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ANALYSIS OF RESPONSES OF COLD PRESSOR TESTS ON PILOTS AND EXECUTIVES

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INTRODUCTION

This report presents analyses of biomedical data collected by the Lovelace Clinic in Albuquerque, New Mexico. Data for a group of 81 professional pilots and a group of 466 executives were obtained annually, when possible, from 1960 to 1968. The most recent data for subjects were analyzed to determine whether differences between basal blood pressure and blood pressures obtained by the cold pressor test were independent of profession and certain medical attributes. These data were qualitative and quantitative as well. The medical attributes were qualitative, indicated by their presence or absence; the blood pressures were quantitative and recorded in units of millimeters (mm) of mercury.

The systolic and diastolic blood pressures obtained by cold pressor test were expected to show an increase over basal blood pressures. If this increase, referred as cold pressor blood pressure (CPBF) response was more than 20 mm for systolic blood pressure or more than 10 mm for diastolic blood pressure, the response of the cold pressure test was considered positive, otherwise, negative.

The independence of the cold pressor test response and each attribute was tested by constructing contingency tables and applying the Chi Square (χ^2) test and the maximum likelihood (ML) test of independence with associated degrees of freedom (DF) as explained in Appendix I.

CATEGORIES OF THE MEDICAL CONDITIONS AND HISTORIES

The medical conditions and histories of the subjects and their families were categorized, using 23 attributes listed below. However, data for attributes 16 to 23 were not available for the subjects' families. The attributes coded from 1 to 22 were either present or absent in subjects' or their families' histories. The attribute of smoking history, coded as 23, had three responses. 1 refers to nonsmoker, 2 to ex-smoker, and 3 to smoker. The abbreviated names of attributes are indicated within parenthesis.

Code #	Medical Attribute	Abbreviation
1.	Heart disease	(HRT)
2.	Other circulatory disorders	(CIRC)
3.	Respiratory disorders	(RESP)
4.	Neurological disorders	(NEUR)
5.	Connective tissue disorders	(CONN)
6.	Gastrointestinal disorders	(GASTR)
7.	Genitourinary disorders	(GENIT)
8.	Endocrine and metabolic disorders	(ENDO)
9.	Herniation	(HERN)
10.	Malignancy	(MALIG)
11.	Ear, nose, and throat disorders	(ENT)
12.	Liver diseases	(LIVR)
13.	Hypertension history	(HYPT)
14.	Diabetes history	(DIAB)
15.	Stroke history	(STRK)
16.	Cardiac drugs	(CARD)
17.	Antihypertension drugs	(ANTHYP)

18.	Diuretic drugs	(DIUR)
19.	Antidiabetes drugs (oral)	(ANTDBO)
20.	Antidiabetes drugs (insulin)	(ANTDBI)
21.	Tranquilizer drugs	(TRANQ)
22.	Other drugs	(OTHD)
23.	Smoking history	(SMOKE)

The cold pressor test response was either positive or negative; hence for the groups of professionals under study cold pressor test response versus a particular attribute formed either a (2 x 2) or a (2 x 3) contingency table. From these contingency tables χ^2 and ML values were calculated and their significance tested.

The data pertaining to all the analyses are presented in the Appendices II and III.

TESTS OF INDEPENDENCE AND RESULTS

A contingency table shows the distribution of subjects indicating responses to two attributes. The distribution of subjects along any one diagonal of a contingency table indicates dependence between two attributes. On the other hand, if two attributes are completely dependent, the distribution is likely to be along a diagonal. Thus, the distribution of subjects in a contingency table provides a basis of inference on the hypothesis of independence between two attributes.

In the present study to test the hypotheses of independence between two attributes, χ^2 and ML tests were employed. Calculation of χ^2 and ML values from data in a contingency table is shown in Appendix I. The calculated χ^2 and ML values were compared to the table value of χ^2 at a five percent level of error. Whenever the χ^2 or a ML value was larger than the table value, the hypothesis of independence was rejected and indicated in tables. In all cases, cold pressor test response was used as one attribute and the other attributes were either progession, or subject's medical condition or medical history. The appropriate contingency tables and results are given below.

COLD PRESSOR TEST RESPONSE AND PROFESSIONS

a. Hypothesis: Cold pressor test response to systolic blood pressure (SYS) is independent of subject's profession.

(2 x 2) Contingency Table

SYS	PROFESSION		TOTAL
	Pilot	Executive	
Negative	59	193	252
Positive	22	273	295
TOTAL	81	466	547

χ^2 value = 27.42, ML value = 27.96, DF = 1

Conclusion: Hypothesis of independence rejected.

b. Hypothesis: Cold pressor test response to diastolic blood pressure (DIAS) is independent of subject's profession.

(2 x 2) Contingency Table

DIAS	PROFESSION		TOTAL
	Pilot	Executive	
Negative	42	150	192
Positive	39	316	355
TOTAL	81	466	547

χ^2 value = 11.71, ML value = 11.24, DF = 1

Conclusion: Hypothesis of independence rejected.

COLD PRESSOR TEST RESPONSE AND MEDICAL ATTRIBUTES OF PILOTS AND EXECUTIVES

The results of four sets of hypotheses tested are presented in Table 1. Two sets pertain to hypotheses of independence between systolic (SYS) and diastolic (DIAS) blood responses to cold pressor tests and pilot's medical attributes. The other two sets similarly pertain to executives.

Table 1 lists and identifies medical attributes of pilots and executives, blood pressures considered, and shows the values of χ^2, ML, and DF. In the column "HYPOTHESIS", the entries show if hypothesis of independence was accepted (ACC) or rejected (REJ) at the 5% level of significance. Blank space indicates non-availability of item.

Table 2 gives similar descriptions as in Table 1, but instead of subject's medical attributes, attributes of subject's family have been tested for independence from cold pressor test responses.

Table 1. Summary of results of tests of independence between cold pressor test responses and subject's medical attributes.

CODE #	MEDICAL ATTRIBUTE (Abbr)	BLOOD PRESS.	PILOTS χ^2 VALUE	PILOTS ML VALUE	PILOTS DF	PILOTS HYPO-THESIS	EXECUTIVES χ^2 VALUE	EXECUTIVES ML VALUE	EXECUTIVES DF	EXECUTIVES HYPO-THESIS
1	HRT	SYS					.05	.05	1	ACC
		DIAS					1.29	1.23	1	ACC
2	CIRC	SYS					.01	.01	1	ACC
		DIAS					.08	.08	1	ACC
3	RESP	SYS	.38	.64	1	ACC	.48	.51	1	ACC
		DIAS	.94	1.33	1	ACC	1.04	1.20	1	ACC
4	NEUR	SYS					.01	.01	1	ACC
		DIAS					2.03	1.87	1	ACC
5	CONN	SYS					.72	.71	1	ACC
		DIAS					.14	.14	1	ACC
6	GASTR	SYS					.25	.21	1	ACC
		DIAS					1.18	1.11	1	ACC
7	GENIT	SYS					1.60	1.57	1	ACC
		DIAS					.88	.83	1	ACC
8	ENDO	SYS					.47	.47	1	ACC
		DIAS					1.69	1.61	1	ACC
9	HERN	SYS					.01	.01	1	ACC
		DIAS					2.03	1.87	1	ACC
10	MALIG	SYS					1.42	1.77	1	ACC
		DIAS					2.11	2.27	1	ACC
11	ENT	SYS					.06	.06	1	ACC
		DIAS					.95	1.56	1	ACC
12	LIVR	SYS					1.88	1.88	1	ACC
		DIAS					.59	.59	1	ACC
13	HYPT	SYS					4.30	6.47	1	REJ
		DIAS					.67	.75	1	ACC
14	DIAB	SYS					.11	.11	1	ACC
		DIAS					3.04	2.85	1	ACC
15	STRK	SYS					.71	1.07	1	ACC
		DIAS					.48	.78	1	ACC

Table 1. (continued)

CODE #	MEDICAL ATTRIBUTE (Abbr)	BLOOD PRESS.	PILOTS χ^2 VALUE	PILOTS ML VALUE	PILOTS DF	PILOTS HYPO-THESIS	EXECUTIVES χ^2 VALUE	EXECUTIVES ML VALUE	EXECUTIVES DF	EXECUTIVES HYPO-THESIS
16	CARD	SYS					3.57	6.49	1	REJ
		DIAS					1.79	1.64	1	ACC
17	ANTHYP	SYS					1.37	1.37	1	ACC
		DIAS					.01	.01	1	ACC
18	DIUR	SYS					.48	.48	1	ACC
		DIAS					.04	.04	1	ACC
19	ANTDBO	SYS					.71	1.07	1	ACC
		DIAS					2.11	2.27	1	ACC
20	ANTDBI	SYS					2.84	3.54	1	ACC
		DIAS					.29	.27	1	ACC
21	TRANQ	SYS					.18	.18	1	ACC
		DIAS					7.28	6.80	1	REJ
22	OTHD	SYS					.01	.01	1	ACC
		DIAS					.08	.08	1	ACC
23	SMOKE	SYS	.22	.22	1	ACC	2.36	2.37	1	ACC
		DIAS	1.20	1.20	1	ACC	.05	.05	1	ACC

Table 2. Summary of results of tests of independence between cold pressor test responses and subjects' family medical attributes.

CODE #	FAMILY'S MEDICAL ATTRIBUTE (Abbr)	BLOOD PRESS.	PILOT'S FAMILY χ^2 VALUE	PILOT'S FAMILY ML VALUE	PILOT'S FAMILY DF	PILOT'S FAMILY HYPO-THESIS	EXECUTIVE'S FAMILY χ^2 VALUE	EXECUTIVE'S FAMILY ML VALUE	EXECUTIVE'S FAMILY DF	EXECUTIVE'S FAMILY HYPO-THESIS
1	HRT	SYS	.64	.72	1	ACC	1.20	1.23	1	ACC
		DIAS	.09	.09	1	ACC	.02	.02	1	ACC
2	CIRC	SYS	2.72	2.64	1	ACC	.17	.18	1	ACC
		DIAS	.94	1.33	1	ACC	.67	.75	1	ACC
3	RESP	SYS								
		DIAS	.00	.00	1	ACC				
4	NEUR	SYS	.76	1.29	1	ACC	.09	.09	1	ACC
		DIAS	.00	.00	1	ACC	.00	.00	1	ACC
8	ENDO	SYS	.38	.64	1	ACC	1.45	1.53	1	ACC
		DIAS	1.09	1.48	1	ACC	9.36	8.63	1	REJ
10	MALIG	SYS					.06	.06	1	ACC
		DIAS					.29	.27	1	ACC
13	HYPT	SYS	3.53	3.34	1	ACC	.28	.29	1	ACC
		DIAS	.92	.92	1	ACC	.14	.15	1	ACC
14	DIAB	SYS	.76	1.29	1	ACC	.27	.28	1	ACC
		DIAS	2.21	2.98	1	ACC	.08	.08	1	ACC
15	STRK	SYS	.76	1.29	1	ACC	.15	.15	1	ACC
		DIAS	.00	.00	1	ACC	.08	.08	1	ACC

In Tables 1 and 2, the results of tests of independence between various medical attributes of the subjects and their families were given. It was thought that dependence of medical attributes may be a consequence of overall medical condition of subjects. In a group of subjects, two different subjects may have incidences of different medical attributes, yet these subjects may have

similar medical conditions. The "medical condition" of a subject was defined to exist if and only if the subject had incidence of any one of the medical attributes coded from 1 through 12 (listed earlier in this report). With this definition, the hypotheses of independence between medical condition and cold pressor test responses were tested for the groups of pilots and executives. The results are listed below.

a. Hypothesis: Cold pressor test response to systolic blood pressure (SYS) and pilot's medical condition are independent.

(2 x 2) CONTINGENCY TABLE

SYS	PILOT'S MEDICAL CONDITION Exists	Does not exist	TOTAL
Negative	1	58	59
Positive	0	22	22
TOTAL	1	80	81

χ^2 value = 0.38, ML value = 0.64, DF = 1

Conclusion: Hypothesis of independence accepted.

b. Hypothesis: Cold pressor test response to diastolic blood pressure (DIAS) and pilot's medical condition are independent.

(2 x 2) CONTINGENCY TABLE

DIAS	PILOT'S MEDICAL CONDITION Exists	Does not exist	TOTAL
Negative	1	41	42
Positive	0	39	39
TOTAL	1	80	81

χ^2 value = 0.94, ML value = 1.33, DF = 1

Conclusion: Hypothesis of independence accepted.

c. Hypothesis: Cold pressor test response to systolic blood pressure (SYS) and executive's medical condition are independent.

(2 x 2) CONTINGENCY TABLE

SYS	EXECUTIVE'S MEDICAL CONDITION Exists	Does not exist	TOTAL
Negative	42	151	193
Positive	48	255	273
TOTAL	90	376	466

χ^2 value = 1.27, ML value = 1.26, DF = 1

Conclusion: Hypothesis of independence accepted.

d. Hypothesis: Cold pressor test response to diastolic blood pressure (DIAS) and executive's medical condition are independent.

(2 x 2) CONTINGENCY TABLE

DIAS	EXECUTIVE'S MEDICAL CONDITION Exists	Does not exist	TOTAL
Negative	39	111	150
Positive	51	265	316
TOTAL	90	376	466

χ^2 value = 6.35, ML value = 6.12, DF = 1

Conclusion: Hypothesis of independence rejected.

CONCLUSIONS

The hypothesis of independence between cold pressor test response and various medical attributes was tested by χ^2 and maximum likelihood tests. The hypothesis was rejected (or accepted) depending on χ^2 value, or ML value being greater (or less) than tabled value of χ^2 associated with 5 percent error. For most of the attributes the hypothesis was accepted; thus, rejections were important. Conclusions are interpreted below.

The pilot group consisted of subjects who were healthy in the sense that they had a complete absence of medical attributes, thus, no conclusions were possible for such a group. The executive group, in contrast, had subjects with varying incidences of medical attributes, thus, the main conclusions pertain to the executive group.

1. Systolic and diastolic blood pressure response to cold pressor test are related to subject's profession (that is, pilot or executive).
2. Diastolic blood pressure response to cold pressor test is related to the use of tranquilizer drugs by executives.
3. Systolic blood pressure response to cold pressor test is related to hypertension history of executives, and their use of cardiac drugs.
4. Diastolic blood pressure response to cold pressor test is related to endocrine and metabolic disorders of the executive's family.
5. Diastolic blood pressure response to cold pressor test among executives is related to their medical condition.

APPENDIX I

CALCULATION OF CHI SQUARE (χ^2) AND MAXIMUM LIKELIHOOD (ML) VALUES FOR CATEGORIZED DATA

Let A and B be two attributes such that A has I(i=1,2,...I), and B has J(j=1,2,...J) categories of responses. Further, suppose a random sample of n subjects shows a_{ij} subjects have i-th response to A attribute and j-th response to B attribute, as shown in (I x J) contingency table below.

(I x J) CONTINGENCY TABLE

CATEGORIES OF ATTRIBUTE A	CATEGORIES OF ATTRIBUTE B: 1	2	. . . j	. . . J	TOTAL
1	a_{11}	a_{12}	. a_{1j} .	a_{1J}	$A_{1.}$
2	a_{21}	a_{22}	. a_{2j} .	a_{2J}	$A_{2.}$
.	.	.	. . .	.	.
.	.	.	. . .	.	.
i	a_{i1}	a_{i2}	. a_{ij} .	a_{iJ}	$A_{i.}$
.	.	.	. . .	.	.
.	.	.	. . .	.	.
I	a_{I1}	a_{I2}	. a_{Ij} .	a_{IJ}	$A_{I.}$
TOTAL	A.1	A.2	. A.j .	A.J	n

For such a table, χ^2 and ML values are computed by the following formulae:

$$\chi^2 \text{ value} = \sum_{i,j} [a_{ij} - (A_{i}.A_{.j}/n)^2]/(A_{i}.A_{.j}/n)$$

$$\text{ML value} = 2\left(\sum_{i,j} a_{ij} \ln a_{ij} + n \ln n - \sum_{i} A_{i.} \ln A_{i.} - \sum_{j} A_{.j} \ln A_{.j}\right)$$

The degrees of freedom (DF) associated with (I x J) contingency table are (I - 1)(J - 1). The above formulae are applicable only when marginal totals $A_{.i}$ and $A_{.j}$ are non zero. When I,J = 2, then the above formula for χ^2 value

reduces to

$$\chi^2 \text{ value} = (a_{11} a_{22} - a_{12} a_{21})^2 n / A_1 . A_2 . A_{.1} A_{.2}$$

The χ^2 and ML values are calculated to test the hypothesis of independence between attributes A and B. This hypothesis is either true or false. If the hypothesis is true, the calculated χ^2 or ML values for most of the samples would not reject the hypothesis, but could possibly reject for some odd samples. For these samples, rejection of hypothesis is an error. Because of randomness of samples, there is no way to ensure zero error. The investigator thus imposes a limit on the chances of such error.

χ^2 or ML values are termed significant if these are larger than the χ^2 table value associated with 5 percent error. Whenever a χ^2 or ML value is significant, the hypothesis of independence is rejected. In such cases, sampled data indicates dependence between A and B attributes.

APPENDIX II

DATA FOR PILOTS AND PILOT'S FAMILIES

a. Data for cold pressor test response on blood pressure (CPBP): The difference between basal systolic and cold pressor systolic blood pressures in millimeters of mercury units are given under SYS. Similarly, the difference between diastolic blood pressures are given under DIAS.

b. The pilot's medical attributes which were present are indicated by the attribute's code number. Smoking history code 23 has category 1 for non-smoker, 2 for ex-smoker, 3 for smoker, and NA for non-availability of data. These are indicated by parenthesis after 23.

SER. NO.	PILOT CODE	CPBP SYS	CPBP DIAS	MEDICAL ATTRIBUTE PRESENT PILOT	MEDICAL ATTRIBUTE PRESENT PILOT'S FAMILY
1	106199	20	10	23 (3)	1
2	106342	15	7	23 (NA)	
3	106343	20	10	23 (NA)	
4	107215	20	10	23 (1)	
5	110411	20	15	23 (3)	13
6	110412	20	10	23 (3)	
7	110413	20	10	23 (NA)	
8	110635	20	12	23 (NA)	
9	110636	20	10	23 (NA)	
10	112878	18	7	23 (1)	13
11	112880	10	10	23 (3)	
12	112881	10	12	23 (3)	13
13	113539	20	15	23 (2)	
14	113540	30	20	23 (NA)	
15	113541	20	20	23 (NA)	
16	114604	20	10	23 (3)	
17	115674	40	28	23 (3)	13
18	120268	30	10	23 (1)	
19	125565	40	10	23 (2)	13
20	144211	20	10	23 (3)	

SER. NO.	PILOT CODE	CPBP SYS	CPBP DIAS	MEDICAL ATTRIBUTE PRESENT PILOT	PILOT'S FAMILY
21	144232	20	15	23 (NA)	
22	144233	20	15	23 (3)	13
23	146401	10	10	23 (NA)	
24	14602	20	5	23 (3)	13
25	147954	30	20	23 (2)	13
26	149487	20	35	23 (NA)	
27	149988	10	10	23 (NA)	
28	150264	15	20	23 (3)	
29	151691	30	20	23 (3)	13
30	155650	20	15	23 (2)	
31	165638	25	10	23 (1)	13
32	167774	10	5	23 (2)	
33	168198	30	18	23 (2)	1
24	168199	32	25	23 (3)	13
35	168784	10	10	23 (3)	
36	171966	10	10	23 (3)	
37	174595	10	20	23 (3)	
38	174596	20	20	23 (3)	8, 13, 14
39	174855	10	20	23 (1)	
40	174856	0	0	23 (2)	
41	175301	20	10	23 (3)	13
42	175302	40	30	23 (3)	
43	178746	20	15	23 (3)	1
44	178747	20	10	23 (NA)	
45	179001	20	25	23 (NA)	
46	179002	20	10	23 (1)	
47	180496	35	25	23 (3)	
48	185095	20	20	23 (3)	5, 14, 15
49	185325	10	10	23 (3)	
50	185326	30	18	23 (NA	
51	200288	30	20	23 (3)	13
52	201113	25	10	23 (NA)	
53	202313	10	5	23 (2)	
54	202590	25	18	23 (3)	
55	202591	20	15	23 (2)	13
56	205410	20	10	23 (3)	
57	205610	15	10	23 (NA)	
58	206536	15	10	23 (3)	
59	206030	20	20	23 (1)	
60	207587	30	25	23 (1)	13

SER. NO.	PILOT CODE	CPBP SYS	CPBP DIAS	MEDICAL ATTRIBUTE PRESENT PILOT	MEDICAL ATTRIBUTE PRESENT PILOT'S FAMILY
61	208105	20	10	23 (3)	13
62	208106	20	10	23 (3)	
63	209415	20	20	23 (3)	
64	210030	10	0	23 (1)	
65	210031	20	15	23 (1)	
66	219148	20	15	23 (3)	
67	221459	15	10	23 (3)	1
68	221518	20	5	23 (2)	4, 15
69	222285	15	10	23 (1)	
70	224807	20	10	23 (1)	
71	232964	25	20	23 (2)	13
72	237123	40	30	23 (2)	
73	237780	30	10	23 (3)	2
74	245557	25	18	23 (NA)	
75	247150	20	10	23 (NA)	
76	249543	40	20	23 (NA)	
77	188719	30	20	23 (1)	
78	192308	15	10	23 (2)	1, 13
79	194887	5	10	23 (2)	1, 13
80	195123	20	20	23 (2)	1
81	105422	20	10	23 (1)	

APPENDIX III

DATA FOR EXECUTIVES AND EXECUTIVE'S FAMILIES

a. Data for cold pressor test response on blood pressure (CPBP): The difference between basal systolic and cold pressor systolic blood pressures in millimeters of mercury units are given under title SYS. Similarly, the difference between diastolic blood pressures are given under DIAS.

b. The executive's medical attributes, which are present, are indicated by the attribute's code number. Medical attribute of smoking, code 23, has category 1 for non-smoker, 2 for ex-smoker, 3 for smoker, while NA refers to the non-availability of data. These are indicated by parenthesis after 23.

SER. NO.	EXEC. CODE	CPBP SYS	CPBP DIAS	MEDICAL ATTRIBUTE PRESENT EXECUTIVE	MEDICAL ATTRIBUTE PRESENT EXECUTIVE'S FAMILY
1	603	30	20	23 (3)	
2	5612	20	10	6	
3	7378	30	15	22, 23 (3)	8,14
4	7420	15	12	23 (2)	4, 15
5	10961	20	10	23 (NA)	
6	11609	40	15	23 (NA)	
7	15661	30	15	23 (3)	
8	15778	60	20	8, 14	
9	17084	30	20	23 (3)	
10	19257	30	20	23 (1)	
11	21096	52	30	23 (3)	
12	25319	40	20	2, 16 23 (2)	13
13	25514	20	10	23 (2)	13
14	28236	30	30	8, 14, 23 (NA)	
15	30529	10	10	1, 17, 18, 23 (3)	
16	32940	60	40	23 (3)	
17	36973	30	15	23 (NA)	
18	40046	45	20	8, 13, 23 (2)	4, 15
19	41089	30	20	23 (3)	13
20	43087	60	50	23 (NA)	

SER. NO.	EXEC. CODE	CPBP SYS	CPBP DIAS	MEDICAL ATTRIBUTE PRESENT EXECUTIVE	MEDICAL ATTRIBUTE PRESENT EXECUTIVE'S FAMILY
21	44484	20	15	5, 8, 23 (2)	
22	45153	30	20	23 (NA)	
23	46064	30	20	23 (1)	4, 15
24	51114	30	20	23 (2)	
25	51622	30	20	1, 3, 4,15,16,18,23(3)	
26	53738	30	20	23 (2)	
27	57650	60	45	23 (3)	4, 15
28	62433	30	35	23 (1)	
29	62877	20	10	23 (1)	
30	63164	40	20	7, 12, 13, 18, 23(1)	
31	63422	20	15	23 (NA)	
32	63488	20	15	23 (NA)	
33	64868	70	23	23 (NA)	
34	66579	0	0	12, 23 (NA)	
35	66985	40	15	23 (3)	13
36	67856	20	15	23 (1)	4, 15
37	69305	25	23	23 (NA)	
38	69672	40	20	23 (NA)	13
39	69762	40	20	13, 23 (3)	13
40	70007	20	15	23 (NA)	
41	71772	20	30	23 (3)	
42	72651	40	25	3, 23 (1)	
43	74506	30	20	23 (NA)	
44	74709	15	10	23 (3)	1, 8, 13, 14
45	78362	20	10	23 (3)	
46	78779	20	10	1, 8, 14, 23 (3)	
47	78922	20	15	23 (3)	13
48	82712	30	20	23 (NA)	
49	83049	20	10	7, 14, 23 (NA)	
50	84003	30	35	23 (3)	
51	84464	30	10	1, 16, 23 (1)	8
52	85812	30	18	23 (1)	8, 14
53	86098	40	25	23 (3)	2
54	86325	30	10	23 (1)	
55	87123	20	20	2, 23 (1)	4, 15
56	87960	40	15	23 (2)	1, 13
57	88004	20	15	23 (NA)	13
58	88715	20	5	23 (3)	2, 4, 15
59	89080	60	30	23 (3)	13
60	89541	50	30	23 (1)	

SER. NO.	EXEC. CODE	CPBP SYS	CPBP DIAS	MEDICAL ATTRIBUTE PRESENT EXECUTIVE	MEDICAL ATTRIBUTE PRESENT EXECUTIVE'S FAMILY
61	90957	30	10	8,14, 23(2)	
62	96172	10	15	23(NA)	
63	96273	20	15	8,9,22,23(1)	
64	97707	30	15	23(NA)	
65	97868	30	10	2,23(NA)	13
66	98850	20	5	23(NA)	
67	99665	20	15	23(3)	4,13,15
68	99776	30	20	23(NA)	
69	99845	20	10	23(NA)	4,15
70	99854	35	10	23(1)	
71	100255	20	10	6,22,23(2)	1,13
72	100261	20	15	23(1)	
73	100394	30	10	23(1)	4,13,15
74	100870	15	12	3,23(NA)	
75	102389	40	30	17,23(1)	13
76	102394	60	30	23(3)	13
77	102395	5	15	23(3)	1
78	102540	10	20	23(2)	13
79	102760	20	10	23(1)	
80	102904	0	0	6,23(1)	
81	103031	20	10	23(2)	13
82	104251	32	20	23(2)	1,4,15
83	104806	5	0	23(3)	
84	105137	35	25	23(1)	
85	105173	50	25	23(NA)	13
86	106202	20	15	1,23(1)	13
87	106390	20	10	23(1)	
88	108257	30	25	8,14,23(NA)	1
89	108306	30	20	23(NA)	13
90	109868	30	15	4,11,23(2)	
91	110416	55	40	6,23(3)	4,13,15
92	110515	30	15	23(1)	13
93	110517	45	25	22,23(3)	
94	110808	0	0	23(3)	
95	110809	80	30	23(3)	
96	110810	40	20	23(NA)	
97	112001	15	10	1,23(3)	13
98	112002	20	18	8,20,23(3)	
99	112003	60	20	13,23(3)	
100	112429	0	0	8,14,23(NA)	

SER. NO.	EXEC. CODE	CPBP SYS	CPBP DIAS	MEDICAL ATTRIBUTE PRESENT EXECUTIVE	MEDICAL ATTRIBUTE PRESENT EXECUTIVE'S FAMILY
101	112431	20	20	23(NA)	
102	112541	40	24	23(NA)	
103	112651	25	15	23(3)	13
104	112882	15	5	23(3)	13
105	112884	30	12	23(NA)	
106	12885	20	10	20,23(3)	
107	112996	10	10	23(NA)	1,13
108	111057	50	20	9,23(1)	13
109	111058	15	10	2,10,23(3)	13
110	111059	30	20	22,23(1)	13
111	111241	45	25	23(NA)	
112	111292	40	20	23(1)	13
113	111293	10	10	23(3)	
114	111517	55	25	1,22,23(2)	13
115	111519	35	25	21,23(NA)	
116	111740	15	10	23(NA)	
117	111742	60	20	23(1)	
118	111774	40	25	23(3)	
119	113069	20	10	21,23(1)	
120	113070	20	5	23(1)	
121	113317	30	10	23(3)	
122	113536	35	20	23(3)	
123	113716	40	15	23(NA)	
124	114101	40	25	23(3)	13
125	114102	10	5	1,5,18,23(3)	13
126	114374	20	25	23(3)	13
127	114600	40	10	23(1)	
128	117438	25	13	23(1)	2,13
129	118177	20	15	1,23(NA)	
130	118716	35	10	23(3)	13
131	122084	50	27	23(3)	13
132	121363	20	20	7,15,23(3)	13
133	121393	35	20	23(1)	4,15
134	121598	30	15	23(3)	10
135	123132	55	30	23(NA)	
136	123395	50	35	5,23(1)	
137	123398	40	25	23(3)	
138	123634	20	10	23(2)	
139	123834	30	10	17,23(2)	
140	124234	33	20	23(NA)	

SER. NO.	EXEC. CODE	CPBP SYS	CPBP DIAS	MEDICAL ATTRIBUTE PRESENT EXECUTIVE	MEDICAL ATTRIBUTE PRESENT EXECUTIVE'S FAMILY
141	124235	25	15	23(NA)	
142	124236	50	30	23(NA)	
143	124246	50	20	23(2)	8,14
144	124704	25	20	23(NA)	13
145	124920	20	10	22,23(3)	
146	125336	10	10	23(NA)	
147	125564	25	15	23(3)	
148	126071	40	20	23(3)	
149	126296	30	10	23(NA)	
150	126859	15	20	7,23(1)	13
151	127085	20	5	23(3)	
152	127415	20	15	23(3)	13
153	138248	35	20	23(NA)	
154	138715	40	20	23(3)	
155	129116	30	20	23(NA)	
156	129118	20	5	23(NA)	
157	129701	40	30	6,23(NA)	
158	132380	20	10	23(1)	
159	132381	55	35	23(NA)	
160	132382	20	10	23(NA)	
161	131700	40	20	17,23(NA)	
162	133784	0		9,23(1)	
163	134009	60	30	17,23(3)	
164	134223	30	20	5,23(3)	
165	134224	40	20	23(1)	13
166	134225	30	12	23(3)	13
167	134226	0	0	23(NA)	
168	134431	20	10	23(3)	
169	134961	35	20	23(3)	
170	135707	10	10	23(2)	
171	136969	30	15	23(1)	
172	137466	25	15	23(NA)	
173	137707	20	15	23(3)	
174	137922	10	20	23(3)	
175	137923	50	20	23(3)	
176	138163	10	5	23(2)	13
177	139036	40	15	23(NA)	
178	142111	10	0	23(2)	
179	142791	40	20	23(3)	
180	141664	20	15	23(NA)	4,15

SER. NO.	EXEC. CODE	CPBP SYS	CPBP DIAS	MEDICAL ATTRIBUTE PRESENT EXECUTIVE	MEDICAL ATTRIBUTE PRESENT EXECUTIVE'S FAMILY
181	146182	25	10	1,21,23(2)	4,15
182	146666	45	20	23(3)	
183	147277	40	30	1,23(1)	
184	147461	42	20	1,4,13,18,23(1)	
185	147711	20	15	23(3)	
186	149486	20	15	23(3)	
187	149489	25	30	23(NA)	
188	150284	25	15	23(1)	13
189	151354	20	10	23(3)	4
190	154175	35	35	23(NA)	13
191	156265	40	25	23(NA)	13
192	156812	30	15	23(3)	13
193	156813	30	0	23(2)	
194	156893	10	15	23(NA)	
195	157601	20	10	23(2)	13
196	159128	55	40	23(1)	13
197	159852	20	15	23(1)	13
198	160587	20	15	23(NA)	1
199	160588	10	10	3,8,14,17,22,23(3)	
200	160820	15	10	23(NA)	
201	160821	15	10	23(NA)	
202	160822	30	20	23(3)	1
203	162529	20	10	23(3)	4,13,15
204	162972	2	10	23(NA)	
205	161022	20	20	23(NA)	
206	161023	20	20	23(NA)	
207	161262	5	15	23(2)	
208	161263	15	25	23(1)	4,15
209	163444	15	10	23(NA)	
210	163630	20	25	3,23(NA)	
211	163788	50	30	23(2)	1,13
212	163843	20	15	2,23(NA)	13
213	163982	15	10	4,23(NA)	
214	164320	30	15	23(3)	13
215	164532	20	10	23(2)	
216	164793	17	15	23(NA)	
217	165448	48	25	23(NA(	
218	166725	45	25	23(NA)	
219	167369	30	20	23(NA)	4,15
220	167636	25	25	23(NA)	

SER. NO.	EXEC. CODE	CPBP SYS	CPBP DIAS	MEDICAL ATTRIBUTE PRESENT EXECUTIVE	MEDICAL ATTRIBUTE PRESENT EXECUTIVE'S FAMILY
221	168131	5	15	11,23(1)	
222	168133	25	15	23(1)	
223	168297	30	15	23(NA)	
224	169465	20	10	5,23(3)	
224	169467	20	10	23(3)	
226	169599	35	10	23(NA)	
227	169647	30	18	3,23(3)	8,14
228	170783	50	30	22,23(2)	
229	170846	10	10	23(1)	
230	172622	20	10	23(1)	
231	172807	25	13	23(3)	1,8,13,14
232	172823	40	25	23(NA)	
233	172899	40	40	23(1)	4,15
234	171325	20	20	23(3)	
235	171506	40	30	23(2)	13
236	171550	25	15	2,8,23(NA)	
237	171734	15	15	23(NA)	
238	173017	23	15	23(3)	
239	173018	30	15	23(3)	13
240	173130	40	30	23(NA)	
241	173213	50	30	23(NA)	13
242	173653	40	20	2,23(2)	13
243	173735	45	35	23(1)	4,13,15
244	173919	40	30	23(NA)	13
245	174628	70	40	23(3)	13
246	174673	60	30	23(3)	
247	175005	30	15	23(3)	
248	175016	20	10	6,21,23(3)	13
249	175181	30	10	23(3)	
250	175349	20	15	23(3)	13
251	175438	45	30	23(1)	13
252	175850	20	20	23(3)	
253	176356	20	10	23(3)	
254	176815	25	20	7,23(1)	
255	177041	28	20	8,14,23(3)	8,14
256	177067	25	10	23(3)	4,13,15
257	177921	25	40	23(1)	
258	178372	20	10	23(3)	
259	178435	0	5	21,22,23(2)	
260	178587	50	20	23(3)	

SER. NO.	EXEC. CODE	CPBP SYS	CPBP DIAS	MEDICAL ATTRIBUTE PRESENT EXECUTIVE	EXECUTIVE'S FAMILY
261	178745	15	10	23(3)	13
262	178783	40	30	17,23(2)	4,15
263	178868	20	15	23(3)	1,13
264	179027	25	15	23(3)	13
265	179094	20	10	6,23(3)	1
266	179406	30	20	23(3)	
267	179615	20	10	23(1)	13
268	180675	30	20	17,18,23(NA)	13
269	180823	60	30	23(NA)	
270	180825	25	15	12,23(NA)	
271	180826	35	15	23(NA)	
272	182601	30	25	23(2)	13
273	182741	15	15	23(1)	14
274	182743	20	10	23(3)	
275	182744	30	20	23(2)	
276	181298	35	30	23(NA)	
277	181543	40	25	23(NA)	4
278	181544	40	20	23(NA)	
279	181698	40	25	23(NA)	
280	183201	20	10	1,23(3)	
281	183202	30	20	23(3)	
282	183203	60	30	23(NA)	
283	183249	40	20	23(1)	1,13
284	183445	50	20	23(2)	13
285	183576	30	18	23(NA)	
286	183635	60	30	23(3)	1
287	183908	25	25	23(3)	
288	183909	33	25	23(3)	
289	183913	60	20	23(1)	
290	184053	25	20	23(1)	4,15
291	184215	45	20	1,22,23(NA)	13
292	184216	35	15	23(NA)	1
293	184355	50	20	23(NA)	
294	184471	20	10	23(3)	
295	184472	20	14	23(3)	13
296	184647	30	10	4,13,23(2)	
297	184648	30	10	23(3)	
298	184709	20	10	23(1)	4,13,15
299	184710	50	20	2,23(2)	
300	184732	20	10	23(3)	

SER. NO.	EXEC. CODE	CPBP SYS	CPBP DIAS	MEDICAL ATTRIBUTE PRESENT EXECUTIVE	MEDICAL ATTRIBUTE PRESENT EXECUTIVE'S FAMILY
301	184777	20	15	23(1)	13
302	184909	30	30	23(3)	
303	184966	35	17	17,18,23(2)	1
304	184967	30	30	23(NA)	
305	185156	20	10	23(3)	13
306	185157	30	10	23(3)	13
307	185218	30	10	8,14,19,23(3)	13
308	185219	35	15	22,23(1)	
309	185585	40	30	23(3)	1
310	185635	60	20	1,8,14,23(2)	
311	185812	10	7	8,14,23(3)	8,14
312	185876	30	10	23(2)	
313	185877	20	10	7,23(3)	
314	186019	35	20	23(3)	13
315	186075	10	5	23(3)	8,14
316	186077	18	25	23(3)	
317	186606	30	20	8,14,23(3)	
318	186623	10	10	23(1)	
319	187010	40	30	7,23(3)	
320	187014	10	10	23(3)	
321	187283	10	5	23(3)	
322	187907	15	5	23(3)	
323	188219	25	10	3,23(3)	1
324	188349	20	20	12,23(NA)	
325	188357	25	20	1,23(1)	
326	189105	50	40	23(1)	
327	189248	15	10	7,14,23(3)	13
328	189816	30	20	1,23(2)	1
329	190677	10	0	23(3)	
330	190906	40	20	23(NA)	13
331	192223	20	15	23(3)	
332	192519	40	25	23(3)	
333	191179	10	10	17,23(1)	1
334	191888	30	19	23(3)	
335	193099	10	10	23(2)	
336	193193	25	15	23(3)	4,15
337	193194	20	15	23(3)	4,15
338	193195	30	20	23(3)	13
339	193272	30	20	23(3)	
340	193313	25	10	23(1)	1

SER. NO	EXEC. CODE	CPBP SYS	CPBP DIAS	MEDICAL ATTRIBUTE PRESENT EXECUTIVE	MEDICAL ATTRIBUTE PRESENT EXECUTIVE'S FAMILY
341	193432	20	10	23(1)	
342	193527	40	25	23(1)	
343	193555	40	20	8,14,23(NA)	
344	193678	20	20	23(3)	
345	194031	30	20	23(3)	8,14
346	194038	30	12	23(1)	
347	194429	30	20	23(NA)	
348	194430	10	10	23(3)	
349	194576	20	15	23(3)	4,15
350	194577	30	20	23(3)	
351	195059	10	10	23(3)	13
352	195154	30	20	23(NA)	
353	195506	40	15	18,23(3)	
354	195752	20	15	23(1)	
355	196073	10	15	23(3)	
356	196270	30	20	23(2)	13
357	196297	40	10	21,23(2)	13
358	196504	20	10	23(1)	8,14
359	196730	20	18	23(3)	
360	196881	30	15	23(3)	13
361	196944	40	20	23(3)	8,13,14
362	197732	30	20	17,23(2)	
363	198167	30	20	23(3)	4,15
364	199490	20	10	4,23(3)	8,13,14
365	199776	10	18	23(3)	
366	200046	90	45	23(NA)	1
367	200048	40	20	23(3)	2
368	200120	40	35	2,23(1)	13
369	200210	35	20	23(3)	
370	200320	25	25	3,23(2)	13
371	200362	20	10	23(NA)	
372	200596	20	10	23(3)	13
373	200897	30	20	23(3)	13
374	200900	15	10	23(3)	
375	202369	45	35	23(3)	4,15
376	202796	25	15	23(2)	
377	202798	20	15	23(3)	
378	202988	40	20	23(3)	13
379	201405	30	10	23(1)	
380	201488	30	15	23(3)	13

SER. NO.	EXEC. CODE	CPBP SYS	CPBP DIAS	MEDICAL ATTRIBUTE PRESENT EXECUTIVE	MEDICAL ATTRIBUTE PRESENT EXECUTIVE'S FAMILY
381	201489	15	20	23(3)	13
382	201490	35	20	23(3)	
383	201491	20	20	23(3)	
384	201494	17	15	23(1)	13
385	201856	10	8	12,23(3)	
386	204301	20	10	23(3)	
387	204389	20	10	23(1)	13
388	204976	15	15	23(3)	
389	205463	20	10	23(NA)	
390	206316	40	20	23(NA)	
391	207823	10	25	23(3)	
392	208632	30	10	23(3)	
393	208633	50	20	6,23(3)	
394	209505	20	20	23(1)	
395	209784	60	45	2,23(NA)	
396	209836	10	15	23(3)	
397	210253	10	10	23(2)	
398	210445	35	30	23(2)	
399	210445	35	30	23(3)	
400	210544	20	13	23(3)	2
401	210545	30	20	23(3)	
402	210817	20	15	23(2)	
403	210964	55	20	5,23(3)	
404	210965	40	15	23(2)	
405	210966	10	20	23(3)	4,13,15
406	212258	20	10	23(3)	4,15
407	215259	15	10	23(1)	
408	211025	40	20	23(2)	13
409	211097	25	20	23(NA)	
410	211998	30	10	1,16,23(3)	
411	213044	30	20	22,23(1)	13
412	214300	30	10	8,9,16,23(3)	
413	214880	20	10	7,14,23(1)	4,15
414	215138	16	4	23(3)	
415	216793	10	10	2,7,23(NA)	4,13,15
416	217649	20	10	2,23(NA)	
417	219079	40	25	23(3)	1,13
418	219263	30	15	23(3)	4,15
419	219264	30	30	23(1)	4,15
420	219265	40	15	8,14,23(3)	

SER. NO.	EXEC. CODE	CPBP SYS	CPBP DIAS	MEDICAL ATTRIBUTE PRESENT EXECUTIVE	MEDICAL ATTRIBUTE PRESENT EXECUTIVE'S FAMILY
421	219967	6	2	23(NA)	
422	223176	30	30	23(NA)	
423	223440	20	10	8,14,23(3)	4,15
424	223701	15	13	23(1)	13
425	224043	20	15	23(NA)	
426	224171	40	30	23(1)	8,14
427	224172	30	10	9.23(3)	
428	224412	30	10	23(1)	
429	224917	20	5	23(1)	13
430	224920	26	10	23(NA)	
431	225512	5	10	23(3)	
432	226823	20	15	23(NA)	
433	226978	45	25	23(NA)	
434	227279	10	5	22,23(3)	1,10,13
435	227690	15	10	23(3)	
436	227813	30	20	23(NA)	
437	227862	25	15	23(3)	
438	228002	50	20	23(2)	1
439	228154	20	18	23(3)	14
440	228626	10	5	23(1)	4,15
441	228923	30	20	23(NA)	4,15
442	229369	10	10	23(NA)	
443	229694	30	20	23(3)	8,14
444	229775	30	20	2,23(NA)	
445	231165	20	5	23(1)	
446	231169	40	20	23(3)	
447	233040	20	20	23(3)	4,15
448	234093	60	30	23(1)	1
449	234141	20	10	23(NA)	
450	236167	40	35	23(NA)	
451	236569	30	20	23(3)	4,13,14
452	237658	35	12	23(1)	
453	239631	10	13	23(2)	
454	239809	50	30	23(1)	
455	240784	50	40	23(1)	13
456	240784	25	10	23(1)	4,15
457	241421	10	10	2,23(2)	1
458	243080	60	35	23(1)	1
459	243347	30	5	23(NA)	13
460	243377	25	5	23(2)	1,8,14
461	244016	20	85	23(2)	
462	244017	20	10	23(3)	
463	244628	10	8	9,23(1)	
464	244766	15	15	23(NA)	
465	246492	30	15	23(NA)	1,4,15
466	253859	20	10	23(3)	

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15. Supplementary Notes

NASA Technical Monitor: William R. Winter, NASA Dryden Flight Research Center

16. Abstract

Statistical analyses were performed to study the relationship between cold pressor test responses and certain medical attributes of a group of 81 pilots and a group of 466 executives. The important results of this study were as follows:

There was a significant relationship between a subject's cold pressor test response and his profession (that is, pilot or executive).

The executives' diastolic cold pressor test responses were significantly related to their medical conditions, and their families' medical conditions.

Significant relationships were observed between executives' diastolic and systolic cold pressor test responses and their history of tranquilizer and cardiac drug use.

17. Key Words (Suggested by Author(s))	18. Distribution Statement
Blood pressure Cold pressor Chi square Maximum likelihood Independence of medical attributes	Unclassified - Unlimited

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