendipitous field experiment. One battalion issued foot powder to each marine prior to cold weather training; the other did not. The use of foot powder was significantly higher in the battalion that issued powder (Mean = 1.02 times/day versus 0.46 times/day, $t = 5.43$, $p < .001$). The battalions did not differ significantly with respect to any of the other three foot care activities ($p > .17$ for each), but the difference in use of foot powder produced a significant difference in overall foot care (Mean = 3.61 times/day versus 3.02 times/day, $t = 2.51$, $p < .02$).

DISCUSSION

The Health Behavior Model is a poor predictor of cold weather health behaviors. The only Health Belief Model (Becker, 1974; Rosenstock, 1966) prediction supported by the data was that perceived efficacy of health behaviors would be related to better health behavior. Although this support was limited to food intake and foot care, these findings did replicate earlier results (Vickers & Hervig, 1984). However, even these reliable associations predicted 5% or less of the variance in behavior.

This project has focused on the basic Health Belief Model proposed by Rosenstock (1966), but recent expansions of this basic model (Becker, 1974) probably would not alter the findings much. Demographic attributes, one component of the revised model, generally did not predict cold weather health behaviors. Also, the reasons given for behaviors in the field included reported barriers to behavior. Barriers were nonsignificant predictors of behavior.

One aspect of the expanded Health Belief Model did receive some support. The small, but significant, associations between water intake and symptoms were consistent with the hypothesis that symptoms are a cue to action. If low water intake had caused symptoms, the associations would have been negative. Instead, the associations were positive and may be evidence that symptoms spurred higher intake. However, this trend was limited to just this one behavior.

The situation-specific health beliefs and attitudes improved on the predictions obtained with the basic Health Belief Model. However, there was no general theme to provide a basis for modifying the Health Belief Model by adding new concepts that would predict all three behaviors. Thus, although specific beliefs and attitudes can predict health behaviors in the cold, a substantial number of specific attitudes would have to be considered to achieve moderately strong prediction.

One possible reason for the weak support for the Health Belief Model is that the most common cold weather health problems are minor musculoskeletal injuries and upper respiratory infections (McCarroll et al. 1977; Sampson, Stokes, Barr, Jobe & Hamlet, 1981). Such illnesses are mild relative to the types of illness that has frequently been the focus of health belief research (Wyler, Masuda & Holmes, 1968). The Health Belief model may apply best when the health risks involved are so substantial that health concerns become an overriding determinant of behavior. A related possibility is that the specific behaviors studied may have affected the findings. Most applications of the Health Belief Model focus on activities undertaken for the specific

purpose of reducing a clearly identified health risk. Nutrition and hygiene activities lack this specific, focused connection to a single health outcome. Finally, recent models of coping with risk suggest that perceiving susceptibility to adverse outcomes motivates a search for ways to cope with the risk. Applying this reasoning, severity and susceptibility would not predict specific health behaviors such as food intake, but would predict the search for alternative courses of action. The present studies did not include measures of such activity.

Situational factors such as workload and morale (as measured by mood) accounted for very little variance in the behaviors of interest, so the Health Belief Model did not fail because these factors overrode health beliefs. Also, situational factors had little effect on the relationship between beliefs and behavior. The positive association between cardiorespiratory symptoms of exertion and water intake suggested that heavy breathing may be a cue for water intake, but this isolated significant finding must be interpreted cautiously.

The above conclusions should be valid despite the reliance on self-reports of behavior. The associations between food intake and weight loss and liquid intake and specific gravity provided one indication of validity. Although these associations were substantially less than 1.00, perfect correlation would not be expected without taking into account other factors affecting the criterion. The weak correlations between behavioral reports and psychological well-being indicated that the reports were not substantially biased by psychological state or general methodological factors such as acquiescence or social desirability.

Other research also supports the validity of the dependent variables. Hirsch, et al. (1984) found correlations of r = .85 to r = .95 between reported and measured food intake for military personnel eating MREs. Further evidence of a correlation between reported water intake and urine specific gravity is provided by comparing Wyant and Caron's (1983) report that men who reported drinking less in the cold than the FY84 sample also had higher urine specific gravities. Direct validity evidence is not available for foot care, but it is known that people can accurately report simple behaviors of this sort when daily reports are cumulated (Epstein, 1979).

Conclusions

Although there were some reliable associations between attitudes and cold weather health behaviors, programs to change health behaviors by changing health beliefs and attitudes would be impractical for two reasons:

(a) There are simpler ways to change behavior. Issuing foot powder improved foot care 16%. Research on field ration indicates that adding flavorings for water and adding breakfast foods could improve water intake and food intake, respectively. Other researchers concerned about performance in the cold currently are testing these possibilities.

(b) Attitude changes would have little effect. The weak associations between attitudes and behavior indicate that large attitude changes are needed to produce substantial behavioral change. The current state of the art is such that it is unlikely that it would be possible to design programs that reliably produce major changes. This problem would be made more difficult by the fact that a very large number of specific attitudes apparently would have to be changed to substantially modify health behavior in the cold.

Another conclusion from these studies is that improving cold weather health behaviors is unlikely to affect performance. These studies have produced no reliable relationships between poor health behavior and physical symptoms which would precede significant performance impairment. Weight loss and urine specific gravity data detailed in prior progress reports have indicated that actual deficiencies were minor compared to recommended intakes (McCarroll, Goldman & Denniston, 1979; Tarpan, Jacey, Heyder & Gray, 1982). It is noteworthy that the recommended intakes assume somewhat heavier work load and salt intake than was typical of the samples studied. Also, the actual deficiencies were substantially less than those which other research has shown do not affect performance (Roberts, Patton, Pennycook, et al., 1984; Wyant & Caron, 1983; Wyant, Wilkinson, Meiselman, Symington & Hunn, 1980).

A third conclusion is that maladaptive behavior patterns do not explain previously noted associations between demographic characteristics and cold injury. With the exception of a modest relationship between race and water intake, there were no reliable associations between the two. Therefore, attention should be directed to the possibility that demographic attributes correlate with cold injury because they are related to the type of work done in the cold or amount of exposure to the cold (Sampson & Jobe, 1981; Sampson, Stokes & Jobe, 1982). Prior work has not demonstrated these hypothesized associations definitively because the studies have lacked control groups for comparison to the cold-injured group.

Recommendations

The conclusions are limited by the fact that they were based on data obtained under relatively mild climatic conditions. Although exact meteorological data were

not available, temperatures typically were well above freezing during most work periods. If a significant proportion of cold weather operations can be expected to involve more extreme cold, additional research to determine how well behavior adapts to needs under those conditions may be useful. The instruments developed in this project could be used for this purpose.

If a need to modify behavior were established by further study, a second recommendation would be that other procedures to modify cold weather health behaviors should be tested before considering the modification of health beliefs and attitudes. This recommendation assumes that modified or supplemented rations and foot powder can be supplied to troops with minimal cost and probably with significant effects. In contrast, useful attitude change programs are likely to be complex, to be costly in terms of personnel time, and to have little effect. However, cold weather training should continue to include elements designed to induce proper beliefs and attitudes. When such elements are a routine part of training, they should produce at least some positive effects without imposing significant costs.

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APPENDIX A

SYMPTOM REPORT MEASURES

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The symptom questionnaire was a modified version of the Environmental Symptoms Questionnaire developed by Kobrick and Sampson (1979) and Sampson and Kobrick (1980). These symptoms were selected to reflect the occurrence of illness syndromes associated with cold weather (Commanding General, Marine Corps Development and Education Command, 1979; Headquarters, Department of the Army, 1068; Hess, 1978) and commonplace illnesses in the cold (McCarroll, Denniston, Pierce & Farese, 1977). Respondents were asked to indicate how much of a problem the symptom had been in the last 24 hours. Response alternatives ranged from "Not at all" (scored 1) to "Extreme" (scored 6).

Items were classified according to the body part or organ system implicated (e.g., respiratory symptoms). Factor analyses then were performed to determine whether the resulting groups of items contained more than one factor. If so, the factors identified in these analyses defined the item composites used to determine the relationships between health behaviors and physical well-being. Unweighted sums of the item responses provided composite scores. The symptom composites are given below with names assigned on the basis of the items with primary loadings in the factor analyses.

EYES: Irritated or gritty feeling eyes; Hot, sticky feeling in eyes; Watery eyes; Difficulty focusing eyes; Blurred vision.

RESPIRATORY TRACT: Extremely dry mouth/throat: Earache; Ringing in my ears; Bleeding nose

UPPER RESPIRATORY INFECTION: Sore throat; Congested, stopped up nose; Cough.

CARDIORESPIRATORY SYMPTOMS OF EXERTION: Shortness of breath; Hard to breathe; Breathing seems fast; Breathing seems irregular; Heart is pounding; Heartbeat seems fast; Chest pains.

CENTRAL NERVOUS SYSTEM: Headaches; Head is throbbing; Dizziness; Problems thinking clearly; Trouble concentrating; Sense of balance is off.

GASTROINTESTINAL SYMPTOMS: Upset stomach; Stomach cramps; Nausea/vomiting; Diarrhea; Constipation; Hemorrhoids

MUSCULOSKELETAL SYMPTOMS: Muscle cramps; Aching joints or bones; Sprain/strain of legs, ankles or feet; Sprain/strain in upper body; Swollen feet

FEVER SYMPTOMS: Chills; Shivering; Fever

SYMPTOMS OF FOOT PROBLEMS: Tender feet; Cold/stiff feet; Numbness in feet; Reddish-blue splotches on feet; Pale, white feet; Tingling, aching feet; Red hot itchy skin on feet when rewarmed

SYMPTOMS OF HAND PROBLEMS: Cold/stiff hands; Reddish-blue splotches on hands; Tingling, aching hands; Red, hot itchy skin on hands when rewarmed

FATIGUE SYMPTOMS: Sleep problems; Loss of appetite; Feel sleepy; Feel weak; General tiredness

CUTS: Cuts, scrapes, or abrasions

SKIN RASH: Skin rash

APPENDIX B

EFFICACY RATING SCALES

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Respondents were asked to indicate what effect they believed specific levels of water intake, food intake, and foot care would have on their risk of becoming ill or being injured during cold weather training. Response alternatives ranged from "Decrease a great deal" (scored 1) to "increase a great deal" (scored 7). This rating scale applied to the following items:

Drinking each of the following amounts of water per day:

a. Less than 1 quart*
b. 1 to 2 quarts*
c. 2 to 3 quarts*
d. 3 to 4 quarts
e. More than 4 quarts

Eating:

a. Less than 1 meal per day*
b. 1 full meal per day*
c. 2 full meals per day*
d. 3 full meals per day
e. 3 full meals plus snacks

Taking care of your feet (e.g., chnging socks, drying your feet):

a. Twice a day
b. Once a day
c. Once every other day*
d. Once every three days or less*

*Items comprising the efficacy scale for the indicated behavior.

APPENDIX C

ITEMS MEASURING REASONS FOR HEALTH BEHAVIORS IN THE FIELD

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Respondents were asked to answer the following questions in terms of how well they described their typical field experiences and behavior. Responses were on a scale from "Disagree Strongly" (scored 1) to "Agree Strongly" (scored 5).

Water Intake

1. I would have drank more but getting water was too much trouble.
2. I would have drank more if the water had been flavored.
3. I didn't worry how much I drank because no real problems were going to develop during our short stays in the field.
4. I knew I drank enough because I did not have any symptoms of dehydration.
5. I would have drank more, but the water purifying tablets made the water taste bad.
6. I watched my urine color to be sure I wasn't getting dehydrated.
7. I tried to keep my water consumption high enough to keep me healthy, but low enough so I was slightly constipated.
8. To be sure I got enough water, I forced myself to drink even when I wasn't really thirsty.
9. I kept my water intake down so I would not be going to the head all the time.
10. I personally don't need to drink as much water as the guidelines recommend.
11. I drank enough water for my personal needs.
12. I know I drank enough because I did not feel thirsty.
13. I would have drank more, but water was not available.

Food Intake

1. I didn't worry about how much I ate in the field because I knew I could make up for it when I got back to base camp.
2. I kept my food intake down because I was trying to lose weight during the training.
3. I knew I ate enough because I did not feel sick or weak.
4. I would have eaten more, but I did not like the food.
5. I made sure I ate the parts of the MREs that provided energy because having energy is critical for doing well in the field.
6. During the training exercises, I always ate enough for my body's needs.
7. Just to be sure I ate enough, I sometimes made myself eat even when I wasn't hungry.
8. I would have eaten more, but there was too little time to prepare the meals properly.
9. I skipped parts of the MREs to avoid problems like nausea, diarrhea, or constipation.
10. I was not sure how much I needed to eat each day to stay healthy.
11. I did not eat parts of the MREs because they would make me thirsty.
12. I know I ate enough because I did not feel hungry.

Foot Care

1. I could have taken better care of my feet, but it was too much trouble.
2. There was no time to take proper care of my feet.
3. I couldn't take care of my feet as well as I wanted to because I did not have dry socks, foot powder, etc.
4. I thought the foot care guidelines were overprotective.
5. I checked my feet only when they felt itchy, sore, or tender.
6. I took care of my feet because I wanted to be sure I followed the guidelines.
7. I did not worry much about my feet because ignoring them for a couple of days in the field would not cause problems.

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This study replicated and extended prior findings that the Health Belief Model (HBM) can predict cold weather health behaviors (CWHB). Major findings in a study of Marines in cold weather training were: (a) Perceived efficacy, one component of the HBM, was a weak, but reliable, predictor of food intake and foot care, but not of water intake. No other HBM component significantly predicted CWHB. (b) By strong, general predictor of CWHB was found in an extensive set of non-HBM beliefs and attitudes

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which were studied. (c) Weight loss and urine specific gravity assessments indicated minor deficiencies in food and water intake. However, even those men with low reported intakes did not report increased incidence of physical symptoms associated with malnourishment and/or dehydration. (e) Distributing foot powder significantly improved foot care.

Modification of health behaviors is unnecessary under the relatively mild weather conditions studied because the minor behavioral deficiencies that occur do not affect well-being. More extreme conditions might make behavior modification desirable in other cold weather settings. If so, modifying rations and supplying foot powder appear to be the most practical means of achieving this end.