SGRD-HR
29 Nov 88

INFORMATION PAPER

SUBJECT: Hydration Methods to Maintain Performance of Soldiers in MOPP IV

1. PURPOSE: U.S. Army Medical-Chemical Defense Review V

2. FACTS:

a. Both USAF and US Army (USARIEM) predictions for sweat rates in MOPP IV (0.5 - 2.0 L/hr) at various air temperatures and work loads are in agreement and clearly indicate the need for a water delivery system to accomodate individual consumption rates of up to 2.0 L/hr. For 24 hours in MOPP, 14 qts. of water may be required to maintain hydration.

b. Effects of various levels of dehydration (body wt loss):

2%	(1.4 L)	- Thirst.
4-5%	(2.8 - 3.5 L)	- Impaired mental performance.
6-7%	(4.2 - 4.9 L)	- ↑ rectal temp., predisposition to heat exhaustion.
>7%	(5.0 - 10 L)	- Marked impaired performance, coma, death.

c. Maintaining euhydration in MOPP IV is difficult because of voluntary dehydration, poor oragnoleptic qualities of warm, iodinated water, complexity (2-handed drinking) of current drinking system, fear of contamination and problems of refilling canteens safely in contaminated environments.

d. A soldier sweating 1 L/hr and unable to refill a 2 qt. canteen will have a 4 L water deficit after only 6 hours and will be at risk or heat exhaustion.

e. USARIEM studies in climatic chambers indicate that the current system significantly reduced fluid intake during work in the heat. The use of a prototype FIST/FLEX system returned drinking during work to control levels (no mask). Planned Natick development of this Improved Mask Drinking System includes USARIEM physiological evaluations.

f. USARIEM and Natick studies have documented the beneficial and additive effects of cooling and flavoring water on voluntary consumption and reducing hypohydration during work in the heat. The effects of cooling and flavoring have not been tested under MOPP IV condutions.

g. Significant issues in the delivery and resupply of water to the individual soldier in MOPP remain to be resolved. The DCSLOG Water Resources Management Action Group (WRMAG) may be a useful Forum to resolve problems in resupplying water safely to the soldier in a contaminated environment.

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17. This slide depicts a drinking water profile for men in conventional battle dress on MOPP IV based on the temperature changes between sunrise and sunset. The consumption data are predicted from the hourly guidelines and result in a 16qt. requirement for men in BDU's.

18. USAF and USARIEM computer models of predicted water costs for CD operations are strikingly similar and reflect ambient temperature and work rate as major inputs. Clearly, moderate work rates above 80°F are constrained to limited durations or heat casualties result. A similar situation is predicted by both models for heavy work above 70°F. A range in hourly water costs from 0.5-2.0 qts/hr is indicated and the through-mask drinking equipment should be capable of providing it.

19. Water as a major constraint to hot weather operations has driven the acquisition and development of a new integrated system of water logistics.

20. This slide depicts some of these new components and capabilities such as ROWPU's, TWDS, SMFT, SMC's etc.

21. As indicated by this slide from Bright Star 83 (Egypt), the Lister bag or 5-gallon can (jerry-can) represents the local source of water for the individual soldier's canteen. This raises legitimate questions concerning the man/water interface in MOPP as a potential operational or logistical cause of potential heat casualties.

22. The principal components of a FIST/FLEX type system are shown in this slide (Fluid intake suction tubing, a hand pump, and a flexible canteen).

23. USARIEM evaluated the current system to determine its' compatibility for use while walking in the heat.

24. In a 5 hour simulated desert walk, subjects wore face masks and drank with both the current and FIST/FLEX type systems. The current system reduced fluid intake during work (30/30 W/R) by 43%. The use of the FIST/FLEX type system returned drinking to control levels (ad lib, no masks).

25. The consumption data is shown in this slide and demonstrates the concurrence between control and FIST/FLEX values. It should be noted that actual constraints to use the current system such as a fear of oral contamination by agent or a requirement in the test for two-handed operations would have widened the observed differences. At the end of 5 hours, each soldier had walked 7.5 miles at a WBGT of 88°F.

26. In this 2nd assessment of the FIST/FLEX (FF) system, subjects walked in MOPP IV under temperate conditions (86°F, db) and used either the FF or current system (CS). FF subjects consumed 33% more water during work periods. Sweat losses in both groups were high (0.84 L/hr) and 3 subjects withdrew from each group between the 3rd and 4th hours complaining of headache. Only 37% (CS) and 44% (FF) of subjects completed the 6h walk. A 3rd evaluation is programmed having subjects carrying weapons and using proper DECON procedures before using the (CS).

FLUID INTAKE (L) AT END OF WORK

	WORK INTAKE	% DRUNK IN WORK
FIST-FLEX (N=7)	1.20 ± 0.23	60
CURRENT (N=7)	0.73 ± 0.22	40
"NORMAL" (N=31)	1.29 ± 0.09	58

Q: IS THERE ANY INDICATION THAT THE CURRENT WATER DELIVERY SYSTEM CONTRIBUTES TO A REDUCTION OF WATER INTAKE DURING WORK IN THE HEAT?

A: YES. THERE WAS A 43% REDUCTION IN FLUID INTAKE DURING WORK.

Q: WILL A FIST-FLEX TYPE SYSTEM REDUCE THIS DEFICIT?

A: YES. A FIST-FLEX TYPE SYSTEM RETURNED WATER INTAKE TO "NORMAL" RATES (UNMASKED, UNRESTRICTED TRIALS)

RECOMMENDATIONS:

1. REPEAT THIS STUDY USING 50/10 WORK/REST CYCLES AND MOPP IV .

2. WHEN THE CURRENT WATER DELIVERY SYSTEM IS USED, ADEQUATE REST PERIODS SHOULD BE PROVIDED.

CONCLUSION:

THE CURRENT SYSTEM OF MASKING & WATER DELIVERY APPEARS TO BE INCOMPATIBLE WITH A SIMPLE SOLDIER TASK (WALKING).

ASSESSMENT OF CURRENT VS FIST/FLEX-TYPE SYSTEM*

* 5-h simulated desert march (30/30 W/R)
* Face masks only
* Current system vs. controls reduced fluid intake 43%
* FIST/FLEX - type system returned consumption to control levels
* Chamber studies lack realism and do not introduce fear of contamination
* Recommend field evaluations under realistic conditions

* WRMAG Meeting #10 - 17 Sep 86

2nd ASSESSMENT OF CURRENT VS FIST/FLEX - TYPE SYSTEM

* 15ss, 4 km/hr, 6-50/10 W/R cycles. 30°C d.b., 10°C w.b.
* MOPP IV & CS vs MOPP IV + FIST/FLEX
* Consumption: CS = 0.28 L/hr; FIST/FLEX = 0.42 L/hr
* FIST/FLEX subjects consumed 33% more water
* Only 37% (CS) and 44% (FIST/FLEX) of subjects completed 6 hr walk