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# HEALTH PROBLEMS AND VITAMIN C IN CANADIAN NORTHERN MILITARY OPERATIONS

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## ABSTRACT

As part of a continuing study of health problems pertinent to Canadian Northern Military operations, two aspects of Vitamin C have been examined in land element personnel participating on Northern Winter Exercises. This report describes results of an ongoing Vitamin C survey designed to examine both the Vitamin C status of troops and the effects of a daily Vitamin C supplement on the incidence and severity of colds in troops undergoing operational training. Results indicate that a daily 1000 mg supplement of Vitamin C reduced significantly the incidence of colds as assessed on the basis of symptom complexes reported on health survey cards. While the overall incidence of colds was influenced significantly by Vitamin C, both on an individual and a tent group basis, the duration of local cold symptoms was not. In those individuals who contracted a cold, nasal and throat and chest symptoms were observed to persist for similar periods of time in both placebo and Vitamin C supplemented groups. The Vitamin C group, however, did show a significant reduction in the duration of the more constitutional symptoms related to a general feeling of "well-being". The Vitamin C status of individuals was assessed on the basis of whole blood ascorbate levels determined before and after participation on Northern exercises. A significant reduction of whole blood ascorbate was observed post-exercise on three separate serials of Exercise New Viking, the troops of which were supplied with RP-4 field rations. In view of the fact that only a minor reduction of whole blood ascorbate was observed on another serial, the troops of which were supplied with IRP field rations, it is not possible to determine whether the reduction in ascorbate status was a reflection of altered dietary intake or an increased requirement for Vitamin C under the activity and exposure conditions experienced on Northern operations. Further work is required to clarify this situation.

# HEALTH PROBLEMS AND VITAMIN C IN CANADIAN NORTHERN MILITARY OPERATIONS

Since the early part of 1972, the Biosciences Division of the Defence and Civil Institute of Environmental Medicine (DCIEM) has been involved in an extensive field program designed to examine some of the health problems pertinent to Canadian Northern Military operations.

Table 1 lists some of the potential health problem areas encountered in a transit military population operating under Arctic or sub-Arctic conditions. These have been divided, somewhat arbitrarily, into two groups: Environmental and Operational.

TABLE 1

POTENTIAL HEALTH PROBLEM AREAS
NORTHERN OPERATIONS

| ENVIRONMENTAL | OPERATIONAL |
|---|---|
| Cold Injury | Nutrition |
| Frostbite | Rations |
| Trench Foot | Dehydration |
| Hypothermia | Constipation |
| Snow Blindness | Tent Eye |
| Sunburn | Physical Fitness |
| Cold Sores | Wound Healing |
| | Upper Respiratory Infection |
| | Dental |

(1) *Environmental* problems are those which arise as a consequence of *direct insult upon the individual by his environment.*

(2) *Operational* problems are those which arise as a consequence of *restrictions placed upon an individual by his environment.*

This report describes results dealing with some problems in the operational category, specifically with regard to rations and Vitamin C, the Vitamin C status of individuals, and the effect of Vitamin C supplementation on symptoms of respiratory distress.

One of the approaches which has been applied throughout the field program has been the administration of a health survey to men taking part in military winter exercises. This survey was established primarily to answer the questions, "does the abrupt introduction of a man into the Northern climate produce any demonstrable change in health pattern? If so, what is the nature of this alteration? "

The majority of health surveys which have investigated environmental factors impinging on health have been concerned with indigenous populations or isolated communities. Data derived from such studies are not applicable directly to transit populations such as members of mobile military forces. Recognition of this fact prompted DCIEM to establish a protocol for obtaining epidemiologic data on military men making periodic excursions into the North. The survey has been restricted to members of the land element for it is these individuals who are exposed most directly to the adverse environment for periods of greater than a few hours.

Table 2 lists the exercises which have been surveyed to date. With one exception (Northern Ramble, May 1972) the field program has utilized men taking part in New Viking training exercises. It is important to recognize the fact that these are *training* exercises and that as such, the men are living under the most "ideal" Arctic conditions in the sense that experienced instructors are with them at all times. Consequently, the men are under constant supervision to ensure that they protect themselves adequately from the environment. Hence, any health problems which arise on such exercises should be taken as a minimal estimate of problems which may arise on more operational missions.

TABLE 2

NORTHERN EXERCISES UTILIZED FOR THE INVESTIGATION OF HEALTH PROBLEMS, 1972-73

| Exercise | Date | Home CFB | N | Northern Location |
|---|---|---|---|---|
| New Viking 37 | March 1972 | Petawawa | 70 | Coral Harbor |
| Northern Ramble | May 1972 | London | 400 | Churchill |
| New Viking 49 | December 1972 | London | 100 | Coral Harbor |
| New Viking 52 | January 1973 | Gagetown | 100 | Churchill |
| New Viking 55 | February 1973 | Petawawa | 100 | Frobisher Bay |
| New Viking 56 | March 1973 | Calgary | 120 | Frobisher Bay |
| New Viking 57 | April 1973 | Petawawa | 100 | Frobisher Bay |

The health survey card used in the collection of field data is shown in Figure 1. The health survey has been conducted on an individual tent-group basis and extensive use has been made of the tent-group commanders who have been responsible for administering the survey cards on a daily basis. The survey period has extended typically from one week before the exercise to one week after the exercise. Tabulation of the incidence of individual symptoms and symptom complexes has been carried out post-exercise and it has become apparent that, to one degree or another, the incidence of individual symptoms is affected by movement into the North. The most marked alteration in symptoms reported has been noted in symptoms related to the upper respiratory system and it is these symptoms which have been examined in greater detail in DCIEM Vitamin C studies.

FIGURE 1

IN-FIELD HEALTH SURVEY CARD

Environmental Biology

HEALTH SURVEY CARD

| | | enter | delete |
|---|---|---|---|
| AGE | 10 20 30 40 1 2 3 4 5 6 7 8 9 | 5 5 | 5 5 5 |
| TENT NO | 10 20 30 1 2 3 4 5 6 7 8 9 | 2 2 | 2 2 2 |
| WEEK | 1 2 3 4 5 6 | 2 2 | 2 2 2 |
| | | 1 1 | 1 1 1 |

NAME _____

S.I.N. NO. _____

| symptom | day 1 | day 2 | day 3 | day 4 | day 5 | day 6 | day 7 |
|---|---|---|---|---|---|---|---|
| SNEEZES | Y N | Y N | Y N | Y N | Y N | Y N | Y N |
| STUFFY NOSE | Y N | Y N | Y N | Y N | Y N | Y N | Y N |
| RUNNING NOSE | Y N | Y N | Y N | Y N | Y N | Y N | Y N |
| ~~SORE THROAT~~ | Y N | Y N | Y N | Y N | Y N | Y N | Y N |
| CHEST COUGH | Y N | Y N | Y N | Y N | Y N | Y N | Y N |
| HEADACHE | Y N | Y N | Y N | Y N | Y N | Y N | Y N |
| CHILLS/FEVER | Y N | Y N | Y N | Y N | Y N | Y N | Y N |
| COLD SORES | Y N | Y N | Y N | Y N | Y N | Y N | Y N |
| ~~EXHAUSTION~~ | Y N | Y N | Y N | Y N | Y N | Y N | Y N |
| SORE MUSCLES | Y N | Y N | Y N | Y N | Y N | Y N | Y N |

| symptom | day 1 | day 2 | day 3 | day 4 | day 5 | day 6 | day 7 |
|---|---|---|---|---|---|---|---|
| THIRST | Y N | Y N | Y N | Y N | Y N | Y N | Y N |
| INDIG./HRTBURN. | Y N | Y N | Y N | Y N | Y N | Y N | Y N |
| ANTACID TABLTS. | Y N | Y N | Y N | Y N | Y N | Y N | Y N |
| NAUSEA/VOMIT. | Y N | Y N | Y N | Y N | Y N | Y N | Y N |
| ~~BOWEL MOVEMT.~~ | Y N | Y N | Y N | Y N | Y N | Y N | Y N |
| FROST NIP | Y N | Y N | Y N | Y N | Y N | Y N | Y N |
| FEET COLD | Y N | Y N | Y N | Y N | Y N | Y N | Y N |
| FEET ITCH | Y N | Y N | Y N | Y N | Y N | Y N | Y N |
| FEET SWOLLEN | Y N | Y N | Y N | Y N | Y N | Y N | Y N |
| ~~FEET SORE~~ | Y N | Y N | Y N | Y N | Y N | Y N | Y N |
| EYE IRRITATION | Y N | Y N | Y N | Y N | Y N | Y N | Y N |
| HOW MANY THERMOS CUPS OF FLUID DID ~~YOU DRINK~~ TODAY? | 1 2 | 1 2 | 1 2 | 1 2 | 1 2 | 1 2 | 1 2 |
| | 3 4 | 3 4 | 3 4 | 3 4 | 3 4 | 3 4 | 3 4 |
| | 5 6 | 5 6 | 5 6 | 5 6 | 5 6 | 5 6 | 5 6 |
| | 7 8 | 7 8 | 7 8 | 7 8 | 7 8 | 7 8 | 7 8 |
| | 9 10 | 9 10 | 9 10 | 9 10 | 9 10 | 9 10 | 9 10 |

An assessment of Vitamin C was undertaken for a number of reasons:

(1) The whole question of Vitamin C and its effect on colds is a topical and debatable issue. It was hoped that some light would be shed on this problem by utilizing a very restricted population of comparable age, typical cold history, common dietary regimen, activity schedule and environmental exposure.

(2) It has been suggested that Vitamin C may play a role in increasing cold tolerance – with particular regard to maintaining peripheral circulation.

(3) Finally, it was determined that the RP-4 rations (1970-71) on which the men were living, apparently provided a maximum of 37-41 mg Vitamin C per day in a single fruit-drink mix. As previous observations suggested that the fruit-drink mix was an unpopular item in the rations and tended to be discarded, it appeared that the individual intake of Vitamin C could be below the recommended daily allowance.

Accordingly, a protocol was established for dispensing tablets of either Vitamin C or placebo to individuals in each tent. Men in each tent group were assigned randomly to either the Vitamin C or placebo group. Extensive use was made again, of tent-group commanders who carried with them the supply of pills for their own tent. Two pill vials were provided for each tent, one containing Vitamin C and one containing placebo. Each vial contained the names of the men who were to receive the respective pills. Pills were dispensed twice a day, once with the morning meal and once with the evening meal. The total dose of Vitamin C received each day was 1000 mg.

At the completion of the exercise the incidence and duration of colds was examined by assessing the presence or absence of a cold on the basis of symptom constellations. In order for a man to be classified as having a cold, he had to have two nasal symptoms in conjunction with a minimum of sore throat or chest cough which persisted for two or more days. As a further restriction, the sore throat or chest cough had to be absent at the time the nasal symptoms began. Frequently, it was found that more constitutional symptoms such as headache, chills and fever, general malaise, nausea or vomiting were indicated at some time during the symptom constellation.

Table 3 indicates that the random allocation of men to the two treatment groups resulted in two well-matched populations with respect to age and typical cold history.

TABLE 3

THE MEAN AGE AND COMMON COLD HISTORY OF MEMBERS OF A SINGLE INFANTRY COMPANY OF 112 MEN ALLOCATED RANDOMLY TO VITAMIN C AND PLACEBO PREPARATIONS

| Group | N | Age | Incidence of Usual Spring Cold % |
|---|---|---|---|
| Vitamin C | 56 | 25.3 ± 6.3* (Range 17 – 40) | 61.6 |
| Placebo | 56 | 25.4 ± 8.1 (Range 17 – 47) | 60.0 |

*Mean ± S.D.

Table 4 depicts the frequency of colds assessed in a single infantry company on a Northern Military exercise. The incidence of colds in two other companies participating on the exercise, but not subjected to pill supplementation, was 21.0% and 29.4% respectively.

TABLE 4

INDIVIDUAL INCIDENCE OF COLDS ASSESSED IN A SINGLE INFANTRY COMPANY OF 112 MEN PARTICIPATING ON A NORTHERN MILITARY EXERCISE

| Group | N | Frequency | Percent Frequency |
|---|---|---|---|
| Vitamin C | 56 | 6 | 10.7 |
| Placebo | 56 | 14 | 25.0 |
| $\chi^2$ | 3.87 | | P=0.05 |

The results indicate that the Vitamin C group experienced significantly fewer colds than the corresponding placebo group. This ameliorating effect of Vitamin C was also reflected in the frequency of colds reported by individual tent groups (Table 5). Of the 14 tent groups involved in this study, nine groups (64.3%) indicated the presence of at least one cold during the exercise period. Of these nine groups, six (66.6%) indicated colds present only in placebo individuals, whereas the remaining three (33.3%) indicated colds present in both placebo and Vitamin C groups. In no case did a tent group indicate the presence of colds in Vitamin C individuals only.

TABLE 5

TENT GROUP INCIDENCE OF COLDS IN AN INFANTRY COMPANY OF 112 MEN PARTICIPATING ON A NORTHERN MILITARY EXERCISE

| Number of Tent Groups Reporting One or More Colds Amongst its Members | Number of Tent Groups Indicating Colds Present | | |
|---|---|---|---|
| | In Vitamin C Individuals only | In Placebo Individuals only | In Both Vitamin C and Placebo Individuals |
| 9/14 | 0/9 | 6/9 | 3/9 |
| (64.3%) | – | (66.6%) | (33.3%) |

The data presented in Table 6 indicate that despite a reduction in the frequency of colds in Vitamin C individuals, the duration of cold symptoms as related to the presence of nasal, throat or chest complaints was not significantly influenced. In other words, if an individual experienced a cold while on Vitamin C, the continued daily intake of 1000 mg/day did not alter the course of the cold with respect to the local symptoms. Examination of the more constitutional symptoms however (Table 7) revealed that the duration of these was significantly reduced in the Vitamin C group. This perhaps is a significant finding for it is these symptoms which are related to the general feeling of "well-being" and it is these symptoms which, in a civilian population, could predispose a person to remain at home. In a military population where refuge cannot be sought easily, it is these symptoms which would tend to reduce a man's level of effectiveness.

TABLE 6

THE MEAN DURATION OF UPPER RESPIRATORY SYMPTOMS REPORTED BY MEN AFFLICTED WITH A COMMON COLD

| Group | N | Duration of Symptoms (days) | |
|---|---|---|---|
| | | Nasal | Throat/Chest |
| Vitamin C | 6 | 4.2 ± 3.8* | 4.3 ± 3.0 |
| Placebo | 14 | 5.6 ± 2.8 | 6.0 ± 3.0 |
| P | | $> 0.4 > 0.5$ | $> 0.2 > 0.3$ |

*Mean ± S.D.

TABLE 7

THE MEAN DURATION OF CONSTITUTIONAL SYMPTOMS RELATED TO A FEELING OF WELL-BEING REPORTED BY MEN AFFLICTED WITH A COMMON COLD

| Group | N | Duration of Symptoms (days) |
|---|---|---|
| Vitamin C | 6 | 0.8 ± 0.8* |
| Placebo | 14 | 2.4 ± 2.1 |
| | | $p < 0.05$ |

On subsequent exercises an examination of the Vitamin C status of men was carried out by examining the whole-blood ascorbate levels before and immediately after the exercise. Table 8 shows the incidence of altered ascorbate status on four Northern exercises. In all cases, a significant number of men demonstrated a decrease in whole-blood ascorbate, however the magnitude of this decrease (Table 9) was significant on only three of the exercises. Coincidentally, these three exercises were supplied with the RP4 ration while the fourth exercise (Serial 56) received IRP field rations. The IRP ration provides approximately 50-90 mg of Vitamin C per day, about 50% of which is in a single fruit-drink mix and 50% is distributed throughout other ration components.

TABLE 8

INCIDENCE OF ALTERED WHOLE-BLOOD ASCORBATE STATUS OCCURRING ON NORTHERN EXERCISES

| Serial | N | % of Individuals Demonstrating a Decrease in Ascorbate | % of Individuals below 0.50 mg% Ascorbate | |
|---|---|---|---|---|
| | | | Pre-Exercise | Post-Exercise |
| NV 49 | 86 | 70 | 4 | 8 |
| NV 51 | 29 | 83 | 28 | 41 |
| NV 55 | 24 | 46 | 21 | 12 |
| NV 56 | 34 | 47 | 32 | 32 |

TABLE 9

MEAN WHOLE-BLOOD ASCORBATE STATUS BEFORE AND AFTER PARTICIPATION ON NORTHERN EXERCISES

| Serial | N | Pre-Exercise Level mg% | Post-Exercise Mean Change | |
|---|---|---|---|---|
| | | | mg% | % |
| NV 49 | 86 | 1.05 ± 0.04* | −0.19 ± 0.04 | −18 |
| NV 51 | 29 | 0.86 ± 0.07 | −0.21 ± 0.04 | −24 |
| NV 55 | 24 | 0.91 ± 0.10 | −0.13 ± 0.06 | −14 |
| NV 56 | 34 | 0.76 ± 0.05 | −0.03 ± 0.06 | − 4 |

*Mean ± S.E.M.

One further point with reference to Table 8 is the rather surprising number of men who demonstrated whole-blood ascorbate levels lower than 0.50 mg%. This value is generally taken to indicate the threshold of a possible sub-clinical scorbutic condition. Two of the four serials examined post-exercise demonstrated a definite shift towards this subclinical scorbutic state, one (Serial 56) remained unchanged and the other (Serial 55) demonstrated a shift in the opposite direction.

In view of the variation in diet and distribution of change in ascorbate status, it is not possible from these data to determine whether the reduction in ascorbate levels, observed post-exercise on three of the four serials, was a consequence of reduced dietary intake of Vitamin C or a reflection of a possible increased requirement for this vitamin under the activity and exposure conditions existing on Northern operations. Clearly, a determination of ascorbate excretion is required before any estimate of requirement under these conditions can be made.

This study is part of a continuing program to assess the nature and incidence of health problems pertinent to Canadian military Northern operations. With regards to Vitamin C and its influence on general body health the data to date suggest that a daily supplement of 1000 mg Vitamin C appears to reduce the overall incidence of colds in transit military populations. It must be appreciated however, that the nature of the military exercise itself represents a marked departure from the "normal" daily routine. Over the period of this study, the men are transported by air into an adverse environment and live in close association with that

environment. Their dietary regimen is altered dramatically with regards both to frequency of meals and nature of food eaten. In view of these factors the results reported here do not necessarily characterize the civilian population in general. Further, insufficient data exist to enable us to determine whether the observed beneficial effect of Vitamin C observed in this study, is prophylactic or therapeutic, although the analysis of colds by tent groups suggests that the effect may be prophylactic. In addition the study was restricted to an examination of the efficacy of a daily 1000 mg dose of Vitamin C, which may represent neither the optimal nor minimal daily supplement required. The whole-blood ascorbate levels of individuals receiving a Vitamin C supplement were increased well above normal (100-150%). In view of the demonstrated decrease in whole-blood ascorbate occurring in non-supplemented men, the optimal dose of Vitamin C may be in a range which is sufficient to prevent such a decrease. Further work is required to clarify this situation.

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