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EK/JM

25th October, 1968.

Mr. Don Fowler,
Lead Industries Association,
292 Madison Avenue,
NEW YORK 10017,
U. S. A.

Dear Don,

You will have received Morgan's letter before this, giving the basic problem. It is:-

Zielhuis has extracted from the literature all group data for Hb/PbB. He has calculated the two regression lines, and then their bisector, arguing that the latter gives the "real" relationship. Thus, from 25 groups, he gets a high correlation (-0.80) between them, and a bisector of Hb = 15.43 - 0.033 PbB (Hb in grams, PbB in ug/100 mls.). The technique of collecting differing data is arguable, as is the use of the bisector to give the "real" relationship.

This exercise stimulated me to do likewise with the grouped Vauxhall data (1962, 540 men) and another factory group (1967, 157 men). I enclose a copy of the analyses of these data, for PbU, PbB and Hb. As you will see, the Hb/PbB data are so close to Zielhuis that any argument that the relationship is false has to be forgotten. Further, from my data, the difference between men of 0 - 29 ug/100 mls. and those of 30 - 49 ug/100 mls. is statistically sound.

These data show two things:-

(a) There is a real Hb/PbB relationship, and

(b) It starts at a very low PbB value.

The only outstanding data are Mike Williams. We have discussed these endlessly. They fall down on two counts:-

(a) The accuracy of his Hb measurements. I have had triplicates done by ourselves and Manchester Royal Infirmary (we agree with each other) and Mike, who shows about 2 g higher on average of 50 samples, with considerable scatter. Dennis now accepts an error in Chloride (Manchester) data, and while arguing that it is a constant, cannot

substantiate this. He further shows a "ranking" difference of Hb with PbB on enormous groups, giving qualitative support to the relationships.

(b) The populations are selected - the best excuse available for their omission.

All of this leaves us in a position of having to agree with Cramer and company, that there is a fall of Hb with PbB, starting at a low level. The remaining question is "how much?" and "is it socially significant?".

If we accept the use of the "bisectors" - I have seen statisticians and they simply will not commit themselves on relationships between two interdependant variables as opposed to the prediction of a variable against a fixed abscissa - we are left with a fall of 3 g Hb for 100 ug/100 mls. PbB, or 20%, and pro rata. This does not make practical sense to me, but then I have never looked at it this way. Certainly, 10% drop (50 ug/100 mls.) would be the upper limit of acceptability socially.

If, however, we can say that PbB is the definitive variable, and our concern is the prediction of the fall in Hb from PbB, we use the Hb/PbB regression line. giving a fall of about 6% at 100 ug Pb/100 mls. and pro rata, fully socially acceptable at, say, 80 ug Pb/100 mls.

All of these exclude confidence limits, etc. - I am arguing principle at the moment.

All of these data come up for discussion in Amsterdam. I told Morgan that I would send you photostats of Zielhuis's paper, but this is impossible for me to do today, so I have summarised the arguments in this letter. Frankly, I do not know what approach to take. Referring to the above, and juggling my remaining mental faculties, 20% at 100 ug Pb/100 mls. is too high, but 6% at 100 ug/100 mls. is too low. My statisticians cannot help me refute the bisector approach, and the regression line is merely a prediction of Hb from PbB, and not necessarily the "real" relationship.

Have you any ideas? I have left my formal contribution to Amsterdam pending a "vision", but haven't had one yet, and time is running out.

Kind regards,

Yours sincerely,

E. King
Director

N	X	Y	Groups X	Groups Y	Sx	Sy	r	p	Range X	Range Y	Regression	Bisecte
540	PbU	Hb	4	9	75	5.5	-0.21	0.05	40-280	76-108	Hb = 96 -0.016PbU	Hb = 104 -0.0
"	Hb	PbU	9	4	5.5	75.	"	"	76-108	40-280	PbU = 382 -2.82Hb	PbU = 1140 - 1
"	PbB	PbU	5	14	30	95	0.43	0.01	0-130	0-500	PbU = 43 + 1.37PbB	PbU = 2.7PbB -
"	PbU	PbB	14	5	95	30	"	"	0-500	0-130	PbB = 0.13PbU + 44	PbB = 0.37PbU
A"	PbB	Hb	5	9	30	5.5	-0.27	0.01	0-130	76-108	Hb = 97.3 -0.052PbB	Hb = 106 - 0.1
"	Hb	PbB	9	5	5.5	30	"	"	76-108	0-130	PbB = 195 -1.42Hb	PbB = 541 - 5.1
B 157	PbB	Hb	4	9	21	7.1	-0.22	0.05	0-100	76-108	Hb = 95.8 - 0.065PbB	Hb = 105 - 0.2
"	Hb	PbB	9	4	7.1	21	"	"	76-108	0-130	PbB =127 - 0.078Hb	PbB= 440 - 4.2

PbU = ug/litre Hb = % PbB = ug/100mls.

From B, $Hb_{(PbB=10,\ N=16)}$ is greater than $Hb_{(PbB=40,\ N=65)}$ (t=2.53, p 0.02)

" A $Hb_{(PbB=10,\ N=51)}$ " " " $Hb_{(PbB=40,\ N=192)}$ (t=2.1, p 0.05)

" " " " " $Hb_{(PbB=70,\ N=51)}$ (t=2.5, p 0.02)

" " " " " $Hb_{(PbB=100,\ N=58)}$ (t=3.29, p0.010

When Hb100% = Hb 14.8g% , Bisectors become :

	Self	Zielhuis	Self, from other two variables.
	PbU = 2.7PbB -43	PbU = 3.12PbB - 45	PbU = 2.2PbB - 28
(A)	Hb = 15.6 - 0.029PbB	Hb = 15.4 - 0.033PbB	Hb = 16.0 - 0.037PbB
(B)	Hb = 15.0 - 0.035PbB		
	PbU = 1140 - 74Hb	PbU = 948 - 59Hb	PbU = 1650 - 92Hb.