EFFECTS OF ACETYLSALICYLIC ACID ON MAN'S SKIN TEMPERATURE IN THE COLD

MSgt W. W. Millard

TECHNICAL DOCUMENTARY REPORT AAL-TDR-63-14

June 1963

ARCTIC AEROMEDICAL LABORATORY

AEROSPACE MEDICAL DIVISION
AIR FORCE SYSTEMS COMMAND
FORT WAINWRIGHT, ALASKA

Project 8238
Task 823801

[redacted]

NOTICES

When US Government drawings, specifications, or other data are used for any purpose other than a definitely related government procurement operation, the government thereby incurs no responsibility nor any obligation whatsoever; and the fact that the government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data is not to be regarded by implication or otherwise, as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.

US Government agencies and other qualified ASTIA users may obtain copies of this report from the Armed Services Technical Information Agency, Documents Service Center, Arlington 12, Virginia.

This report has been released to the Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C., for sale to the general public.

Arctic Aeromedical Laboratory, United States Air Force (AFSC), APO 731, Seattle, Wash.
Rpt. AAL-TDR-63-14. EFFECTS OF ACETYLSALICYLIC ACID ON MAN'S SKIN TEMPERATURE IN THE COLD. June 1963, 10 p. incl. illus., tables, 7 refs.
Unclassified Report

The purpose of this study was to determine what effect the usual dosage of acetylsalicylic acid (aspirin) would have on the normal pattern of cold defense in man. Seven subjects participated in the experiment, with three exposures per subject conducted at 4° C. Subjects received ten grains of aspirin in one exposure and a ten-grain placebo in the second; the third exposure was a control with no capsule given. Results of these exposures are shown in graphs of skin and rectal temperatures. A discussion of the results is presented. The usual dosage of acetylsalicylic acid in itself appears to have no significant effect on the normal pattern of cold defense in man. There was a psychogenic reaction when a placebo or aspirin was administered.

1. Salicylic Acids
2. Body Temperature
3. Exposure
I. Project 8238
Task 823801
II. Millard, W.W., MSgt, USAF
III. Available from OTS
IV. In ASTIA collection

Arctic Aeromedical Laboratory, United States Air Force (AFSC), APO 731, Seattle, Wash.
Rpt. AAL-TDR-63-14. EFFECTS OF ACETYLSALICYLIC ACID ON MAN'S SKIN TEMPERATURE IN THE COLD. June 1963, 10 p. incl. illus., tables, 7 refs.
Unclassified Report

The purpose of this study was to determine what effect the usual dosage of acetylsalicylic acid (aspirin) would have on the normal pattern of cold defense in man. Seven subjects participated in the experiment, with three exposures per subject conducted at 4° C. Subjects received ten grains of aspirin in one exposure and a ten-grain placebo in the second; the third exposure was a control with no capsule given. Results of these exposures are shown in graphs of skin and rectal temperatures. A discussion of the results is presented. The usual dosage of acetylsalicylic acid in itself appears to have no significant effect on the normal pattern of cold defense in man. There was a psychogenic reaction when a placebo or aspirin was administered.

1. Salicylic Acids
2. Body Temperature
3. Exposure
I. Project 8238
Task 823801
II. Millard, W.W., MSgt, USAF
III. Available from OTS
IV. In ASTIA collection

ABSTRACT

The purpose of this study was to determine what effect the usual dosage of acetylsalicylic acid (aspirin) would have on the normal pattern of cold defense in man. Seven subjects participated in the experiment, with three exposures per subject conducted at 4° C. Subjects received ten grains of aspirin in one exposure and a ten-grain placebo in the second; the third exposure was a control with no capsule given. Results of these exposures are shown in graphs of skin and rectal temperatures. A discussion of the results is presented. The usual dosage of acetylsalicylic acid in itself appears to have no significant effect on the normal pattern of cold defense in man. There was a psychogenic reaction when a placebo or aspirin was administered.

PUBLICATION REVIEW

Horace F. Drury

HORACE F. DRURY
Director of Research

EFFECTS OF ACETYLSALICYLIC ACID ON MAN'S SKIN TEMPERATURE IN THE COLD

SECTION 1. INTRODUCTION

There is an intensive cutaneous vasoconstriction of the extremities in man when exposed to a cold environment. In 1936 Bierman (Sollmann, 1949) reported a marked increase in skin temperature of the extremities, expecially the toes, after acetylsalicylic acid (aspirin) was ingested.

Acetylsalicylic acid is an analgesic-antipyretic (Sollmann, 1949). The analgesic (pain threshold raising) effect is usually attained with 0.3 to 1 gm (5 to 15 grains). The mechanism of the antipyretic action is sweating, hydremia and cutaneous vasodilation accompanied by an increase of heat loss (Davison, 1949). In normal individuals the heat lowering effect is compensated by an increased heat production, so that no further lowering is attained.

The purpose of these initial experiments was to determine what effect the usual dosage of acetylsalicylic acid would have on the normal pattern of cold defense in man. Due to the pharmacological properties of acetylsalicylic acid, it was thought that a delay in the vasoconstrictive activity might occur and enhance man's tolerance in cold environments.

SECTION 2. METHODS

Seven subjects participated in the experiment. Instrumentation consisted of 27 copper-constantan thermocouples for measuring skin and rectal temperatures. These temperatures were manually recorded from Yellow Springs telethermometers. Experiments were conducted in the environmental chamber, with three exposures per subject at 4° C. Subjects received 10 grains of aspirin in one exposure and a 10-grain placebo in the second, with no prior knowledge of which capsule they received. The third exposure was a control with no capsule given. Cold chamber programming and recording were accomplished using a Brown "Electronik" potentiometer. All equipment was calibrated to $\pm 0.5^{\circ}$ C.

Clothing consisted of 100% cotton thermistor underwear (approximately 0.3 clo value). Representative skin and core temperatures were measured on the body by means of the thermistor underwear. The heat loss rate is shown in Table I.

TABLE I

RATE OF HEAT LOSS

($Kcal/m^2$ hr)

SUBJECT	CONTROL	PLACEBO	ASPIRIN
A	89.79	98.30	98.20
B	86.86	89.86	90.66
C	73.77	90.48	66.87
D	83.57	96.64	86.85
E	80.69	74.16	91.94
F	87.40	93.10	101.56
G	94.68	91.97	96.71

Note: No statistical analysis of these data carried out.

The discriminating physiological measurements or assessments taken during the experiments were continuous rectal and skin temperatures, mean body temperatures, and rates of heat loss. Mean body temperatures were calculated with Burton's coefficients (Burton and Edholm, 1955):
$MBT = 0.65\ t_r + 0.35\ t_s$.

Five additional skin temperatures on each foot were recorded by means of thermistors. The skin temperatures of both feet were averaged and are referred to as "foot body temperature" and "foot toe temperature." These were then averaged to present a single value.

The sites of the skin temperature measurements are shown in Figures 1a and 1b.

The experimental procedure was to administer the capsule of aspirin or placebo, dress and instrument the subject who then remained seated at an ambient temperature of 75° F for 15 minutes prior to entry to the cold chamber. Skin and rectal temperatures were taken prior to cold exposure for control readings. Subject then walked into the cold chamber and sat and rested with his feet approximately 12 inches from the floor for one hour.

SECTION 3. RESULTS AND DISCUSSION

Figure 2 illustrates the average decrement of the foot, toe and mean foot temperature values (see Table II). Foot and toe temperature loss was less when the placebo and aspirin were taken. There appears to be a psychogenic reaction from the placebo experiment. (It was interesting to note that three subjects claimed the placebo made them sleepy.)

Figure 3 illustrates the onset and degree of shivering. Although this was a subjective observation, there appeared to be a much faster onset of shivering in the aspirin experiment than in the others. Heavy shivering was observed only in the aspirin experiments, although the rectal temperatures of the subjects in the control and aspirin experiments fell approximately the same amount, .23° C and .25° C respectively.

Table II illustrates the decrease in mean body, mean foot and mean toe temperature of the seven subjects. A t test of paired samples (Table III) shows we would accept the hypothesis of no increase in mean temperature change in cases 1, 2, 3, 6 and 9 and we reject it in cases 4, 5, 7 and 8.

SECTION 4. CONCLUSIONS

The usual dosage of acetylsalicylic acid in itself appears to have no significant effect on the normal pattern of cold defense in man.

There appeared to be a psychogenic reaction when a placebo or aspirin was administered.

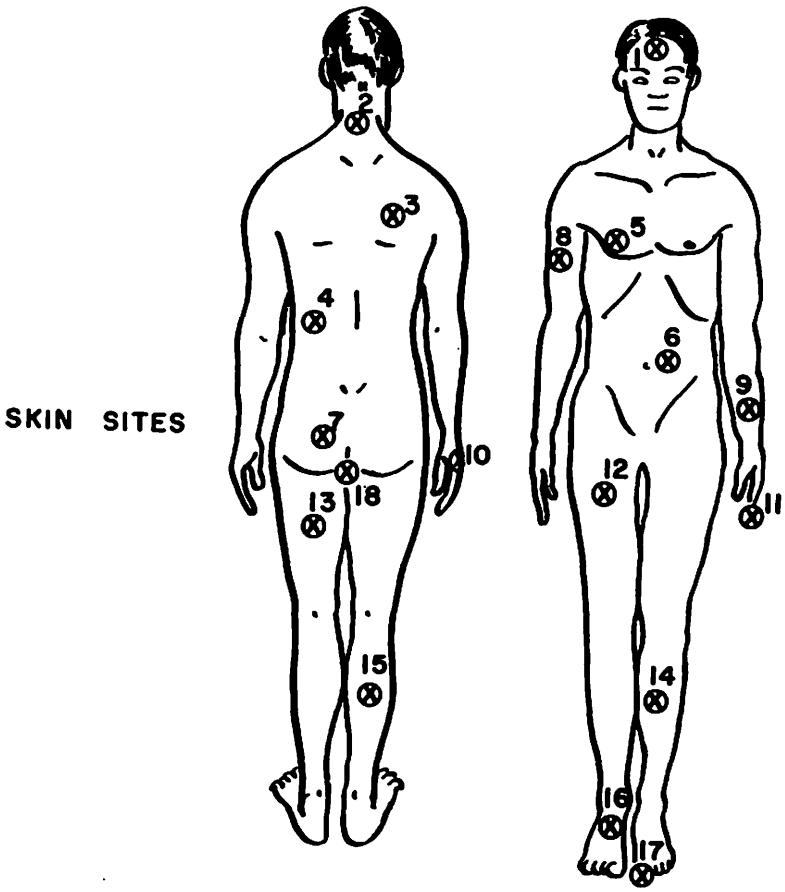

FIGURE 1a

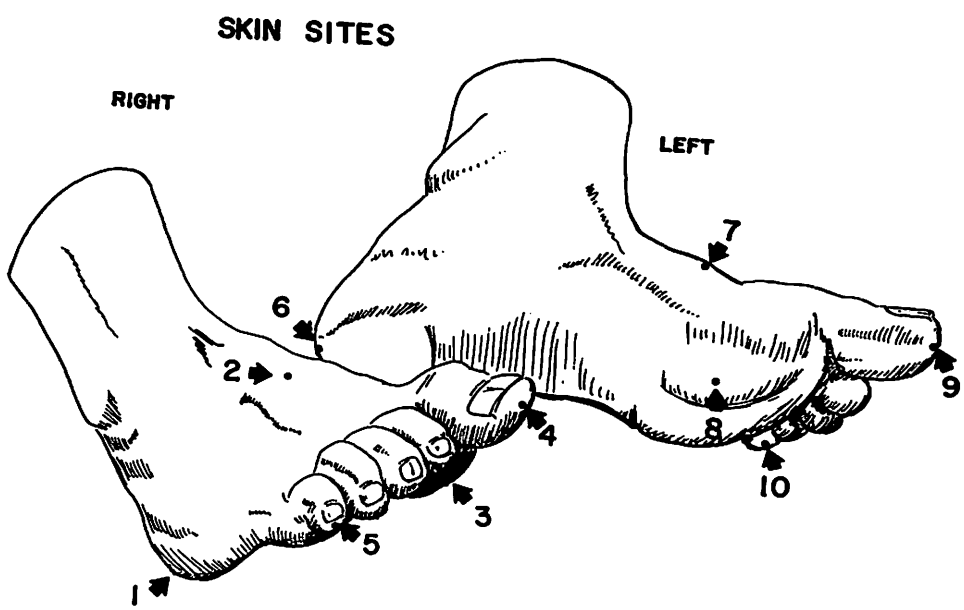

FIGURE 1b

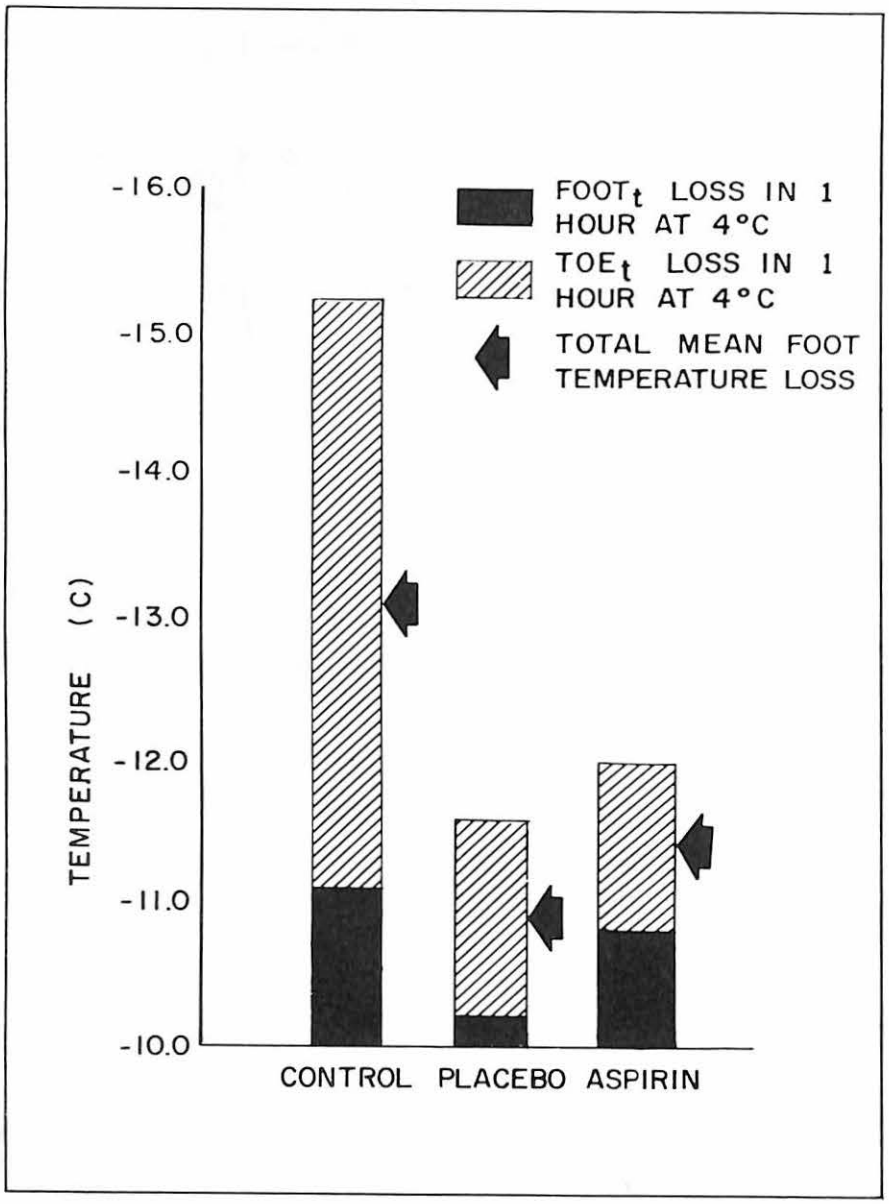
-16.0
-15.0
-14.0
-13.0
-12.0
-11.0
-10.0
TEMPERATURE (C)
FOOT$_t$ LOSS IN 1 HOUR AT 4°C
TOE$_t$ LOSS IN 1 HOUR AT 4°C
TOTAL MEAN FOOT TEMPERATURE LOSS
CONTROL
PLACEBO
ASPIRIN

FIGURE 2

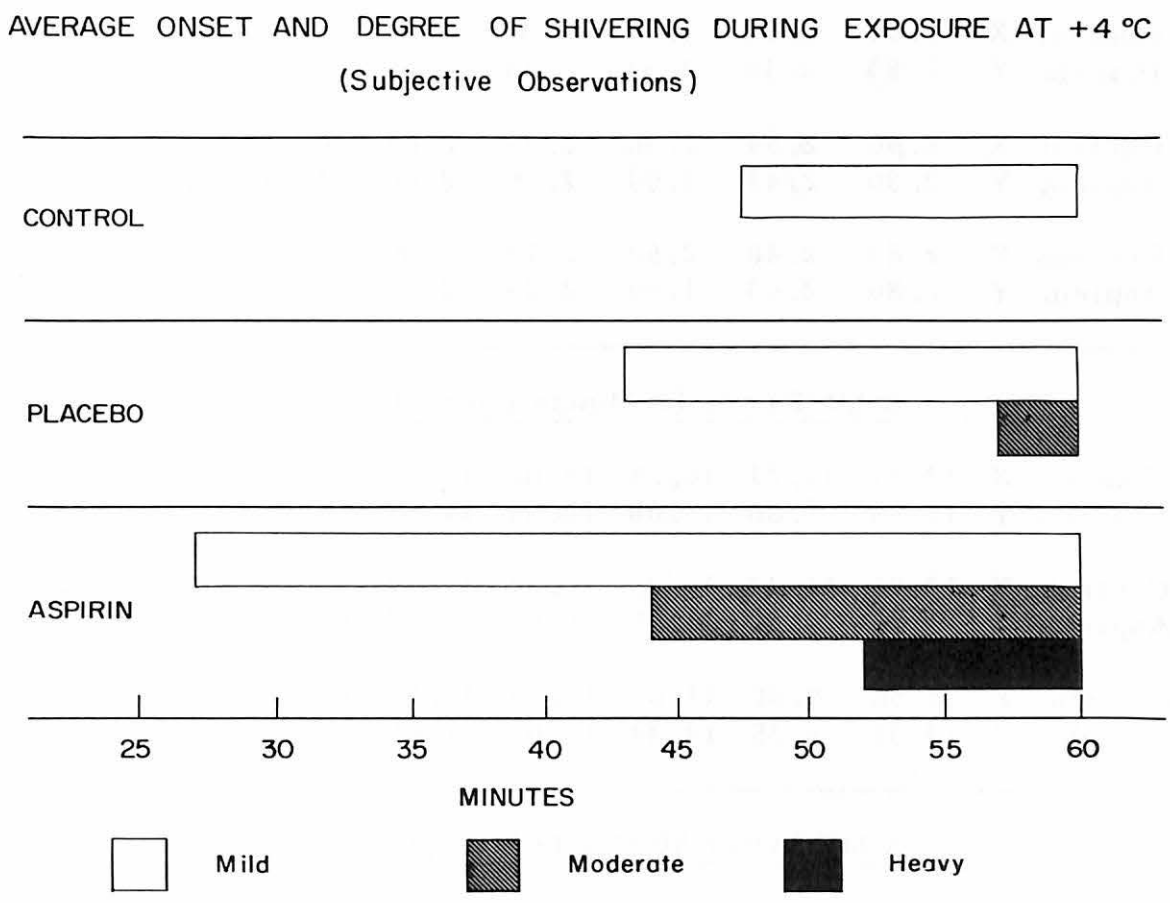
AVERAGE ONSET AND DEGREE OF SHIVERING DURING EXPOSURE AT +4 °C
(Subjective Observations)
CONTROL
PLACEBO
ASPIRIN
25
30
35
40
45
50
55
60
MINUTES
Mild
Moderate
Heavy

FIGURE 3

TABLE II

	CONDITIONS		SUBJECTS							
			A	B	C	D	E	F	G	*
			Δ MBT Over 60 Minute Interval							
1.	Control	X	2.50	2.54	2.36	2.30	2.64	2.71	2.95	N. S.
	Placebo	Y	2.83	2.40	2.52	2.78	2.00	2.80	2.42	
2.	Control	X	2.50	2.54	2.36	2.30	2.64	2.71	2.95	N. S.
	Aspirin	Y	2.80	2.43	1.99	2.35	2.66	2.94	2.54	
3.	Placebo	X	2.83	2.40	2.52	2.78	2.00	2.80	2.42	N. S.
	Aspirin	Y	2.80	2.43	1.99	2.35	2.66	2.94	2.54	
			Δ MFT Over 60 Minute Interval							
4.	Control	X	12.91	11.27	16.35	15.02	11.59	12.53	12.33	Sig.
	Placebo	Y	11.56	8.80	11.68	10.54	11.53	12.18	13.87	
5.	Control	X	12.91	11.27	16.35	15.02	11.59	12.53	12.33	Sig.
	Aspirin	Y	11.56	9.80	11.68	10.54	11.53	12.18	12.87	
6.	Aspirin	X	11.56	9.80	11.68	10.54	11.53	12.18	12.87	N. S.
	Placebo	Y	13.31	8.25	12.34	12.03	11.41	9.54	9.61	
			Δ MTT Over 60 Minute Interval							
7.	Control	X	17.75	16.37	20.60	19.57	16.45	18.30	17.60	Sig.
	Placebo	Y	19.00	7.88	17.75	16.00	15.37	13.87	13.75	
8.	Control	X	17.75	16.37	20.60	19.57	16.45	18.39	17.60	Sig.
	Aspirin	Y	14.75	12.75	13.62	14.00	15.25	16.50	16.75	
9.	Aspirin	X	14.75	12.75	13.62	14.00	15.25	16.50	16.75	N. S.
	Placebo	Y	19.00	7.88	17.75	16.00	15.37	13.87	13.75	

* Significant at P = .05 or better

MBT: Mean Body Temperature
MFT: Mean Foot Temperature
MTT: Mean Toe Temperature

TABLE III

Assuming that the decrease in temperature may be treated as a normally distributed variable, and that $\sigma_x = \sigma_y$, we may apply the statistic (Mood, 1950):

$$t = \frac{(\bar{x} - \bar{y}) - (\mu_x - \mu_y)}{\sqrt{n_x s_x^2 + n_y s_y^2}} \sqrt{\frac{n_x n_y (n_x + n_y - 2)}{n_x + n_y}}$$

where $d.f = n_x + n_y - 2$

In each case we test

$$H_o: \mu_x = \mu_y$$

against

$$H_1: \mu_x > \mu_y$$

For the cases listed in Table II we find:

$t = +\ 0.2545$
$t = \ \ 0.2856$
$t = \ \ 0.0348$
$t = \ \ 2.2489$
$t = \ \ 2.1099$
$t = \ \ 0.6648$
$t = \ \ 2.2159$
$t = \ \ 2.2159$
$t = \ \ 0$

Comparing these values of t with the 5% critical value of $t = 2.68$, using only the right hand tail because of H_1 we find that the results in cases 1, 2, 3, 6 and 9 are not significant but that the results in cases 4, 5, 7 and 8 are significant.

REFERENCES

1. Burton, A. C. and Otto G. Edholm. Man in a Cold Environment. Edward Arnold, Ltd., London, 1955.

2. Davison, F. R. Handbook of Materia-medica, Toxicology, and Pharmacology. C. V. Mosby Co., St. Louis, 1949.

3. Mood, A. M. Introduction to Theory of Statistics. McGraw-Hill Book Co., New York, 1950.

4. Sollmann, Torald. A Manual of Pharmacology. W. B. Saunders Co., Philadelphia and London, 1949.

ADDITIONAL REFERENCES

5. Kuno, Yas. Essential Problems in Climatic Physiology. Nankodo Publishing Co., Ltd., Kyoto, Japan, 1960.

6. Newburgh, L. H. Physiology of Heat Regulation. W. B. Saunders Co., Philadelphia and London, 1949.

7. Selle, W. A. Body Temperature, Its Changes with Environment, Disease and Therapy. C. C. Thomas, Springfield, Illinois, 1952.